Vehicle Fuel Efficiency

Potential measures to encourage the uptake of more fuel efficient, low carbon emission vehicles

Public Discussion Paper

Prepared by
Australian Transport Council (ATC)
and
Environment Protection and Heritage Council (EPHC)
Vehicle Fuel Efficiency Working Group

With support from
The Australian Government

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Abbreviations

ACIS  Automotive Competitiveness Investment Scheme
ADR  Australian Design Rule
AFCP  Alternative Fuels Conversion Program
AfMA  Australasian Fleet Managers Association
ATC  Australian Transport Council
BITRE  Bureau of Infrastructure, Transport and Regional Economics
CAFE  Corporate Average Fuel Economy
CCP  Cities for Climate Protection
CNG  Compressed Natural Gas
COAG  Council of Australian Governments
CPRS  Carbon Pollution Reduction Scheme
EC  European Commission
ECMT  European Council of Ministers for Transport
EEBP  Energy Efficiency Best Practice
EPA  Environmental Protection Agency
EPHC  Environmental Protection and Heritage Council
EU  European Union
FCAI  Federal Chamber of Automotive Industries
GRPE  Group of Rapporteurs on Pollution and Environment
GTR  Global Technical Regulation
GVG  Green Vehicle Guide
GVM  Gross Vehicle Mass
ICLEI  International Council for Local Environmental Initiatives
IEA  International Energy Agency
ISO  International Organisation for Standardisation
ITF  International Transport Forum
LEEV  Light duty Environmentally Enhanced Vehicle
LNG  Liquefied Natural Gas
LPG  Liquid Petroleum Gas
MVP  Motor Vehicle Producer
NACE  National Carbon Emissions
NAFC  National Average Fuel Consumption
NEDC  New European Driving Cycle
PULP  Premium unleaded petrol
SUVs  Sport Utility Vehicles
ULP  Unleaded petrol/Premium unleaded petrol
UNECE  United Nations Economic Commission for Europe
VFE  Vehicle Fuel Efficiency
WHDC  Worldwide Harmonised Duty Cycle
1 Introduction

1.1 Overview

At its meeting in February 2006, the Council of Australian Governments (COAG) requested the Australian Transport Council (ATC) and the Environment Protection and Heritage Council (EPHC) to provide a report on programs and incentives to encourage the uptake of more fuel-efficient and low emission passenger and freight vehicles, and to provide advice on opportunities for reforms to regulations, standards, codes and labelling requirements to improve vehicle fuel efficiency. A joint ATC/EPHC working group prepared an initial report which was endorsed by ATC and EPHC, and transmitted to COAG at the end of 2006.

COAG noted the report at its 13 April 2007 meeting. The then Prime Minister, as chair of COAG, subsequently wrote to the chairs of ATC and EPHC requesting the councils to “develop jointly a package of vehicle fuel efficiency measures designed to move Australia towards international best practice”. In response to that request, the COAG Vehicle Fuel Efficiency (VFE) Working Group has prepared this public discussion paper to assist in the preparation of a report to ATC and EPHC in early 2009.

Since the commencement of the report, a number of events have occurred which are relevant to Australia’s transport and climate change agenda, and have a material impact on a discussion of potential measures. In late 2007, the Australian Government committed Australia to cutting greenhouse gas emissions by sixty per cent from 2000 levels by 2050.

On 16 July 2008, the Australian Government released a Green Paper outlining a Carbon Pollution Reduction Scheme (CPRS). The CPRS is expected to commence in 2010 and will be the primary mechanism to address the market failure of uncapped greenhouse gas emissions and encourage activities and investment to reduce emissions.

The CPRS will place a limit on the amount of carbon pollution Australia can emit through the ‘Carbon Cap’. Parties will be required to buy a ‘pollution permit’ for each tonne of carbon they contribute to the atmosphere, providing a strong incentive to move to more greenhouse efficient practices and technologies. The Government proposes including the transport sector in the CPRS. The carbon price arising from the CPRS will be reflected in the price of transport fuels.

In order to give households and businesses time to adjust to the scheme, the Government will cut fuel taxes on a cent for cent basis to offset the initial price impact on fuel, associated with the introduction of the CPRS. The Government will periodically assess the adequacy of this measure for three years and adjust this offset accordingly. At the end of the three year period the Government will review this adjustment mechanism. For heavy vehicles, it is also proposed that fuel taxes be cut on a cent for cent basis for the first year of operation of the CPRS.

It is expected there may be a need for a range of measures that complement the CPRS. These will address market failures, facilitate the transition to the CPRS and deal with equity issues associated with assisting low income households adjust to the CPRS. The Australian Government has initiated a COAG process to assess the complementarity of existing programs and identify key principles for future complementary measures.

Measures that focus on achieving abatement, other than the CPRS, will be assessed against the price benchmark of the CPRS. This paper recognises the primacy of the CPRS and proposes measures that will serve to assist the Australian transport sector to move towards best practice fuel efficiency. The potential measures discussed in this paper will need to considered in light of the outcomes of the CPRS Green Paper consultation process and the final design of the CPRS.

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2 The Australian Government is offering a range of additional assistance measures in particular for low and middle income households, to help with adjustment costs and improve household energy efficiency.
The independent review known as the Garnaut Climate Change Review was commissioned by Australia’s state and territory governments in late 2007, to examine the impacts of climate change on the Australian economy and recommend medium to long-term policies and policy frameworks to improve the prospects for sustainable prosperity. Transport forms an important component of the review as transport emissions contribute some fourteen per cent of Australia’s greenhouse gas emissions. The Garnaut Climate Change Review Issues paper concerning transport, planning and the built environment was prepared earlier in 2008. A draft report was released on 4 July 2008 and the final report is due for submission on 30 September 2008.

Another matter relevant to this report is the review of Australia’s automotive industry announced in February 2008. This review will report on key outcomes of the current policy settings for the automotive manufacturing sector and evaluate the appropriateness of the Automotive Competitiveness and Investment Scheme in the current competitive environment. The review will also make an assessment of the challenges and opportunities currently facing the sector, including how those challenges and opportunities might impact on the long-term viability and sustainability of the sector including the impact of climate change and changing consumer preferences towards low emissions and fuel efficient vehicles. The review provided a final report to Government on 31 July 2008.

1.2 Aim

The aim of this discussion paper is to present for public comment a range of potential measures which are considered by the ATC/EPHC Working Group to offer the capacity to improve the fuel efficiency of the road vehicle fleet. Following consideration of the public comment, the Working Group will prepare a final report for consideration by Ministers of the ATC and EPHC.

The measures presented in this paper do not represent the position of any Government and are being presented for evaluation and discussion purposes. Nevertheless, COAG by establishing this Working Group has indicated a desire to consider measures that would deliver ‘world’s best practice’ in vehicle fuel efficiency to address the problem of increased CO₂ emissions from transport, and thus this paper represents an important opportunity for stakeholders to present their views.

1.3 Scope

Given the context of this work within the COAG Plan for Collaborative Action on Climate Change, the Working Group has defined vehicle fuel efficiency in terms of greenhouse gas emissions per kilometre travelled, rather than volume of fuel consumed. This enables effective comparisons between vehicles across fuel types and the consideration of fuel switching where this leads to a greenhouse benefit.

The Working Group has also determined that the scope of its work will:
• be limited to road vehicles, and
• focus on measures which:
  – are complementary to the announced CPRS;
  – improve the greenhouse emissions performance of new vehicle models relative to existing models;
  – increase the overall proportion of lower greenhouse emission vehicles in the vehicle population;
  – do not compromise the pollutant emission standards set out in the Australian Design Rules (ADRs) for motor vehicles; and
  – support delivery of improved transport greenhouse efficiency reductions in the short-medium term (5–20 years).

This focus on vehicle fuel efficiency is consistent with the recent conclusions of the report to the European Council of Ministers for Transport (ECMT) which stated that in relation to CO₂ abatement in the transport sector, “vehicle fuel efficiency measures deliver most (benefit)”.  

The scope of the Working Group’s analysis does not include potential improvements in the operational efficiency of vehicles, such as more efficient driving behaviour and improved maintenance of vehicles. Measures aimed at delivering emissions reductions through travel demand management are also outside the scope of the discussion paper, including:

- changing road conditions;
- encouraging more efficient organisation of trips;
- alternate modes of transport; and
- urban planning to reduce trip lengths.

These matters are the subject of separate consideration by ATC and EPHC.

Similarly, matters relating to tariffs and taxation issues are being addressed in other fora and are not addressed by this Working Group. For example, the taxation of fuel is included in the Government’s recently announced review of Australia’s taxation system and has been canvassed in the August 2008 discussion paper (http://taxreview.treasury.gov.au).

### 1.4 Submissions

Comment on this discussion paper is invited from interested stakeholders and members of the public. While comments are welcome on any aspect of the paper, readers are particularly asked to respond to the questions in Section 4 regarding the potential measures.

All submissions will be treated as public, unless confidentiality is requested for all or part of the submissions. The Working Group requests, however, that the scope of any material requested to be kept confidential be limited to the minimum necessary.

Comments are requested in writing by 7 November 2008 and addressed to:

**Vehicle Fuel Efficiency Consultation**

c/- Department of the Environment, Water, Heritage and the Arts

GPO Box 787

CANBERRA ACT 2601

Alternatively, comments may be sent via email to: vfedpaper@environment.gov.au

*Late submissions may not be accepted.*
2 The Nature of the Challenge

2.1 Profile of the Australian Vehicle Fleet

In order to assess the scope for improving the fuel efficiency and reducing CO$_2$ emissions from vehicles in the Australian fleet, there is a need to understand the current makeup of the Australian vehicle population.

There are about 15 million motor vehicles on the road in Australia. Passenger vehicles make up over 77% of the Australian fleet. These include passenger cars and sports utility vehicle (SUV) wagons. Figure 1 provides a breakdown of the vehicle fleet.

![Proportion of vehicle types in Australian fleet – 2007](source)

The number of vehicles in the Australian fleet has been growing at an average rate 2.9% per year since 2003. The motorcycle sector has experienced stronger than average growth (7.9% per year) whilst the light and heavy commercial sectors also experienced above average growth over the same period. Light commercial vehicles are designed primarily for carrying goods and have a GVM of up to 3.5 tonnes. They include utilities, panel vans, cab-chassis and goods carrying vans. Table 1 provides details of average annual growth rates for each vehicle class.

![Average annual growth of registered vehicle numbers (2003–2007)](source)

The average age of the passenger vehicle fleet in 2007 was 9.7 years, which is a slight drop from the age in 2005 of 9.9 years. About 20% of passenger vehicles are more than 15 years old. Commercial vehicles have an older average age – 10.7 years for light commercial vehicles,

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6 ABS Motor Vehicle Census 9309.0
7 ABS Motor Vehicle Census 9309.0
11.2 years for light trucks and 15.7 years for heavy trucks. The fleet is turned over each year through the addition of around 7% of the fleet from new sales and the scrapping of around 4% of the fleet.8

The types of new vehicles being purchased is a key factor in determining the overall fuel efficiency of the vehicle fleet into the future. There were 1.05 million vehicles sold in Australia in 2007, of which 60% were passenger cars, 17% were light commercial vehicles and 19% were sports utility vehicles (SUVs).9 Figure 2 shows a breakdown of sales in 2007.

![Figure 2: Australian Vehicle Sales (by class) – 2007](image)

Source: FCAI, VFACTS Vehicle Sales, December 2007

Over the last two decades there has been substantial growth in the sale of new SUVs, which on average are less fuel efficient than standard passenger cars. Figure 3 illustrates this growth from 1988 onwards. There has also been an expansion in the light and heavy commercial markets. The passenger car market has continued to grow, although at a lower rate.10

![Figure 3: Annual New Vehicle Sales in Australia (1988–2007)](image)

Source: Australian Automotive Intelligence, 2008, Australian Automotive Intelligence Yearbook – 2008

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8 ABS Motor Vehicle Census 9309.0
9 FCAI, VFACTS Vehicle Sales, December 2007
10 ABS, Feb 2008, 9314.0 – Sale of New Motor Vehicles, Time series data
2.1.1 Light Vehicles (up to 3.5 tonnes)

Light vehicles include passenger vehicles, light commercial vehicles and motorcycles. An examination of the light vehicle data illustrates that the composition of new passenger vehicle sales has changed significantly in recent years with a marked increase in the sale of smaller cars. Sales of new large passenger cars have declined over the last decade. Figure 4 illustrates annual sales data for the passenger car segment from 1988–2007.

![Figure 4: New Passenger Car Sales (1988–2007)](image)

Source: Australian Automotive Intelligence, 2008, Australian Automotive Intelligence Yearbook – 2008

Sales data for the SUV market segment, from 1988–2007 (Figure 5) shows strong growth in this segment over the past two decades. In particular there has been strong growth in the compact and medium SUV market segments and, to a lesser extent, the luxury segment. Over the same period there has been a decline in the sale of large SUVs.

In recent years there has been significant growth in the motorcycle and scooter market. Between 2003 and 2007 Australian motorcycle registrations increased by an average of 7.9% per year, compared with a 2.9% increase for the fleet as a whole.\(^{11}\) The increase in motorcycle registrations was from a low base (3% of vehicles in 2007 – refer Table 1). Motorcycles and scooters can provide a fuel efficiency advantage, however there are a range of safety and practical issues that may restrict their widespread use on Australian roads.

The market for passenger cars, SUVs and light commercial vehicles features a mix of private, commercial and government buyers. In 2007, private buyers purchased just under 50% of all light vehicles (under 3.5 tonnes GVM), with businesses (including rental fleets) purchasing 43% and Governments purchasing 7%. Slightly more than half of the passenger vehicles were purchased by private buyers (55%) with 38% bought by businesses and 7% by governments. Light commercial vehicles were mostly purchased by businesses (67%), however private purchases were still significant (22%). Over half of SUV purchases were by private buyers (54%).\(^{12}\) These results are reflected in Figure 6.

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\(^{11}\) ABS Motor vehicle census 2007

\(^{12}\) FCAI, VFACTS Vehicle Sales, December 2007
Figure 5: New SUV Sales (1988–2007)
Source: Australian Automotive Intelligence, 2008, Australian Automotive Intelligence Yearbook – 2008

Figure 6: Vehicle Sales by Buyer Type (2007)
Source: FCAI, VFACTS Vehicle Sales, December 2007
An analysis of sales of passenger cars shows that private buyers purchase mostly small and medium sized cars, whereas governments and businesses purchase mostly large cars (see Figure 7).

Sales of Australian-made vehicles are highly dependent on fleet purchases, which represent about 75% of their sales. Government purchases, across all tiers, account for about 45% of these fleet sales and the rest are for business fleets.

Government and business fleet purchases have a different profile to private purchases, where buyers are favouring smaller, more fuel efficient vehicles. The difference in buying patterns can be partly explained by procurement preferences for Australian-made vehicles which are only available in the large and medium car segment.

In 2007, Australian-made vehicles comprised 19% of the total new vehicle market, and only about 11% of the private passenger new vehicle market. Just over 60% of Australia’s new vehicles are imported from just three countries – Japan, Thailand and Korea. This is illustrated in Figure 8.

In trend terms, there has been an increase in the proportion of imported vehicles in the Australian light vehicle market. As illustrated in Figure 9, since 1994 when the share of this market was split evenly between locally produced and imported models, there has been a significant growth in the share of imports while that of local production has continued to fall.

Australian car manufacturers made over 335,000 vehicles in 2007 of which about 40% were exported. The majority of total automotive exports were to the Gulf States (45% by value), New Zealand (15%), North America (11%) and Korea (8%).

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**Figure 7: Purchasing Profile by Buyer – 2007**

Figure 8: New Vehicle Sales by Country of Origin – December 2007
Source: FCAI, VFACTS Vehicle Sales, December 2007

Figure 9: Sales into the Australian Light Vehicle Market, by Origin
Source: FCAI, VFACTS Vehicle Sales, December 2007
2.1.2 Heavy Vehicles (over 3.5 tonnes)

The heavy commercial vehicle (HCV) market includes both trucks and buses. Trucks are over 97% of HCV sales, with the rest being buses and coaches. Within the truck sales, 41% are classified as large (>15 tonnes), 34% small (3.5–7.5 tonnes) and 22% medium (7.5–15 tonnes).

Prior to 2000, there was a steady decline in HCV sales in the previous quarter century. This appears to have arisen from a combination of improved vehicle durability and the use of larger trucks to carry goods – requiring fewer of them. The increasing transport task has gradually reversed this downward trend, and there is now a trend towards sales of larger trucks to achieve higher load factors in freight movements. Since 2001, annual sales of heavy commercial vehicles have doubled, from 18,669 units (2001) to 37,231 units (2007), although the 2007 sales may have been boosted somewhat by the introduction of stricter emission standards from January 2008.14

The great majority of trucks over 3.5 tonnes are imported as fully built-up vehicles from Japan. At the heavier articulated end of the truck market, manufacturers from Europe and the United States are dominant and a significant proportion of vehicles are assembled in Australia and offered with custom drivetrains (engines, transmissions, wheel axles etc) and bodies to suit particular buyers and uses. The focus of the small Australian based truck manufacturing industry is on high horsepower prime movers for articulated vehicles including road trains and B-Doubles. The industry is primarily made up of assemblers and vehicle builders utilising imported engines (predominantly US), transmissions and other components. Around 6,600 trucks were assembled in Australia in 2007, which is around 20% of all heavy trucks over 3.5 tonnes.

The Australian bus and coach industry consists of bus body builders, chassis manufacturers and ancillary suppliers. According to the Bus Industry Confederation, all buses 8 tonnes and above sold on the Australian market have been locally assembled on imported chassis, with smaller buses being predominately fully imported Japanese models. Between 800 and 1,000 buses are built in Australia each year. There was a higher than average 1400 bus and coach sales in 2007 (both fully imported and locally built) ahead of new emission standards which took effect from early 2008.15

The major purchasers of new heavy commercial vehicles are the larger fleet operators, with smaller fleet operators often buying their vehicles second hand from the larger companies. There tends to be a close working relationship between vehicle suppliers and the major fleet operators in meeting their specialised fleet requirements.

2.1.3 Vehicle fuels

As illustrated in Figure 10, petrol is the dominant fuel used by light vehicles, with diesel totally dominant in the heavy vehicle sector.

There are a growing number of imported diesel powered passenger cars coming onto the market which offer improved fuel and greenhouse efficiency in comparison to the equivalent petrol powered model. Diesel sales represented just over 1% of new passenger car sales in 2005 but have risen to over 4% in 2007.16 Sales of diesel models are more prevalent in the SUV (24%) and light commercial vehicle markets (57%). In contrast, almost all heavy trucks, and most buses, are powered by diesel.

The only other fuel that has significant market penetration is LPG. Around 3% of the total vehicle fleet is powered by LPG, although these vehicles use 7% of total fuel by energy content, primarily due to LPG’s use in taxis and other high-mileage fleet vehicles. Just over 1% of all new passenger and light commercial vehicles in 2005 were factory-fitted LPG models, with annual sales in 2007 (12,900) increasing to 1.6%.17 There are also more after-market LPG conversions of petrol vehicles. Industry estimates suggest that 92,000 vehicles were converted to LPG in 2007.18

14 Australian Automotive Intelligence Yearbook 2008
16 Source: FCAI, VFACTS Vehicle Sales, December 2007
17 Federal Chamber of Automotive Industries VFACTS
18 ALPGA, 2008, Personal Communication (2 May 2008)
Petrol/electric hybrid vehicles represented 0.6% of sales in the combined passenger car and SUV market in 2007.

Compressed natural gas (CNG) has been used in the transport sector for over 20 years predominantly within public transport bus fleets. Brisbane, Canberra, Sydney, Perth and Adelaide operate a proportion of buses on CNG.

2.1.4 Fuel Consumption Performance

Average fuel consumption, as indicated in Table 2, varies according to the fuel and the vehicle class. Most passenger vehicles operate using petrol, with an average fuel efficiency of 11.2 L/100km. The higher average fuel consumption for diesel passenger vehicles reflects the current situation where these vehicles tend to be larger SUV’s, although recent indications are that this is changing.

<table>
<thead>
<tr>
<th>Vehicle Class</th>
<th>Petrol (L/100km)</th>
<th>Diesel (L/100km)</th>
<th>LPG/Dual Fuel (L/100km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger vehicles</td>
<td>11.2</td>
<td>12.5</td>
<td>15.5</td>
</tr>
<tr>
<td>Light commercial vehicles</td>
<td>13.2</td>
<td>12.3</td>
<td>15.0</td>
</tr>
<tr>
<td>Rigid trucks</td>
<td>21.6</td>
<td>29.8</td>
<td>33.6</td>
</tr>
<tr>
<td>Articulated trucks</td>
<td>37.9</td>
<td>55.6</td>
<td>–</td>
</tr>
<tr>
<td>Specialised trucks</td>
<td>–</td>
<td>26.2</td>
<td>–</td>
</tr>
<tr>
<td>Buses</td>
<td>16.4</td>
<td>27.5</td>
<td>–</td>
</tr>
<tr>
<td>Motorcycles</td>
<td>6.4</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Source: ABS, 2007, Survey of Motor Vehicle Use 9208.0
The average fuel consumption of all light vehicles has hardly changed over the last decade. Engine technology in terms of fuel consumption per power output has improved substantially and there has been an improvement in fuel efficiency in the new passenger vehicle fleet. However, potential fuel savings across the whole light vehicle fleet have been offset by increases in vehicle power, size and weight, by the strong growth in sales of four wheel drive sports utility vehicles (SUVs), and increases in the fuel consumption of light commercial vehicles.

Figure 11 illustrates the fuel efficiency and carbon emissions from new light vehicles entering the Australian fleet. It depicts a steady improvement of new vehicle fuel efficiency, for petrol passenger vehicles, over the last two decades, with a 10% improvement in CO₂ emissions in 2002–2007. It is important to note that prior to 2002, this data did not include vehicles in the 2.7–3.5 tonne range. These heavier vehicles include many light commercial vehicles, and the larger SUVs (the SUVs are incorporated in the ABS data for passenger vehicles in Table 2 above). Larger SUV’s, on average, have higher fuel consumption rates than other passenger vehicles, and, in part, the growth in this market has tended to offset improvements in the average fuel efficiency of “standard” passenger cars.

As noted earlier, the vehicles bought by fleets have a different profile from those of private consumers. When considered in fuel consumption terms, the Department of Environment, Water, Heritage and the Arts (DEWHA) has estimated that the average fuel consumption of new government and business fleet purchases of passenger vehicles in 2007 to be 10.5 L/100km, whereas the average fuel consumption of new private purchasers of passenger vehicles was 9.6 L/100km in the same year, an eleven percent difference.

On a weight for weight basis, diesel vehicles are more fuel efficient than a comparable petrol model. Diesel engines are more expensive to produce than petrol engines and this is reflected in higher relative purchase costs for diesel variants of models. In the current Australian market, the price differential between a petrol vehicle and the diesel variant ranges from $1000 to $8500.  

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19 ABS Survey of Motor Vehicle Use 9208.0, BTRE Information Sheet 18 – Fuel Consumption of New Passenger Vehicles
An analysis of “best performing” and “best selling” small and medium petrol cars suggests that consumers are seeking a balance between fuel efficiency and a range of other factors, such as purchase price. A comparison of the relevant petrol vehicles from the small and medium classes is provided in Table 3. The best performing models provide a 15–16% reduction in CO₂ emissions, compared with the best sellers. However, based on current fuel prices, purchasing the lower priced vehicle presents a more attractive financial option over the lifetime of the vehicle. In the examples quoted in Table 3, the owner would need to travel almost 200,000km for medium car category to recoup the extra cost of the higher priced vehicles in fuel savings, and almost 500,000km for small car. However, the table also illustrates that price competitive fuel efficient vehicles are available.

Table 3: Comparison of “best performer” and “best seller” petrol cars by class

<table>
<thead>
<tr>
<th>Car Class (Petrol)</th>
<th>Best Performer (CO₂ emissions)</th>
<th>Best Seller (CO₂ emissions)</th>
<th>Recommended Retail Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Car (Petrol)</td>
<td>Fiat 500</td>
<td>Toyota Yaris</td>
<td>$22,990</td>
</tr>
<tr>
<td></td>
<td>Fuel Consumption (Combined) (L/100km)</td>
<td>Fuel Consumption (Combined) (L/100km)</td>
<td>6.0</td>
</tr>
<tr>
<td></td>
<td>CO₂ emissions (g-CO₂/km)</td>
<td>CO₂ emissions (g-CO₂/km)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>118</td>
<td>141</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Medium Car (Petrol)</th>
<th>Best Performer (CO₂ emissions)</th>
<th>Best Seller (CO₂ emissions)</th>
<th>Recommended Retail Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Peugeot 207 1.6 XT</td>
<td>Toyota Corolla</td>
<td>$24,990</td>
</tr>
<tr>
<td></td>
<td>Fuel Consumption (Combined) (L/100km)</td>
<td>Fuel Consumption (Combined) (L/100km)</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>CO₂ emissions (g-CO₂/km)</td>
<td>CO₂ emissions (g-CO₂/km)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.1</td>
<td>7.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>145</td>
<td>172</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$24,990</td>
<td>Recommended Retail Price $20,990</td>
<td></td>
</tr>
</tbody>
</table>

Source: Green Vehicle Guide and manufacturer websites (June 2008)

It is also important to note that there are significant differences in fuel consumption performance within vehicle classes. The indicative analysis of Green Vehicle Guide data reported in Table 4 illustrates the magnitude of the differences.

Table 4: Comparison of Highest and Lowest CO₂ Emitting Vehicles by Class

<table>
<thead>
<tr>
<th>Vehicle Class*</th>
<th>CO₂ Emissions (g/km)</th>
<th>Annual Difference Between Lowest and Highest Tonnes CO₂ per vehicle per year#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lowest Emissions in Class**</td>
<td>Highest Emissions in Class**</td>
</tr>
<tr>
<td>Small Car</td>
<td>120</td>
<td>200</td>
</tr>
<tr>
<td>Medium Car</td>
<td>130</td>
<td>270</td>
</tr>
<tr>
<td>Large Car</td>
<td>160</td>
<td>300</td>
</tr>
<tr>
<td>People Mover</td>
<td>200</td>
<td>330</td>
</tr>
<tr>
<td>Light truck</td>
<td>210</td>
<td>330</td>
</tr>
</tbody>
</table>

* Classes as per Green Vehicle Guide
** Lowest and highest emission values are conservative and do not represent the single lowest or highest emitting vehicle model in each class. In the three “car” classes, the chosen lowest emission figure represents the value at or below which there are at least five different models available. The chosen highest emission figure in the car classes excludes “exotic” or unusual vehicles, and in the case of the large car class excludes 8+ cylinder models and 4WDs.
# Assuming annual travel of 15,000km.

22 Assumes a price of $1.60 per litre for petrol
2.2 Greenhouse Emissions and the Transport Sector

The transport sector contributed 79.1 Mt CO₂-e or 13.7% of Australia’s net emissions in 2006. Road transport was responsible for 87% of these emissions, or 12.0% of Australia’s total emissions. Greenhouse gas emissions from road transport have been increasing at an average of 1.7% per annum since 1990. Figure 12 reflects the growth in greenhouse emissions from the road transport sector since 1990. It shows that higher than average growth in the light commercial and heavy commercial market segments has contributed 47% of the growth in road transport emissions.

Due to their size and load, heavy commercial vehicles, consume significantly more fuel and contribute greater greenhouse emissions per kilometre than a smaller passenger vehicle. Figure 13 compares the relative proportion of each market segment and their relative contribution to greenhouse emissions. It can be seen that whilst heavy commercial vehicles make up just over 4% of the fleet, they contribute over 22% of emissions.

The greenhouse gas emissions from the transport sector in 2010 have been projected to be 89.9 Mt CO₂-e, +/- 6 per cent – see Figure 14. This represents a 45% increase over the 1990 level. Emissions from road transport are projected to be 76.4 Mt CO₂-e in 2010 (41% over 1990 levels), with emissions from rail, aviation and shipping projected to reach 11.6 Mt CO₂-e, or 50% above 1990 levels.

The bulk of emissions growth between 1990 and 2010 is due to road vehicles, which are responsible for emissions growth of 22 Mt CO₂-e. Even though trucks are a smaller sector, fast growth in light commercial vehicles and articulated trucks means that they make up almost half this projected growth (11.5 Mt CO₂-e), with the larger passenger vehicle sector making up the rest (10.5 Mt CO₂-e). By comparison, non-road transport sectors (air, rail, sea) are projected to grow by approximately 3.8 Mt CO₂-e over the same period.

For 2020, the indicative ‘with measures’ projection is 103.7 Mt CO₂-e. This represents a 67% increase on the 1990 level of 62.1 Mt CO₂-e. Emissions growth between 2010 and 2020 is forecast.

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23 Department of Climate Change (2008), National Greenhouse Gas Inventory (2006)
24 However, when considered in energy efficiency terms this is not a valid comparison, as these vehicles are very fuel efficient given the large volume and mass of freight they carry.
to slow to 1.6% per annum compared to 1.8% between 2005 and 2010. Slowing emissions growth in the latter half of the projection period is driven by forecasts of slower economic growth, the effects of saturation of per capita car travel and a continuing drive for fuel efficiency improvements.

Figure 13: Comparison of Fleet Proportion and Proportion of Greenhouse Emissions by Sector (2005)


Demand for road transport is considered to be relatively inelastic (-0.1 to -0.2) with respect to fuel prices in the short term. Even though the cost of fuel is an important contribution to overall transport costs, it tends to be overshadowed by the total generalised cost of motoring, i.e. the combination of other operating costs (such as depreciation and maintenance) and original vehicle
purchase costs and access charges, as well as the value that travellers place on travel time and convenience relative to other travel modes.\footnote{26}

The transport sector has been exposed to sustained growth in fuel prices in recent years. Growth in the international price of refined fuels (petrol and diesel) is being driven by a combination of factors including increased demand from the developing economies of China and India, restrictions on the ability of refineries to meet demand and ongoing political uncertainty in the Middle East. Australian fuel prices tend to follow movements in international refined fuel prices.

As noted earlier, increasing fuel prices are enhancing the attractiveness of fuel efficient vehicles and the cost-effectiveness of measures to improve vehicle efficiency. To put this into perspective in terms of greenhouse mitigation measures, the 40 cents/litre petrol increase seen in Australia over the last three years is the equivalent of applying a carbon tax to petrol of $160/tonne CO$_2$-e.

Nevertheless, it is widely accepted that the elasticity of fuel use with respect to petrol prices is very low in the short term, as vehicle owners often have limited opportunity to change travel patterns or switch to more fuel efficient vehicles. The elasticity is still relatively low in the medium term, although there is greater capacity to make changes in vehicle purchases in that time frame. Figure 15 provides an indication of the patterns of petrol prices and purchasing behaviour over the late 2004 to early 2008 period, using CO$_2$ emissions data from the Green Vehicle Guide on the top 20 selling models in the light vehicle fleet.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{chart.png}
\caption{Average CO$_2$ Emissions of Top Sellers (columns) compared to Petrol Price Movements (line)}
\end{figure}

Notes:
1. Sales figures based on VFACTS, with Top 20 sellers representing around 50% of vehicle sales.
2. CO$_2$ emissions from the Green Vehicle Guide. CO$_2$ value chosen for each vehicle is the value for the best performing variant. This means that the total and average CO$_2$ emissions are an underestimate. This is confirmed by FCAI data\footnote{27} which reports a sales weighted CO$_2$ average of 230 and 226 g/km for 2006 and 2007 respectively (4.8% and 5.4% higher than Figure data).

While the data should be treated as indicative only, and other factors may be at play, the above chart indicates that the steep rise in petrol prices during 2005 is followed by a significant change in purchasing behaviour in 2006 towards more economical vehicles (as measured by CO$_2$ emissions), particularly in the first three months of the year. However, the tapering off of this

\footnote{26} Greenhouse Gas Emissions From Australian Transport: Base Case Projections To 2020, BTRE (2005)
increase in fuel prices during the second half of 2006 and during most of 2007, is associated with a virtual standstill in the average CO₂ emission levels of the top selling models in 2007 and into 2008, despite the “floor” in the petrol price in 2007 (around 120 c/L) being much higher than that in the beginning of 2005. This suggests that consumers become accustomed to a higher fuel price and that the capacity of fuel prices alone to drive sustained changes in purchasing behaviour is limited, unless the prices are very high or increasing rapidly and consistently.

2.3 Consumer Behaviour in the Road Transport Sector

The CPRS is expected to provide the most cost effective approach to reducing CO₂ emissions on an economy wide basis.

The demand for road transport tends to respond slowly to changes in the price of fuel. In the short term, vehicle owners often have limited opportunity to change travel patterns or switch to more fuel efficient vehicles.

Lack of access to objective information on fuel consumption can be a barrier to the uptake of low emission vehicle technology. The Fuel Consumption Label and the Green Vehicle Guide are significant steps toward reducing this market barrier for light vehicles. However, in the case of heavy vehicles, vehicle purchasers can have difficulty accessing objective and comparable fuel consumption information. Smaller heavy vehicle fleet operators, in particular, often have to rely upon limited and subjective evidence from industry contacts or vehicle sellers.

Research suggests consumers can undervalue the ongoing financial savings over the life of a vehicle arising from improved fuel efficiency relative to other purchasing considerations (such as purchase price and lifestyle considerations). Vehicle choice is informed by a range of factors, of which fuel efficiency is one. While fuel efficiency may carry a high social value in relation to future benefits and costs, individual consumers may ascribe a lower private value to fuel efficiency, relative to other factors.

2.4 Current Measures

Australia has a range of measures in place that influence vehicle fuel efficiency.

There are a number of national level programs which do not have improved fuel efficiency or lower CO₂ emissions as their primary objective, but do have some influence on these objectives. Such measures include:

• The Automotive Competitiveness and Investment Scheme (ACIS) which included $150 million R&D program to encourage local vehicle manufacturers to invest in advanced technologies, including those offering emission and fuel efficiency improvements;
• The Light Metals Action Agenda, encompassing the aluminium, magnesium and titanium industries, which provides a framework for the growth of the Australian light metals industry, which has potential application in the vehicle manufacturing industry; and
• The Co-operative Research Centre for Advanced Automotive Technology which has been established to provide the automotive industry with the opportunity to work with research providers in design, engineering and manufacturing research to enhance the industry’s international competitiveness.

There are a number of current measures which do have reducing emissions or improving fuel efficiency as a key or primary objective. These are summarised below.

Green Car Innovation Fund

The Australian Government has announced the establishment of a scheme to support innovation in the light vehicle sector, through the five year $500 million Green Car Innovation Fund, which is

scheduled to commence in 2011. On 10 June 2008, the Australian Government announced that $35 million from the fund will be provided to Toyota to support the manufacture of a hybrid Camry model in Australia. The Victorian Government is also supporting the project.

**National average fuel consumption target**
A voluntary national average fuel consumption (NAFC) target for new passenger cars was negotiated between the Australian Government and the Federal Chamber of Automotive Industries (FCAI). The target established in 2003 was 6.8 L/100km for petrol passenger cars by 2010. If delivered, this would represent an estimated 18% improvement in the fuel consumption of new vehicles between 2002 and 2010 – a rate of improvement similar to the EU and Japanese targets, but starting from a higher absolute level.

The fuel consumption testing procedure that underpinned the NAFC target was changed in 2004 to reflect a change in testing standards. The revised test (in Australian Design Rule (ADR) 81/01) produces higher nominal fuel consumption figures for the same vehicle model than the previous testing procedure. ADR81/01 also expanded the scope of vehicles to include diesel and LPG vehicles, and increased the maximum mass from 2.7 tonnes to 3.5 tonnes.

The new test procedure and wider scope necessitated a review of the 2010 NAFC target. It was also decided that, consistent with international practice, it would be appropriate to convert the previous NAFC target to a National Carbon Emissions (NACE) target expressed in g CO₂/km. Further negotiations have occurred with the FCAI to align the target with the new test procedures and to set targets which included all light vehicles up to 3.5 tonnes. These negotiations have not been finalised.

The FCAI has proposed a NACE target of 222 g CO₂/km for all new light vehicles by 2010. An independent analysis, commissioned by the FCAI and the Australian Government in 2004, recommended a NACE target of 214 g CO₂/km for new light vehicles by 2010. The FCAI proposal represents virtually no improvement over the NACE already achieved in 2007.

**Alternative Fuels Conversion Program (AFCP)**
The AFCP, administered by the Department of the Environment, Water, Heritage and the Arts, provided assistance to industry to develop and trial natural gas and LPG engines in heavy duty vehicles. The AFCP ended in June 2008. Launched in January 2000, AFCP has assisted the purchase or conversion of over 1000 trucks and buses. Recent trials have focused on the use of LNG in long haul trucks, which is showing promise for that type of transport operation.

The AFCP has demonstrated that there are no easy alternative fuel solutions for heavy vehicles that will deliver consistent greenhouse and air quality benefits. Critical barriers to the uptake of gaseous fuels have been a lack of a refuelling network and infrastructure, coupled with a lack of mature gas vehicle technology available and ready for adoption by the heavy vehicle industry.

Experience from the AFCP suggests that the utilisation of natural gas or LPG does not guarantee a better greenhouse gas outcome, with many of the vehicles tested under the program showing no advantage over an equivalent diesel engine, and some showing a significant disadvantage. The program has also highlighted the lack of a heavy commercial vehicle test facility.

**Fuel consumption labelling**
From 1 January 2004, ADR81/01 *Fuel Consumption Labelling for Light Vehicles* has required fuel consumption labelling of all new vehicles up to 3.5 tonnes irrespective of fuel source. The label indicates how many litres of fuel a vehicle will use to travel 100 kilometres, as well as the greenhouse gas emissions per kilometre. ADR81/01 is mandatory, but sets no limits on emissions or fuel consumption. It is aimed directly at informing consumers as to the relative performance of individual models. ADR81/01 specifies that the test procedure must comply with the United Nations Economic Commission for Europe Regulation 101 (UNECE R101) in order to harmonise Australian

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29 The new testing procedure is set out in UNECE Regulation 101 as adopted in ADR81/01 *Fuel Consumption for Light Vehicles.*
testing and reporting of greenhouse gas emissions and fuel consumption with the approach used internationally.

A revised labelling standard (ADR81/02) will take effect from October 2008 for new model vehicles and will be mandatory on all new vehicles from April 2009. The new label (see Figure 16) will display three fuel consumption numbers – ‘combined’, ‘urban’ and ‘extra-urban’ – produced from the standard UNECE test cycle, as well as the CO₂ value for the combined test. This approach is consistent with the labels used in the EU and other countries. The current label only provides the combined test cycle numbers for both fuel consumption and CO₂ emissions. Most vehicles have much higher fuel consumption on the ‘urban’ part of the test cycle, and for drivers who spend a lot of time in city traffic conditions, the new label will provide a more accurate indication of fuel consumption than simply the combined result. A sample of UK vehicles indicates urban fuel consumption values are 20–50% higher than the combined values.30

Figure 16: Sample Fuel Consumption Label required under ADR81/02

Green Vehicle Guide
The Green Vehicle Guide (GVG) website provides model specific information to consumers on the fuel efficiency and greenhouse emissions of all light vehicles less than 3.5 tonnes produced since mid-2004, matching the information required on the fuel consumption labels.32 In summary, a consumer is able to assess the performance of individual vehicles on the GVG in terms of:
• greenhouse emissions (presented both as a rating out of 10, and the actual CO₂ emissions value in g/km from ADR81),
• fuel consumption in L/100km (as calculated under ADR81),
• air pollution performance (as a rating out of 10, based on the emissions standard to which the vehicle is certified),
• overall environmental performance (as a 1–5 star rating based on the sum of the greenhouse and air pollution ratings).

30 Based on data provided on the UK Vehicle Certification Agency’s website at: http://www.vcacarfueldata.org.uk/
32 The GVG is at: www.greenvehicleguide.gov.au
Since its launch in August 2004, the GVG website has had over 750,000 visits. It is utilised by private vehicle buyers and fleet managers in both government and industry, to assist them in making informed purchasing decisions regarding the environmental performance of individual vehicles. GVG ratings are increasingly being used in vehicle purchasing policies of governments and business, and will be used by the ACT government as the basis for new graduated stamp duty charges for new vehicles. The GVG is also widely used in the media as the authoritative source of environmental information on new vehicles. The GVG data is also provided to a number of other websites focused on providing consumer oriented vehicle information.

The website was recently upgraded to improve its functionality and provide the capacity to include the additional fuel consumption and greenhouse data provided by ADR81/02. The upgrade also added a user populated fuel cost calculator to assist consumers. Figure 17 illustrates typical information provided from a vehicle search on the GVG website.

**Figure 17: Sample results from Green Vehicle Guide**

### Government fleet procurement policies

Governments at all levels are incorporating fuel efficiency, CO₂ emissions or overall environmental performance as an element in their fleet purchasing policies. An increasing number of fleets are using the *Green Vehicle Guide* ratings as the basis for the environmental elements of their policies, although many current policies with a stated environmental objective use engine type or size or fuel type as the basis for fleet selection. For a more complete listing of current government fleet environment policies refer to Measure 2.3 in Section 4.2 of this paper.

Of the current fleet purchasing schemes, those operated by the Australian Government, NSW, Queensland, Tasmania and the ACT directly utilise the *Green Vehicle Guide* ratings, with Queensland and Tasmania using the Guide’s CO₂ based greenhouse rating and the others using the overall rating (which includes both greenhouse and air pollution factors).

The impact of these policies has yet to be measured in many cases, as they are relatively new, however, some data is available. In the Australian Government fleet, the proportion of vehicles achieving a score of greater than 10 has increased since the policy’s introduction in 2003 as shown in Table 5.

The Western Australian Government fleet purchasing policies in favour of four cylinder vehicles is estimated to have reduced CO₂ emissions by around 4,200 tonnes CO₂ a year compared to what would have been emitted by the 2002 fleet.
Table 5: GVG Rating of Vehicles in Commonwealth Fleet

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<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 10</td>
<td>23</td>
<td>27</td>
<td>35</td>
</tr>
<tr>
<td>Less than or equal to 10</td>
<td>49</td>
<td>65</td>
<td>62</td>
</tr>
<tr>
<td>No rating available</td>
<td>28</td>
<td>8</td>
<td>3</td>
</tr>
</tbody>
</table>


Other measures
A number of States and Territories have stamp duty and registration rates that are linked, in part, to the number of cylinders or the mass of the vehicle. As smaller engines and lighter vehicles are usually, though not always, more fuel efficient these measures indirectly favour the purchase of more fuel efficient vehicles in many cases. Differential vehicle charges are discussed in more detail in Section 4.

2.5 Impact of Current Measures
As indicated above, there are a range of measures currently in place in Australia which are designed (principally or in part) to reduce CO₂ emissions from the transport sector. Some of these measures have been included in the greenhouse gas projections specified in Section 2.1. These measures are estimated to reduce emissions by 1.8 Mt CO₂-e in 2010, increasing to 5.0 Mt CO₂-e in 2020. The major measures include the:

1. Environmental Strategy for the Motor Vehicle Industry (including National Average Fuel Consumption targets and changes to the Australian Design Rules), projected to deliver abatement of 0.6 Mt CO₂-e in 2010 and 2.5 Mt CO₂-e in 2020.

2. Government Biofuels Initiatives, projected to deliver 0.2 Mt CO₂-e of abatement in 2010 and 0.3 Mt CO₂-e in 2020.

3. Alternative Fuels Conversion Program, projected to deliver 0.01 Mt CO₂-e of abatement in 2010 and 2020.

4. Travel Demand Management, projected to deliver 0.2 Mt CO₂-e of abatement in 2010 and in 2020.

5. State and Territory Actions to encourage more sustainable transport choices are projected to deliver 0.8 Mt CO₂-e of abatement in 2010 and 2.0 Mt CO₂-e in 2020.

As a percentage of total road transport emissions these projected savings are small, representing 2% in 2010 and 4% in 2020.

As noted earlier, the CPRS will be the primary mechanism to address uncapped greenhouse emissions and encourage activities and investment to reduce emissions. However, other measures that assist the Australian transport sector to move towards best practice fuel efficiency, measured against the CPRS price benchmark, also merit consideration.
3 Capacity for Improvement

In considering what measures might be proposed for improving vehicle fuel efficiency and reducing vehicle CO₂ emissions, it is important to realistically assess the magnitude of improvements that are feasible in the context of the Australian vehicle fleet. There is little value in proposing measures that:

• are predicated on the widespread adoption of technologies that are not commercially viable in the nominated time frame,
• assume benefits that are not substantiated by the available evidence, or
• require policy approaches inconsistent with the open economy that operates in Australia.

Section 3.1 looks specifically at the key role that engine and vehicle technologies play in delivering lower vehicle CO₂ emissions, and the potential magnitude of benefits from those technologies. Section 3.2 examines the potential offered by changes in the transport fuel mix. Section 3.3 considers the broad range of policy measures that are being utilised around the world to address the challenge of reducing CO₂ emissions from vehicles.

3.1 The Role of Vehicle Technology

As noted in Section 1.3, the scope of this review is on measures which have the potential to deliver fuel efficiency improvements from the new vehicle fleet in the short-medium term. Consequently, this discussion of technology will also focus on that time frame. Due to the high level of uncertainty regarding longer term technologies, the Working Group does not consider it productive to examine measures predicated on technologies only likely to become viable in the long term (such as mass production of fully electric vehicles or hydrogen powered vehicles).

Vehicle technology plays a key role in reducing vehicle CO₂ emissions. The European Commission has noted that “improvements in car technology have delivered the bulk of the CO₂ reductions” to date. A 2006 report prepared for European transport ministers also noted that “most future CO₂ emission reductions are expected to come from new technologies, and improvements of currently available technologies”. International research suggests that there is still considerable scope for fuel consumption improvements in road vehicles operating on conventional internal combustion engines, through more widespread adoption of fuel saving engine/transmission technologies and improved vehicle design and materials. In the light vehicle sector, shifting to more fuel efficient engines, particularly diesels, and vehicle or engine downsizing also offer the capacity for significant improvements. These technologies are capable of widespread deployment in the short term (5–10 years).

Greater use of hybrid technologies also offers considerable potential for emission reductions in the medium term (10–20 years).

Part 1 of the recent King Review commissioned by the UK Government is a useful consolidation of recent research in this arena. The Review concluded that 30% fuel consumption savings are achievable for the average new vehicle in the short (5–10 years) time frame. This is consistent with other reports, including a recent analysis prepared for the OECD’s International Transport Forum (ITF) which indicated that efficiency gains of around 25% should be possible for petrol vehicles from engine improvements alone.

The ITF report also noted that advanced direct injection turbocharged diesel engines are currently about 30% more efficient than conventional petrol engines of similar performance, and while

further improvements in diesels are possible the capacity for improvement is less than that for petrol engines. The ITF report also pointed to an earlier report by the US National Research Council which concluded that cost effective fuel consumption improvements of 12–27% for passenger cars, and 25–42% for light trucks, can be achieved.37

A 2007 US report examined the feasibility of achieving a 50% reduction in fuel consumption in US cars by 2035, and concluded that such an objective was possible using a combination of incremental improvements in engines and transmissions, reductions in drag, rolling resistance, weight and size, and deployment of more efficient alternative power trains.38 The report also noted however, that “the nature and magnitude of the changes required to meet this goal run counter to the trend towards larger, heavier, more powerful vehicles over the past 25 years”.

In summarising recent analyses, the King Review identified a range of potential technologies and their estimated efficiency benefits as set out in Table 6.

Table 6: Estimated Fuel Savings from a Range of Vehicle and Engine Technologies and Design Measures

<table>
<thead>
<tr>
<th>Technology/Materials/Design Measure</th>
<th>Estimated Fuel Saving (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downsize engine with turbo/supercharging</td>
<td>10–15</td>
</tr>
<tr>
<td>Direct injection and lean burn</td>
<td>10–13</td>
</tr>
<tr>
<td>Light weighting</td>
<td>10</td>
</tr>
<tr>
<td>Electric motor assist</td>
<td>7*</td>
</tr>
<tr>
<td>Stop-start with regenerative braking</td>
<td>7*</td>
</tr>
<tr>
<td>Variable valve activation</td>
<td>5–7</td>
</tr>
<tr>
<td>Dual clutch transmission</td>
<td>4–5</td>
</tr>
<tr>
<td>Reduced mechanical friction components</td>
<td>3–5</td>
</tr>
<tr>
<td>Stop-start</td>
<td>3–4*</td>
</tr>
<tr>
<td>Low rolling resistance tyres</td>
<td>2–4</td>
</tr>
<tr>
<td>Improved aerodynamics</td>
<td>2–4</td>
</tr>
</tbody>
</table>

* In stop-start urban driving conditions, the percentage improvement from these technologies is expected to be significantly higher.

Source: Based on Tables 4.1 and 4.2 of King Review, Part 1 (pp 45–46). Sources nominated by King Review include International Energy Agency, California Air Resources Board, Institute of European Environmental Policy, and Ricardo Consulting.

The King Review also noted that more widespread adoption of these technologies could be characterised as an “evolutionary” process, rather than a radical technological shift, and thus making them technologically achievable in the short term. The 30% overall estimate is also based on “adopting a small selection of the most cost-effective technologies”.

Straight substitution of petrol vehicles with diesel vehicles can also deliver significant benefits, with diesel engines using around 25–30% less fuel than equivalent petrol models.

The lower carbon to hydrogen ratio and higher octane rating of LPG (relative to petrol and diesel) also offers the potential for LPG fuelled vehicles to deliver CO₂ emission reductions. In the Australian context however, this potential has generally not been realised as the engines and fuel delivery technologies utilised in LPG vehicles (both mono and bi-fuel) have been less than optimal. Future adoption of emerging LPG engine and fuel delivery technologies (e.g. liquid injection) has the potential to improve the CO₂ emissions performance of LPG.

Over the medium term (10–20 years), the King Review concludes that greater utilisation of hybrid technologies (discussed further below) can offer significant benefits of 20–35% for mild hybrids.

25–50% for full hybrids, and potentially greater than 50% for plug in hybrids. Mild and full hybrids vehicles already exist in the market, while plug-ins are under development.

A report prepared for the UK Department for Transport39 (and broadly supported by the UK Government) concluded that continued improvements in conventional engines, reducing weight, mild hybrids and other near market technologies offer the prospect of “developing very significantly lower carbon vehicles over the longer term”.

The estimated costs for these technologies vary widely, and the net cost (technology cost less fuel savings over the life of the vehicle) is highly dependent on the price of fuel. One 2007 OECD estimate suggests that a realistic combination of technologies delivering a 25–30% improvement in fuel efficiency of a petrol engine vehicle would cost US$2000–2600 per vehicle in technology costs, but only $190 in net cost terms (at 2007 oil prices, and based on first 90,000 km of vehicle’s life).40 The King Review concluded that the payback period for technologies delivering a 30% fuel consumption improvement would be 3–5 years for most UK drivers.

A recent US paper also estimated that improvements in conventional engines and transmissions could be deployed in high volumes in the near term and deliver around 30% reduction in fuel consumption in the US light vehicle fleet, at cost increases of US$1500–$3500 per vehicle. The paper also concluded that the improvements in fuel consumption would deliver fuel savings to offset the increase in vehicle costs within a few years, depending on the particular technology and the price of fuel.

In relation to hybrids, the King Review (p. 50) concludes that “hybrid technology is not currently a cost-effective solution for most drivers, but there is considerable future scope for reduced production costs, as manufacturing volumes rise, and for improvements in battery technology. The least expensive forms of hybrid technology – mild hybrid technology, which bundles together stop-start, regenerative braking and electric motor assistance – may become available in cars much more widely in the short term at a cost acceptable to many consumers.”

Lightweight battery-electric vehicles have been available overseas for a number of years, and “plug-in” hybrid vehicles are now been developed. The range of such vehicles is limited by current battery technology and they are not necessarily emission free. They need to be recharged from an electricity source, which will often be the electricity grid. In many parts of Australia, coal fired power stations provide a significant proportion of the electricity produced on the grid. The use of electricity from such sources will still produce significant greenhouse gas emissions. The creation of significant greenhouse benefits from battery-electric vehicles will depend upon corresponding change in the carbon intensity of the electricity grid, through an expanded use of renewable and other energy sources.

Strategies to address the safety and functionality concerns relating to very light vehicles (including motorcycles and scooters) through the provision of appropriate safe infrastructure or reform of road rules may support more widespread uptake of very light vehicles. However these lie outside the scope of this paper.

3.2 The Role of Fuels

Vehicle emissions, whether related to urban air quality or greenhouse, are clearly a consequence of the interaction between the fuel and the vehicle technology. As engines have become more complex, and as noxious emission standards for vehicles become more stringent, significant improvements in petrol and diesel fuel quality have been also been required to enable the effective operation of emission control technology.

In addition, a range of alternative transport fuels have been developed, or are being explored, which may offer the capacity for additional reductions in greenhouse emissions from vehicles.

As indicated in Figure 10, petrol is the dominant transport fuel in the light vehicle market, with diesel even more dominant in heavy vehicles. For the purposes of this paper the potential CO₂ benefits offered by switching from petrol to diesel in the light vehicle sector is considered in the earlier discussion around vehicle technologies in Section 3.1, not in this section on fuels.

3.2.1 Fuel Quality and Cost Issues
The demand for refined petroleum products within Australia is increasing at an average of approximately 3.5% per annum since 2001. Rates vary for different fuels, with the petrol demand increasing at 2% and the demand for diesel at 5% per annum. Demand for fuel is also increasing internationally. Diesel is the dominant fuel in Asia and in recent years there has been a significant increase in demand. This has resulted in higher international and wholesale diesel prices.

Around 70% of crude oil used in Australian refineries is imported and thus supply is largely dependent on global supply and demand. During 2006–2007 crude oil was sourced from over sixteen countries, mainly within the Asia-Pacific region but also from the Middle East. The spread between domestic and imported crude oil from a number of different sources helps to reduce disruption risks to supply in Australia.

There are seven refineries in Australia which supplied 73% of Australian refined product demand in 2006–2007. Imported refined products were predominantly sourced from the Asia-Pacific region, with approximately 60% sourced from Singapore. Australia’s policy of import price parity means that wholesale prices are linked closely to the Singapore benchmark prices of petrol (MOPS95 Petrol) and diesel (50ppm sulfur standard). As Australian refineries are operating at full capacity, without expansion, additional demand will be met from increased imports.

The price of diesel has also been affected by the need to use high quality crude oil to produce the highly refined and low sulfur fuels suitable for use in modern fuel efficient cars and essential to maintaining good air quality. Diesel currently supplied in Australia is required to meet a 50ppm sulfur limit. From 1 January 2009 this will be reduced to 10ppm sulfur.

Both Unleaded and Premium Unleaded Petrol (ULP and PULP) are available in Australia. ULP is restricted to a maximum of 150ppm sulfur, and has an octane number of 91. PULP has an octane number of 95, and a sulfur content capped at 50ppm from 1 January 2008. PULP has an octane number of 95. Currently ULP is more widely used in Australia than PULP (approximately 83% and 17%, respectively, of petrol consumption).

A key objective of the Government’s fuel standards policy has been to align Australian fuel quality with international standards (particularly with Europe, as the European fuel standards are matched to the UNECE vehicle emission standards (which are adopted in Australia). This ensures that fuel quality supports the introduction of vehicles with improved engine and emissions control technology. Along with Japan, Australia has been a leader in this regard in the Asian region where petrol suitable for vehicles meeting Euro 3 emission standards is now widely available. All areas of China and India will have moved to Euro 3 based standards by 2010. Major countries including Japan, China and India are also now phasing in petrol and diesel to support Euro 4 compliant vehicles. The use of 10ppm sulfur diesel and a greater use of PULP brings Australia more closely into alignment with Euro 4 level fuel standards.

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41 Personal communication: 2008, Department of Resources, Energy and Tourism
42 DITR, Australian Petroleum Statistics, June 2007
43 MOPS95: mean of Platts Singapore 95 research octane number
Europe is planning to move to more stringent emissions standards. Euro 5 and Euro 6 emission standards for light petrol and all diesel vehicles will be implemented from late 2009 and late 2011 respectively. The primary focus of these new standards is on reducing NOx from all vehicles, and PM emissions from light diesel vehicles. Fuel sulfur levels in Europe are also being lowered from 1 January 2009 to 10ppm. In diesel, this is primarily to support the Euro 5 emission standards for light and heavy vehicles, and in petrol, to facilitate the adoption of the widest possible range of fuel saving technologies. Petrol with an octane rating equivalent to PULP will also be mandatory.

There is considerable debate regarding the necessity to reduce the sulfur content of petrol to 10ppm, particularly given that reducing sulfur levels in petrol to 10ppm will require additional energy at the refinery with resultant increases in greenhouse gas emissions. The vehicle industry in Australia continues to argue for further reductions in the sulfur content in petrol to 10ppm, recently stating that “further improvements in petrol quality will need to be achieved if the Australian market is to receive the full benefit of these [advanced emissions] technologies”. Evidence to the contrary is also available. However, consideration of any move to 10ppm sulfur limits in petrol are outside the scope of this discussion paper and will be addressed elsewhere.

3.2.2 Alternative Fuels

For the purposes of this paper, any fuel other than petrol or diesel is considered an alternative fuel.

In that context, LPG is the only alternative fuel with significant penetration in the Australian market and can, potentially, deliver reductions in greenhouse gas emissions. However, in Australia the majority of LPG-powered vehicles are conversions of petrol engine models and generally do not deliver all of the potential environmental benefits. There are still some significant technical advances possible with LPG, including vapour and liquid injection systems, which can improve performance, however these technologies have not been widely adopted in Australia at this stage.

Biofuels and biofuel blends promise to provide a less greenhouse intensive alternative to petroleum fuels, but this depends on feedstock and production method. At current rates of production these fuels are only likely to replace a small proportion of the traditional fuel market. Biofuels are produced using a range of biological feedstocks and include ethanol and biodiesel. Biofuel blends refer to products which are based on petroleum based fuels (petrol and diesel) and include a small proportion of a biofuel (such as ethanol or biodiesel).

The maximum blend level of ethanol in petrol is set by legislation at 10% (known as E10). Almost all new petrol engine vehicles are able to use E10. On a life-cycle basis it has been estimated that E10 delivers 1%–4% savings in greenhouse gas emissions relative to straight petrol, although this is very dependent on feedstock and production processes.

In relation to biodiesel, the Australian Government has proposed a 5% maximum blend level for general use (B5). Many diesel engine manufacturers will not warrant vehicles operated on more than 5% biodiesel blends, although the quality control and composition of the biodiesel is often the critical factor, and some manufacturers advise that their engines will accept higher blend rates if this is properly addressed.

Natural gas, which is mainly methane (CH4), can be used as a transport fuel either as Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG). In general, while CNG and LNG offer potential greenhouse benefits over petrol and diesel, the potential emission of methane in the form of unburnt gas in the exhaust can mean that these fuels can be considerably worse from a greenhouse perspective than conventional petrol and diesel.

49 ALPGA submission to the 2008 Review of the Australian Automotive Industry (2008)
50 Report of the Biofuels Taskforce to the Prime Minister (2005)
The full fuel cycle emissions from natural gas will vary from state to state due to indirect emissions from the extraction, production and transportation of the gas. Since electricity is usually used to further compress or liquefy the gas for on-board storage for transport applications, this will add to the indirect emissions. These emissions will also vary depending on the source of the electricity used for liquefaction or compression of the natural gas.

Compressed natural gas (CNG) is a viable fuel particularly where it can be used in fleets with central refuelling facilities, e.g. transit buses. The large storage tank requirements of CNG to achieve reasonable travelling range restrict its viability to large commercial vehicles rather than passenger vehicles. The large scale use of CNG in Australia would only be possible through significant commitment to refuelling infrastructure and vehicle development. It will not however guarantee an improvement in fuel efficiency or CO₂ emissions.

Liquefied natural gas (LNG) in large trucks has similar potential environmental benefits to CNG but with smaller gas storage requirements. However, significant difficulties need to be overcome before it could be used widely in the heavy vehicle fleet due to a lack of available gas engine technology that would deliver air quality and greenhouse gas benefits over traditional diesel engines, and the need for extensive refuelling infrastructure. However, if these issues can be addressed its lower cost compared to diesel could provide a net economic advantage to fleet operators.

Hydrogen has potential to be an emission-free fuel with a number of trials of hydrogen fuel cell vehicles now occurring around the world. Significant technical challenges need to be overcome before it would be commercially feasible, including the development of affordable and efficient drivetrains and carbon neutral methods of producing and distributing the hydrogen fuel. There is broad agreement that hydrogen as a transport fuel is only likely to be an option in the long term, if at all.

3.3 Policy Measures Overview

3.3.1 Summary of Measures

In surveying measures being used by governments around the world to promote vehicles with low fuel consumption and low greenhouse emissions, it is possible to broadly categorise these into whether they target the supply of, or demand for, new vehicles, and the extent of intervention in the market.

Measures aimed at increasing the supply of low emission vehicles include:
- support for research and development into new vehicle technologies,
- support to manufacturers to develop vehicles which use alternative fuels,
- voluntary automotive industry agreements on fuel efficiency, and
- mandatory vehicle fuel efficiency or CO₂ emission standards.

Measures aimed at increasing demand for greenhouse efficient vehicles include:
- provision of information to car purchasers on vehicle performance, e.g. fuel consumption labelling on vehicles,
- voluntary industry agreements on business fleet procurement,
- preferential application of traffic management measures for identified low emission vehicles, e.g. use of transit lanes, cheaper parking areas, reduced road tolls,
- government fleet procurement policies,
- differential government taxes and charges based on fuel efficiency or greenhouse gas emissions (or proxies such as engine size or vehicle weight), e.g. vehicle registration, stamp duty, import duties, and
- subsidies for purchase or conversion of alternative fuelled vehicles.
3.3.2 Effectiveness of Measures

The efficacy of these measures varies widely. Overseas experience to date suggests that the measures most likely to deliver better fuel efficiency and lower greenhouse gas emissions include:

- vehicle taxation/charges linked to emissions performance,
- road use charging linked to emissions performance,
- purchase incentives for low emission vehicles to encourage investment in appropriate emission reduction technologies, and
- performance based emission targets for the vehicle industry (whether voluntary or regulatory).

Of these four sets of measures, all but the road use charging measure are within the scope of this paper. Travel demand measures designed to discourage car use and encourage public transport or non-motorised travel not within the scope of this paper, but are being addressed through the TravelSmart program.\(^\text{51}\)

A 2006 ECMT report found that there is a lack of ex-post analysis of individual government policies for reducing transport emissions.\(^\text{52}\) Based on countries’ expectations of the impact of measures, it concluded that fuel tax increases and specific fuel carbon taxes have had the highest impact on emissions in the small number of countries reporting them as part of greenhouse policy, although it noted the political sensitivities of using fuel taxes to influence greenhouse emissions.

Agreements with car manufacturers and importers to improve the fuel efficiency of new cars was ranked second highest in terms of impact. Restructuring vehicle taxation, so that it is based on a vehicle’s greenhouse gas emissions and strongly differentiated, was ranked next as it can reinforce the achievement of vehicle fuel efficiency standards and targets.

Improving on-road fuel efficiency through information and education was ranked fourth. Initiatives to promote fuel efficient driving, particularly through training programs for both car and truck drivers offer significant cost-effective savings. Fuel efficiency feedback devices in vehicles such as econometers, shift indicator lights and tyre pressure monitors also proved highly effective in some studies.

It is important to note, however, that these conclusions do not, of themselves, suggest that there is a net public policy case for undertaking such measures – rather that they are potential tools to improve vehicle fuel efficiency and lower greenhouse gas emissions that would need to be assessed for their relative cost-effectiveness. Measures such as vehicle taxation and road use charges clearly are also used by Governments to meet other public policy objectives.

As noted in the introduction to this paper, the 2006 ECMT report also concluded that in addressing CO\(_2\) emissions in transport, measures directed at improving vehicle fuel efficiency are likely to deliver most benefit.\(^\text{53}\) Other reports also emphasise a focus on fuel efficiency as the most effective strategy in reducing CO\(_2\) emissions from road transport.\(^\text{54, 55}\)

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\(^\text{51}\) TravelSmart Australia is a joint initiative of Commonwealth, State and Territory governments that brings together government and community based programs that encourage people to reduce the environmental impacts of their car use. TravelSmart projects seek to inform individuals about the travel choices available to them and provide motivation for them to make voluntary changes in behaviour towards more sustainable modes of travel such as public transport, walking, cycling and car pooling. Households have been the major focus of TravelSmart projects, with larger projects routinely achieving decreases in car use of 4–15 % in targeted households and corresponding increases in alternative travel modes. The TravelSmart Australia website www.travelsmart.gov.au has been established to provide a range of information and resources on best-practice methods of encouraging travel behaviour change and has links to jurisdictional programs.


3.3.3 Potential Impacts

Sustained high prices for transport fuels have the capacity to impact negatively on many sectors of the Australian community. Research suggests that the groups affected quickly and most severely by increases in fuel prices tend to be those who have limited or no alternative to the use of passenger cars (i.e. lack of public transport services). These will often include people living in socially disadvantaged outer suburban areas, the fringes of urban areas or in rural and remote areas.56

A future carbon price, through the CPRS, may have related impacts on the same groups.57 The Australian Government has announced transitional measures that will reduce the immediate impact of the CPRS on the price of transport fuel, and is also offering a range of additional assistance measures for low and middle income households, to help with adjustment costs and improve household energy efficiency.58

The measures outlined in this paper have the overall purpose of improving the fuel efficiency of vehicles. These measures have the potential to reduce the overall fuel consumption of Australian motorists and hence reduce their fuel costs. However, there may be a range of financial and other barriers which could make it difficult for some groups to participate in, and benefit from, the measures. The design and implementation of any measures will need to consider issues of equity and propose strategies to maximise the opportunity for disadvantaged groups to benefit from improved fuel efficiency.

The Australian vehicle manufacturing industry (and associated component suppliers) currently focus on the production of large cars for local and export markets. The industry is currently facing a range of challenges and opportunities arising from changing consumer preferences within Australia and in overseas markets. Growth in consumer demand for improved fuel efficiency and low emission vehicles is one of several factors that will influence the industry.

3.3.4 Principles for Design and Implementation

In considering each of the measures detailed above individually and collectively, some principles may be observed that will assist in achieving the optimum outcomes:

1. Performance-based approach – measures should be designed to deliver the goal (in this case, greenhouse gas reductions), without being technology prescriptive in terms of fuels or vehicle technologies – this approach should help facilitate innovation by industry and avoid perverse outcomes through unforeseen side-effects.;

2. Certainty – government should aim to provide industry with a certain operating environment as far as possible into the future in support of long-term business planning – this should help minimise the costs of compliance, and promote innovation through better coordination of investments.

3. Balance – both supply and demand-side measures should be selected and designed in a co-ordinated way, and establishing a short, medium and long-term performance-based framework for implementing measures is likely to assist industry transition to lower emissions vehicles.

4. Harmonisation – to minimise the costs of compliance and promote innovation, measures should be harmonised as much as possible with international standards and across Australian jurisdictions. Consistency between measures in terms of the metrics and targets used is also inherently desirable.

56 Dodson J and Sipe N 2005 Oil Vulnerability in the Australian City
57 Brotherhood of St Laurence, 2008, Carbon use in poor Victorian households
3.3.5 Rationale for Complementary Measures

While the CPRS will provide the primary mechanism for reducing CO$_2$ emissions on an economy wide basis, additional measures may be warranted to assist with the transition to a low carbon economy.

Complementary measures can be justified if they lead to lowest possible cost abatement or are of a transitional nature such that they change the capacity of the economy (including households and business) to adapt and respond to the CPRS.\(^59\)

Measures may be required to address market failures that are not adequately addressed by the CPRS or that impinge on its effectiveness in driving emission reductions. These potentially include market failures such as information barriers.

Lowest cost abatement may be facilitated by measures which support and drive research, development and demonstration of new technologies, particularly where investors are unable to capture the full benefit of their investment.

In developing complementary measures for consideration, it is important to assess any possible negative implications they may have for the ongoing operation of the CPRS, such as reducing efficiencies, dampening price signals or distorting market responses.

4 Assessment of Potential Measures

In considering potential measures to improve the fuel efficiency of the new vehicle fleet, it appears that a combination of measures is likely to achieve better results than any single measure. It is also worth noting that, while short term gains are possible in terms of influencing purchasing decisions, the long time it takes for new vehicles to become dominant in the vehicle fleet means that it will take a number of years to achieve significant change to the greenhouse gas emissions of the vehicle fleet from the introduction of new vehicle technologies and/or fuels.60

To facilitate the assessments in this section, each potential measure is allocated to one of three broad categories as follows:

1. Measures to Increase Supply of Low Emission Vehicles
2. Measures to Increase Demand for Low Emission Vehicles
3. Measures to Improve Consumer Awareness

Given the range of policy approaches available, the Working Group considered it constructive to establish a set of evaluation criteria to assess the merits of potential options and identify those appearing worthy of further investigation. The evaluation criteria (in no particular order) are the:

- complementarity with the CPRS,
- level of improvement in fuel efficiency expected from the measure,
- cost effectiveness of the measure and where the cost will fall – on government, industry or the wider community,
- timeframe for implementing the measure,
- timeframe in which the measure would achieve its objectives (short, medium, long term),
- means by which the measure could be implemented, including the need for legislation,
- international experience with measures of this type, and
- suitability of the measure in the Australian context.

4.1 Measures to Increase the Supply of Low Emission Vehicles

Consumer demand should be the prime determinant of which vehicles are successful in the market. If the consumer prefers smaller vehicles, then the manufacturers will need to adjust or continue to lose market share. However, in an environment where there is a policy objective to improve the efficiency of the Australian vehicle fleet, and consumer purchasing patterns are not leading to an increase in the supply of more efficient vehicles, consideration of measures to increase the supply of these vehicles may be warranted.

As noted in a 2008 ITF report on vehicle emission reduction policies, “there is evidence to doubt whether consumers’ decisions on fuel efficiency are in line with what is socially desirable, suggesting that complementary instruments such as fuel efficiency standards may be justified”.61 The report goes on to state that “the issue here is not that consumers make “wrong” decisions in the sense of miscalculating savings from better fuel efficiency from their private point of view, but that private and social valuations of future benefits and costs differ”.

Within the CPRS, motor vehicle manufacturers will not be liable for CO₂ emissions arising from the use of vehicles they have produced. The effects of a carbon price are likely to be primarily felt by vehicle manufacturers through changes over time in consumer preferences. A market signal for vehicle manufacturers to adopt fuel efficient technologies may be muted in the short to medium term, as a result of the combined effects of market failures around vehicle purchasing decisions and the delayed impact of the CPRS on the price of fuel. A cost efficient pathway may be achievable in the short to medium term through specific measures to increase the supply of low emission vehicles.

In this section, the Working Group considers the merits of setting CO₂ vehicle emission standards, as a means of supporting the objective of best practice fuel efficiency outcomes.

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60 In 2007, a little over 1 million new light vehicles were sold in Australia, compared with a total light vehicle fleet estimated at 13.7 million vehicles. The BITRE estimates that it takes around 20 years for half the light vehicle fleet to turnover.

Category 1: Measures to Increase the Supply of Low Emission Vehicles

1.1 CO₂ emission standards for new light vehicles

**Proposal**

Establish revised sales weighted average CO₂ emission standards for new light vehicles, which aim to significantly reduce the average level of CO₂ emissions from the Australian light vehicle fleet. This has the effect of improving the average fuel efficiency for new vehicles.

**Means of Implementation**

Sales-weighted average CO₂ standards could be implemented by means of a voluntary or mandatory approach.

A voluntary agreement could be implemented via a formal written agreement between the Australian Government and the vehicle industry, represented by the Federal Chamber of Automotive Industries.

The alternate approach, a mandatory standard, would require suitable legislation. The *Motor Vehicle Standards Act 1989*, the current legislative mechanism for setting vehicle emission standards, would not appear to be suitable for a fleet based standard. However, *ADR81/02 Fuel Consumption Labelling for Light Vehicles* provides an agreed methodology for measuring CO₂ emissions for all light vehicles supplied to the Australian market.

A standard would be most effective if it included all light vehicles for which adequate fuel efficiency data is available. This includes those vehicles falling within the scope of ADR81/02, including small, medium and large cars, SUVs and light commercial vehicles.62

A process for ongoing monitoring and routine public reporting of progress toward meeting the standard would be included within the measure. The implementation of this process would vary depending on whether any future standard was voluntary or mandatory.

**Timeframe for Implementation**

To provide adequate time for the vehicle industry to respond, a two-step standard could be considered. An initial target date of 2015, with a longer term target for 2020, could be adopted.

**Benefits**

Over the long term, the vehicle CO₂ emission improvement from this measure could be significant, as the proportion of lower emissions vehicles in the vehicle population increases. The magnitude of the benefit relative to a “business as usual” situation, is dependent on the stringency of the standard and the capacity of the measure to deliver benefits over and above improvements driven by market forces (such as changes in fuel prices and consumer preferences) and other policy measures that may be introduced (such as fleet purchasing policies and fiscal measures).

To provide an indicative measure of the potential impacts on vehicle CO₂ emissions from a range of CO₂ emission standard levels, the BITRE undertook some projections for the Working Group based on a range of scenarios. These scenarios have been prepared for the purposes of discussion only. Assumptions and notes regarding these scenarios are at Appendix A to this paper.

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62 Light vehicles are defined as those with a gross vehicle mass of 3.5 tonnes or less.
CO₂ National Average Carbon Emission (NACE) Scenarios

1. NACE for new vehicles sold in 2015 is 180g CO₂/km
2. NACE for new vehicles sold in 2015 is 170g CO₂/km
3. NACE for new vehicles sold in 2015 is 160g CO₂/km
4. Scenario 2 + NACE for new vehicles sold in 2025 is 115g CO₂/km
5. Scenario 3 + NACE for new vehicles sold in 2025 is 115g CO₂/km
6. NACE for new vehicles sold in 2020 is 150g CO₂/km.

To put the scenarios in context, the g/km CO₂ values represent the following percentage reductions (rounded to nearest 5%) over the reported 2007 NACE of 226 g/km:
- 180 g/km : 20%
- 170 g/km : 25%
- 160 g/km : 30%
- 150 g/km : 35%
- 115 g/km : 50%

Figure 18 illustrates the long time it takes for improvements in the average fuel consumption of new vehicles to flow through the overall fleet. For example, under scenario 6, the average CO₂ emissions of the fleet in 2030 is estimated to be just under 200 g/km, even though a new vehicle average of 150 g/km was applicable to all new vehicles from 2020.

Figure 18: Projected Average CO₂ Emissions of the Light Vehicle Fleet under a Range of CO₂ Emission Targets for New Vehicles
Source: BITRE (unpublished) 2008

Nevertheless, setting and achieving new vehicle CO₂ emission standards could be an effective measure in improving the fuel efficiency of the transport fleet. As indicated in Figure 19, under a business as usual (BAU) condition, there is significant emissions growth predicted and all measures, even the most moderate, have some success in reversing or at least slowing that growth. Figure 19 indicates however, that only those scenarios (Scenarios 4 and 5) which have both near and longer term CO₂ emission standards lead to a reversal of the growth in CO₂ emissions from the light vehicle fleet, and appear to offer the prospect of reducing fleet emissions...
to a level at or below current levels. This modelling has not considered the potential for an increase in discretionary travel arising from reduced travel costs through fuel efficiency improvements. Actual fleet emissions may be slightly lower as a result.

![Figure 19: Projected CO₂ emissions from the Light Vehicle Fleet under a Range of CO₂ Emission Targets for New Vehicles](source: BITRE (unpublished) 2008)

**Costs**

Should a revised vehicle CO₂ emissions standard be adopted, the financial cost to Government will depend upon whether the target is voluntary or mandatory.

A voluntary agreement would involve minimal direct cost to Government. Where a possible future standard is mandatory, there would be higher ongoing costs associated with more formal monitoring of compliance with the standard.

A revised CO₂ standard could initially impact variably on manufacturers, and be passed onto consumers through higher purchase costs. The magnitude of these costs would be variable, but could be significant in some cases. Overall costs incurred will depend primarily on the stringency of the target and the timeframe for its implementation. There will be additional administration costs, particularly with a mandatory approach.

The European Commission estimates that compliance with its proposed 130g/km target by 2012 may increase vehicle purchase prices by up to 6%, while noting that this level of increase will be compensated by lifetime fuel savings. A recent presentation by the EC noted that on average, consumers would pay an additional €1100–1300 per vehicle, but on average €2700 less for fuel over the vehicle’s life (based on average fuel prices over 2006–07). A 2008 ITF report also notes...

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that “many think that cost estimates in the [European] Commission’s Impact Assessment [of the new CO₂ standard] are on the high side, since they don’t account for the economies of scale, learning by doing, or consumers’ response in terms of moving away from heavier cars.”

The relevance of these figures in the Australian context is unclear as the Australian fleet is quite different in structure to that in Europe. For example, the Australian fleet on average produces significantly higher levels of CO₂ emissions, and has a much lower proportion of diesel vehicles.

In the US, the new 2015 fuel economy standards are expected to cost on average $650 per car and $979 per light truck. The US Department of Transport also estimates that (based on prices of US$2.26 per gallon in 2016) the increased prices on passenger cars would be recovered from fuel savings in 56 months (50 months for light trucks).

King (2008) also notes that cost estimates ahead of vehicle emission regulations tend to be overestimates, pointing to an example in the US, where the regulator estimated that the average price increase at $170/vehicle, while industry estimated the cost at $788/vehicle. In 1998, the actual average compliance cost was shown to be $83/vehicle. A recent workshop on energy efficient transport technologies also noted that in the motor vehicle sector, historical data suggests that actual industry costs post regulation and under mass production, are typically more than 50% below pre-regulation estimates.

State of Play in Australia

A voluntary national average fuel consumption (NAFC) target for new cars has been in place in Australia since the late 1970’s. The latest agreement was negotiated between the Australian Government and the Federal Chamber of Automotive Industries (FCAI) in 2003. That target is 6.8 L/100km for petrol passenger cars by 2010. As explained in Section 2.3 of this paper, the Australian Government and FCAI agreed to have further negotiations to align the target with the new fuel consumption test procedures and to set an updated equivalent CO₂ based target for all light vehicles.

The FCAI has proposed a target of 222 g CO₂/km for all light vehicles (including SUV’s and light commercials) and fuel types. An independent analysis conducted in 2004 recommended a target of 214 g CO₂/km for all light vehicles by 2010. The FCAI have stated that their target is adjusted to factor in the non-availability of petrol with a maximum sulphur content of 10ppm. As mentioned earlier, there are a range of views regarding the necessity for 10ppm sulphur petrol to enable the adoption of low emission vehicle technologies.

While there have been improvements in the on road fuel efficiency of the new car fleet over time, the previous targets have not been achieved, and the fuel efficiency of the light vehicle fleet as a whole has not improved due in part, to the growth in sales of SUVs and light commercial vehicles, and increased vehicle weight due to extra safety features. The FCAI reports a 10% improvement in the national average CO₂ emissions for all new light vehicles sold in Australia since 2002 – the reported NACE in 2002 was 252 g CO₂/km and 226 g CO₂/km in 2007. However, the Working Group is not aware of any data or information that demonstrates that a voluntary NAFC/NACE target has had any impact on this reduction, or on vehicle manufacturers’ marketing decisions.

Changing buyer preferences in favour of smaller cars and, to a lesser degree, a growth in sales of diesel powered vehicles would appear to be the main factors driving reductions in emissions of the new car fleet. These factors would be expected to have a stronger influence on the marketing decisions of vehicle makers than the presence of the voluntary NAFC target.

**International Experience**

A number of countries have set vehicle fuel efficiency or greenhouse emission standards or targets but they vary considerably by the method of implementation (voluntary or mandatory) and by the method used to measure the standard. In practice a variety of units are used to express fuel efficiency targets, however, for the purpose of comparison, the target levels presented in this paper have been converted to g-CO₂/km and have been referenced against the UN test procedure used in ADR81/01.

Given the high level of vehicle imports, the fuel efficiency targets set in the EU, Japan and the USA for passenger and light commercial vehicles can have a direct influence on the availability of more fuel efficient new vehicles in the Australian market.

Few governments have applied standards to the fuel efficiency of light and heavy trucks. In the United States, the *Energy Independence and Security Act 2007*, restructured the Corporate Average Fuel Economy (CAFE) standards. The Act sets a target of 35 miles per gallon (6.7 L/100km) for the combined fleet of cars and light trucks by model year 2020. In addition a separate fuel efficiency standard is to be created for work trucks, while a fuel efficiency program is established for medium and heavy duty trucks.

Figure 20 provides a comparison of existing and proposed international greenhouse emission targets for passenger vehicles. It can be seen that the European Union and Japan currently have the most stringent emission targets. The current Australian NAFC target is middle ranking.

![Figure 20: Comparison of International Greenhouse Gas Emission Standards for New Passenger Cars](image)

**Note:**

The figure shows the emission standards or agreements for different regions. All standards have been converted to the European drive-cycle for comparison. The 2012 figure for the EU assumes that the 120 g/km aim is adhered to.

**NB:** Dotted lines denote proposed standards. Standards are not always directly comparable since different countries use different test cycles and measures (e.g. the EU uses grams of CO₂/km, whereas the USA sets standards in terms of miles per gallon). In this graph all standards are converted to grams of CO₂/km, according to the new European drive cycle (NEDC).

Asia

The general approach in Asia is to set mandatory fuel efficiency standards on vehicle classes according to either vehicle weight (Japan, China) or engine size (Taiwan, Korea). In most of these countries vehicle makers can achieve the standard for a particular class by averaging across the models they sell within that class. China alone requires each vehicle model in a class to achieve the relevant standard.

Japan has established fuel efficiency targets for both petrol and diesel passenger and light commercial vehicles, using a “best in class” or “top runner” approach, in which the standards are based on the best performing vehicles in each class.72 For most vehicles, the targets are to be met by each vehicle maker for each vehicle weight class. The targets represent fleet wide new vehicle consumption equivalent to 129 g-CO₂/km for passenger vehicles by 2010. The majority of Japanese vehicles sold in Japan have already achieved their class standard. A revised target equivalent to 115 g-CO₂/km has been established for 2015.73

European Union

The EU currently has a voluntary agreement with car makers for average carbon dioxide emissions from new passenger vehicles to be 140 g CO₂/km by 2008, equivalent to a petrol fuel consumption of around 5.7 L/100km. Japanese and Korean manufacturers have agreed to similar targets for cars exported to the EU. It has become clear that the target will not be achieved, with the current EU average for new cars being about 163 g CO₂/km (L/100km). The EU has concluded that the voluntary agreement “did not succeed” and that a legislative approach is necessary.74

The EU has agreed to setting a mandatory target for passenger cars of 130 g CO₂/km by 2012, the toughest standard so far proposed internationally.75, 76 On 19 December 2007, the EU adopted a proposal for legislation covering the measure. The draft legislation defines a limit value curve (see Figure 21) of permitted emissions of CO₂ for new vehicles linked to the mass of the vehicle. The curve is set in such a way that a fleet average for all new cars of 130 grams of CO₂/km should be achieved.

From 2012, each manufacturer will be required to ensure that the average emissions of all their new cars registered in the EU, are below the target average of the permitted emissions for those cars. Manufacturers will still be able to make cars with emissions above the limit value curve provided these are balanced by cars which are below the curve. Manufacturers’ progress will be monitored each year by the Member States on the basis of new car registration data. Manufacturers will be charged an excess emissions premium if the average emissions of their vehicles is above the permitted limits. The premium (fee) is charged on the basis of the following formula:

Total Premium = Excess emissions (g/km over target) x No of Vehicles Registered by Manufacturer x Value of Premium (€)*

*Premium rate is €20 per g/km in 2012, €35 in 2013, €60 in 2014 and €95 from 2015

The UK Government has also called on the EU to set a 100 g CO₂/km target by 2020.77 The European Commission has indicated it will review the implementation of the 2012 target in 2010, and consider the possibility of setting more ambitious targets around the 2020 timeframe.78

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73 Ministry of Land, Infrastructure & Transport, 2007, Japan’s Environment Measures in the Transport Sector
75 The scope of the 130g/km target does not include light commercial (goods) vehicles. A separate target of 175g/km by 2012 and 160g/km by 2015 is proposed for light commercial vans. A corresponding target for LCV’s was 201g/km in 2002.
76 The overall target is 120g/km, however the additional 10g/km is expected to be delivered by measures outside of the emissions measured under the standard test.
North America

The US has a mandatory Corporate Average Fuel Economy standard (CAFE). This has also been adopted as a voluntary industry scheme in Canada. Each car maker is required to achieve an average fuel efficiency standard across all their vehicle models each year. Different standards apply to cars and light trucks. The current CAFE is equivalent to 225 g-CO$_2$/km for cars and 299 g-CO$_2$/km for light commercial vehicles and SUVs. As a part of the Energy Independence and Security Act 2007, the CAFE standard is proposed to be raised to the equivalent of 173 g-CO$_2$/km by 2015 for passenger cars. The longer term target is to achieve an overall target equivalent to 177 g-CO$_2$/km for cars and light commercials by 2020, which represents a 40% improvement over the current combined fleet (the 2015 target represents a 25% improvement).79

To avoid non-compliance, manufacturers can earn CAFE “credits” to offset deficiencies in their performance if the average fuel efficiency of a particular vehicle model exceeds the standard. Manufacturers whose fleets fail to meet the CAFE standard are subject to financial penalties ($5.50 per tenth of mile per gallon under the target multiplied by the number of vehicles sold in the year).80 Despite the standard, the average fuel efficiency of the US passenger and light truck fleets has been deteriorating due to increased sales of light trucks and SUVs, with the larger models not covered by CAFE.

The US has recently agreed on new fuel efficiency standards for light trucks which are based on the “footprint” of the vehicle. The footprint is defined as the product of the vehicles wheel base and its track width. A target equivalent to 189 g-CO$_2$/km by 2015 has been proposed for light trucks.81 Vehicles will be divided into several footprint classes, each representing a different range of footprint. It is proposed that each footprint class will have a target average fuel efficiency. Each manufacturer will still be required to comply with the overall light truck target for the model year.82

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New Zealand

The New Zealand Government has announced its intention to introduce a mandatory CO₂ light vehicle emissions target.³³ It is proposed that the combined average emissions of new and used vehicles entering the light vehicle fleet be reduced to 170g CO₂/km by 2015. The current estimate of average emissions is around 220g CO₂/km. The NZ government has proposed that the mandatory scheme be implemented by one of three means – a tradeable credit scheme, a vehicle levy for all vehicles over the target value or an industry code of compliance with a regulatory fallback option. A public consultation process has been undertaken in relation to the proposal and advice on the implementation of the measure is being prepared for Government.

Key Issues

The decision to revise and retain vehicle CO₂ emission standards is complex. As noted in the 2008 paper from the ITF, “while the market does not operate perfectly, the alternative of government intervention also struggles to achieve perfection”.³⁴

In considering overseas and Australian experience, it appears that voluntary schemes have not achieved their targets, although mandatory schemes such as the US CAFE system, can also lead to sub-optimal outcomes and even undesirable market distortions.³⁵, ³⁶ The IEA, in its 2007 advice to the G8 summit, agreed that mandatory fuel efficiency standards for light vehicles is a “necessary condition” for delivering significant energy savings in the transport sector.³⁷ A recent international forum also concluded that “a fuel economy standard is a key component of a policy package that stimulates the use of technology to improve fuel economy”.³⁸

The design of mandatory schemes is also important. They can be implemented in a range of ways, some much more complex than others. The proposed new EU legislation for example, appears to be very complex with high administrative burdens for both manufacturers and governments, while all of the potential implementation options for the proposed NZ scheme appear to be simpler in administrative terms. In comparison to the EU proposal, the NZ scheme is structurally simple and applies the same target value to all manufacturers.

The EC considered three basic models in developing its approach – uniform targets for all manufacturers, a “utility” or “attribute” based approach and a percentage reduction. It finally settled on the utility based option, and chose mass as the parameter.³⁹ The EC concluded that the utility approach was on balance the most equitable in taking into account the different focus of various manufacturers, including those predominantly focused on larger vehicles.

There is also considerable debate over the relative merits of using weight or “footprint” (wheelbase x width) in such a standard. As noted by the ITF, “the choice of attribute is not neutral, and there is considerable agreement that footprint is better than weight. This is because weight-based standards may reduce the appeal of reducing weight to improve fuel efficiency, and with a poorly designed standard, an incentive to add weight rather than cut emissions might result. Footprint based standards avoid such problems to a large extent as footprint is more difficult to change without affecting vehicle characteristics that consumers value highly”.⁴⁰

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³³ Ministry of Transport (2008) Improving the fuel economy of vehicles entering the New Zealand fleet Discussion Paper
The selected design of a mandatory scheme would be a significant issue for all manufacturers, including the Australian vehicle manufacturing industry, which is currently focused on producing large cars. However, while more analysis would be required to determine the most appropriate design for the Australian context, any scheme, whether mandatory or voluntary, should utilise a sales weighted averaging methodology covering the full range of models sold in Australia by each manufacturer. This provides flexibility for manufacturers while still meeting the overall CO₂ target.

Determining an appropriate CO₂ standard would need to consider what technology options are available in the Australian context, but at face value Australia would appear to have considerable scope for improvement in the short-medium term – at least 30% – without markedly affecting model mix. In particular, diesel penetration is very low in Australia and wider adoption of diesels alone would deliver significant CO₂ reductions. In order to avoid any undesirable air quality outcomes, new vehicles should comply with Euro 5 emission standards. Engines optimised for LPG also offer potential for CO₂ reductions. There is evidence that some improvement in CO₂ performance is occurring already due to fuel quality improvements and increasing consumer concern over higher fuel prices. As major manufacturers will be designing vehicles to respond to the CO₂ emission targets in the European and Japanese markets, vehicles utilising these improved vehicle technologies will become available to the Australian market.

Timing is also a critical factor, as vehicle design and production planning is a lengthy process, even more so when manufacturers are potentially being required to move away from a business as usual approach. This has become apparent in the discussion around the new EC standards planned for introduction in 2012, with proposals from the European Parliament to delay the implementation until 2015 (albeit with a more stringent target), and other suggestions to phase in the target.

The issue of a two step standard also needs to be considered. There is an argument that setting a longer term standard, as well as a less stringent, near term standard, can increase regulatory certainty for manufacturers, particularly when the technology required to meet a longer term target represents more that just incremental change. The preliminary BITRE analysis reported earlier indicates that a two step standard approach is likely to deliver the largest benefits. This is consistent with the approach proposed by the UK Government requesting the EU to set a target for 2020–25, as well as the current target for 2012.

CO₂ emission standards can operate as a stand alone measure, although manufacturers would argue that the risks they take in producing lower emission vehicles for the market are reduced if there are additional incentives for consumers to purchase these vehicles (in addition to fuel savings). As noted in the 2007 ITF report, “economic incentives that align consumer interests with the vehicle manufacturer’s responsibilities under standards make ambitious standards politically feasible”. Incentives issues are discussed later in this paper (see Section 4.2).

Conclusions

Current trends suggest that it is unlikely market forces alone will deliver the magnitude of vehicle CO₂ emission improvements which might be expected to be required by the policy directions being adopted in a number of overseas countries. In considering such scenarios, many countries are utilising or planning to introduce/strengthen CO₂ emission standards which the vehicle industry is required to meet. Increasingly, countries are turning to mandatory targets, given limited evident success with voluntary agreements.
In the Australian context, the Working Group is unaware of any evidence to suggest that continuing with a voluntary agreement for CO\textsubscript{2} targets is productive either in terms of the efficient use of government or industry resources, or from a greenhouse perspective.

Implementation of a mandatory regime would require a detailed assessment to determine its net benefits, and would need to be assessed in the context of other market and demand measures that might be introduced. If the case was made for a mandatory scheme, more detailed work would be required to determine the standard value, the design of the scheme and the legislative mechanisms to enforce it.

<table>
<thead>
<tr>
<th>Your Views</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Do you consider there is a case for tightened CO\textsubscript{2} standards for the light vehicle fleet in Australia?</td>
</tr>
<tr>
<td>• If you consider tightened standards are required, should they be voluntary or mandatory?</td>
</tr>
<tr>
<td>• Do you have a view about the design of any system – for example do you agree that the standard should be a sales-weighted average? Do you agree with the EC proposal to link the standard to vehicle weight, or should it be based on different parameters?</td>
</tr>
<tr>
<td>• Do you consider that CO\textsubscript{2} standards can effectively operate independently of other measures, or are other measures critical to their success?</td>
</tr>
<tr>
<td>• Do you consider that market pressures, such as rising fuel prices, will be sufficient to deliver significant vehicle CO\textsubscript{2} emission improvements for the light vehicle fleet, without the need for CO\textsubscript{2} standards?</td>
</tr>
</tbody>
</table>
4.2 Measures to Increase Demand for Low Emission Vehicles

As noted in the introduction to Section 4.1, consumer demand should be the prime determinant of which vehicles are successful in the market. The need to address demand as well as supply measures is highlighted by the European Environment Agency, which notes that in the context of the 2012 CO₂ target, manufacturers are offering a larger range of vehicles meeting the target, but too few of them are being purchased to offset the sale of cars with higher emissions.⁹⁴

The potential measures addressed in this section provide mechanisms to encourage increased consumer demand for low emission vehicles.

Measure 2.1 considers a framework for restructuring vehicle registration and stamp duty charges that provide an incentive for the purchase of new vehicles with lower CO₂ emissions.⁹⁵ Measure 2.2 examines the merits of direct financial incentives for the purchase of vehicles meeting a specified CO₂ performance threshold(s). Measure 2.3 explores the potential for establishing fleet purchasing arrangements designed to encourage the purchase of low emission vehicles for government and business fleets.

The Working Group also investigated the option of a vehicle scrappage scheme as a measure to improve overall fleet fuel efficiency. These schemes generally operate by encouraging consumers to surrender older, inefficient vehicles in exchange for cash or access to an alternative mode of transport (e.g. public transport or bicycle). Whilst there are international examples of such schemes which may have produced positive outcomes in terms of local air quality improvement and raising community awareness, the Working Group considers that scrappage schemes offer limited potential to reduce greenhouse emissions in the Australian context, and thus they are not investigated further in this paper.

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⁹⁵ This paper sometimes uses the language of "incentive". This term is used broadly, to encompass changing the relative price or cost signals applying to different vehicles – it could encompass both price/cost advantages or disadvantages.
Category 2: Measures to Increase Demand for Low Emission Vehicles

2.1 Restructure State and Territory registration and stamp duty charges for light vehicles

Proposal
Realign existing State and Territory stamp duty and/or registration charges for light motor vehicles on a sliding scale based on greenhouse (CO\textsubscript{2}) emissions.

Means of Implementation
Any new scheme may need to be tailored to the particular circumstances of each State and Territory,\textsuperscript{96} and legislative changes may be necessary depending on how duty and registration rates are set in each jurisdiction. A national framework would then be developed setting out key design principles which individual jurisdictions could then tailor in a manner consistent with relevant policies. Some jurisdictions could also consider including additional elements in the framework criteria, such as the inclusion of traditional air pollutant factors.

Timeframe for Implementation
Each State and Territory has a different model for their registration and stamp duty in terms of both legislation and administration systems. These and other factors mean that timeframes will need to be developed by each jurisdiction based on their specific circumstances. Table 7 below provides an indication of the forecast duration for each step of the implementation process:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Duration (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Develop and finalise national purchasing framework based on CO\textsubscript{2} emissions</td>
<td>6</td>
</tr>
<tr>
<td>Jurisdictions assess how framework might be implemented in each case</td>
<td>6</td>
</tr>
<tr>
<td>Jurisdictions consult with the public and industry – system model refined</td>
<td>3–6</td>
</tr>
<tr>
<td>Jurisdictions seek internal agreement to implement their system model</td>
<td>6</td>
</tr>
<tr>
<td>Jurisdictions implement necessary administrative and legislative changes</td>
<td>6–12</td>
</tr>
<tr>
<td>Jurisdictions finalise changes and commence new registration and duty rates; Education/communications campaign to promote the changes</td>
<td>3</td>
</tr>
</tbody>
</table>

Based on this timeframe, state and territories could have new CO\textsubscript{2}-based stamp duty and registration rates in place within two to three years.

Benefits
Studies have been undertaken in the EU aimed at quantifying the costs and benefits of CO\textsubscript{2}-differentiated vehicle taxation.

A 2002 study for the European Commission Directorate-General for the Environment found that from an average new car emissions level of 172g/km in the year 2000, implementation of a CO\textsubscript{2}-differentiated vehicle taxation scheme would result in an average 5% reduction in new car emissions by 2008.\textsuperscript{97} The modelling for this work incorporated such assumptions as no vehicle downsizing, no change to the proportion of diesel vehicles, no changes to company car taxation schemes, and revenue neutrality in terms of the cost to government (refer ‘Financial Costs to

\textsuperscript{96} The Working Group notes that the discussion is occurring in the context of the Council for the Australian Federation, and the Australian Transport Council of transport Ministers, of the potential to move to a possible national registration and licensing scheme for all vehicles. If this eventuated, it would potentially make the proposal easier to implement than is implied in the discussion of this measure.

Government below. The study also forecast larger reductions in new car emissions in the event that some vehicle downsizing occurred.

A second study from 2002 sought to examine the effect of CO₂-differentiated vehicle taxation in Sweden. It found that for a new vehicle registration tax including vehicle-cost and CO₂ dependent elements, a reduction of the overall fleet emissions of approximately 5% per annum after 20 years or 1% per annum after 5 years would result. Other effects of the policy measure identified in the study included an increased fleet average age (due to decreased vehicle scrapping) and overall fleet size reduction.

Anecdotal evidence from the Dutch bonus/penalty new vehicle purchase rebate/taxation scheme introduced in July 2006 indicates that the small car sales have shifted towards low-emission variants, however sales of large vehicles have yet to show a similar response.

A number of reports suggest that policies which lead to a better informed consumer, combined with incentives to encourage manufacturers to supply improved technology vehicles, can deliver significant emissions and fuel consumption improvements. The International Energy Agency adds that even modest incentives can send strong signals to both consumers and vehicle manufacturers.

The UK Government introduced differential company car tax changes in 2002 directly linked to the CO₂ emissions of a vehicle. A 2006 evaluation of the changes concluded that the new arrangements had led to significant reductions in CO₂ emissions from the company car sector, primarily due to a shift in purchasing behaviour to lower CO₂ emitting vehicles. As illustrated in Figure 22, this policy has triggered change to the extent that average CO₂ emissions of company cars are lower than that of the private market (the reverse applies in Australia and many other countries). In the 2008 budget, these changes were strengthened with an additional measure which reduced the depreciation allowance for company cars to 10% for those models emitting over 160g/km (compared with a rate of 20% for those under 160g/km).

![Figure 22: New Car Average CO₂ Emissions (UK)](chart-sourced-from-ECMT-2007-Cutting-Transport-CO₂-Emissions---What-Progress-European-Conference-of-Ministers-of-Transport)
Analogous schemes which encourage behavioural change towards the purchase of vehicles that emit lower levels of air pollutants have been found to be effective. Under the annual vehicle tax incentive scheme introduced in Germany in mid-1997, the proportion of low (Euro 3) emission passenger cars in the fleet increased from less than 1% to 70% of new vehicle sales within one year, even though the Euro 3 standard was not a mandatory requirement until 2000. In Sweden, the introduction of a lower vehicle tax in 1993 based on emissions standards led to 75% of new vehicles in 1996 meeting better than minimum standards.

**Costs to Government**

With reference to Table 8, there will be costs associated with the various implementation components. The largest contributor to these costs, the administrative system changes, will vary between jurisdictions according to the nature of their existing system and the potential for the changes to be ‘piggy-backed’ on other changes.

In terms of the scheme’s operation, the change in revenue relative to the ‘business-as-usual’ scenario will be dependent upon the system design. A common objective is for the system design to be ‘revenue neutral’. This proposal provides a stamp duty/registration fee reduction for low emission vehicles, offset by small increases to the stamp duty/registration fee payable on the highest emitting vehicles. In practice the design of most revenue neutral systems design leaves the majority of cars unaffected.

Conversely jurisdictions could implement a system of differential charges/taxes at a cost to government (in terms of lost revenue) or raising revenue (by increasing charges/taxes overall). Stamp duty charges and registration charges have different bases. Stamp duty is essentially a revenue device, whereas registration charges are often paid alongside compulsory third-party insurance fees and system administration expenses. By way of example, the breakdown of the nominally standard registration charge in Victoria can be seen in Table 8 (refer also to ‘Key Issues’ discussion).

**Table 8: Breakdown of Victorian Vehicle Registration Costs – example provided is for a light passenger vehicle with an inner-urban registration address**

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
<th>Proportion of Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration charge</td>
<td>$178.00</td>
<td>30%</td>
</tr>
<tr>
<td>Transport Accident Commission fee</td>
<td>$378.00</td>
<td>64%</td>
</tr>
<tr>
<td>Insurance duty</td>
<td>$37.80</td>
<td>6%</td>
</tr>
<tr>
<td>Total “Perceived” Registration Cost</td>
<td>$593.80</td>
<td>100%</td>
</tr>
</tbody>
</table>

Each of the eight jurisdictions collect different proportions of revenue from stamp duty and registration on light motor vehicles when measured as percentages of the total State Own-Source (SOS) revenue collection. However, this is driven by the significant variability in State revenue bases – taxes/charge levels on vehicles are broadly comparable around Australia. With reference to Figure 23 below, stamp duty revenue ranged from 3.0% to 5.1% of total SOS revenue in 2006–07. For the same year, registration revenue ranged from 2.9% to 8.8%. The values for combined stamp duty and registration revenues range from 7.0% to 12.9% of SOS revenue.

Accordingly decisions regarding the design details of any system may need to be tailored to the circumstances of particular jurisdictions.

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Other Costs

The principal costs outside of those incurred by government will fall on consumers who purchase vehicles subject to a higher rate of stamp duty or registration charge (although this may be offset by reductions for other consumers). However consumers could avoid increased costs or even reduce their costs through choosing alternative vehicles that still meet their needs – precisely the behavioural change that is the intention of the scheme.

Critics of such a system may claim that the discounts available to consumers for low emission vehicles are either partially or completely offset by the additional cost associated with the technologies that make the vehicle a low emitter. To examine this claim a review of a selection of vehicles from the Australian vehicle market was undertaken assessing purchase price against greenhouse gas emissions. As noted in Figure 24 below, there is no clear correlation between the two attributes, indicating that no additional cost to the consumer would be expected in promoting the purchase of low emission vehicles.

Manufacturers who wish to improve the CO₂ emissions performance of individual models to enable them to qualify for lower charging rates will incur design and manufacturing costs. As stated above, this behavioural change on behalf of the manufacturers may be considered the intended outcome.

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106 Adapted from Commonwealth Grants Commission, Report on State Revenue Sharing Relativities 2008 Update
of the scheme, and may also be linked with the opportunity for manufacturers to secure competitive advantage.

Notably, the European automotive industry supports harmonised CO₂-related taxation of vehicles as a means of shaping consumer demand and setting incentives by which the industry and fuel suppliers will respond (refer also to ‘Key Issues’ below). Harmonisation of schemes adopted by Australian jurisdictions would minimise development costs of seeking to align vehicle designs with scheme attributes.108

State of Play in Australia
As illustrated in Table 9, each jurisdiction currently uses different measures to set light vehicle registration, including vehicle selling price, gross vehicle mass, number of cylinders, and engine capacity (i.e. displacement volume). None of these parameters relate directly to CO₂ emissions.

Table 9: Australian Light Vehicle Registration Fee Structures

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>NSW</th>
<th>VIC</th>
<th>QLD</th>
<th>WA</th>
<th>SA</th>
<th>TAS</th>
<th>NT</th>
<th>ACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basis for Fee Structure</td>
<td>Tare weight</td>
<td>Mass Rating Charge (MRC)*</td>
<td>Number of cylinders</td>
<td>Number of cylinders</td>
<td>Tare weight</td>
<td>Number of cylinders#</td>
<td>Engine capacity</td>
<td>Tare weight</td>
</tr>
</tbody>
</table>

* MRC: the maximum mass of the vehicle, including any load, recorded on the compliance plate as the GVM, GTMR or ATM of the vehicle.
# One scale for ‘Class A’ vehicles and another for trucks with a GVM over 3 tonnes.

Stamp duty systems also differ across jurisdictions, with rates varying from 2% to 6% of purchase price depending on the jurisdiction and vehicle purchase price. With a small number of exceptions, the schemes make limited use of environmental parameters.

The ACT ‘green vehicles’ stamp duty scheme, due to commence by 2009, links stamp duty payable on new vehicles to vehicle environmental performance rather than focussing on a functional attribute of the vehicle (e.g. fuel type). The scheme includes assessment of both CO₂ and air pollutant emissions, as set out in the Green Vehicle Guide. The ACT scheme is intended to be revenue neutral, with higher polluting vehicles paying slightly higher duty rates to offset concessions provided to lower emission vehicles.

A number of states offer concessions or benefits to drivers of hybrid vehicles (Queensland, Victoria and South Australia), two of which currently are the lowest CO₂ emitting vehicles available. However these concessions are not adaptive to changes in the vehicle market, including the high potential for a wider range of more efficient petrol and diesel models to become available, and, in the longer term, the entry into the Australian market of fully electric vehicles.

International Experience
As a broad observation, many developed countries have undertaken significant steps to realign their taxes and charges to better support environmental objectives through direct linkages to CO₂ emissions performance or fuel efficiency. This is in clear contrast with the Australian arrangements noted above.

As indicated in Table 10, as of March 2008, fifteen EU member states had implemented a diverse range of CO₂-related vehicle charges.

<table>
<thead>
<tr>
<th>Country</th>
<th>CO₂/Fuel Consumption Taxes/Charges</th>
</tr>
</thead>
</table>
| Austria | A fuel consumption tax (Normverbrauchsabsage or NoVA) is levied upon the first registration of a passenger car. It is calculated as follows:  
  - Petrol cars: 2% of the purchase price x (fuel consumption in litres – 3 litres).  
  - Diesel cars: 2% of the purchase price x (fuel consumption in litres – 2 litres).  
  Under a bonus-malus system starting on 1 July 2008, cars emitting less than 120g/km receive a maximum bonus of €300. Cars emitting more than 180g/km pay a penalty of €25 for each gram emitted in excess of 180g/km (160g/km as from 1 January 2010). Alternative fuel vehicles attract a bonus of maximum €500. |
| Belgium | 1. Tax incentives are granted to private persons purchasing a car that emits less than 115g CO₂/km. The incentives consist of a reduction of the invoice price with the following amount:  
  - Cars emitting less than 105g/km: 15% of the purchase price, with a maximum of €4,350.  
  - Cars emitting between 105 and 115g/km: 3% of the purchase price, with a maximum of €810.  
  2. The company car tax is based on CO₂ emissions.  
  3. The deductibility of expenses related to the use of the car (60 to 90%) is linked to CO₂ emissions.  
  4. The Walloon Region operates a bonus-malus system whereby new cars emitting 145g/km or less obtain a bonus (maximum € 1,000 for cars below 105g/km) and cars emitting more than 195g/km pay a penalty (maximum € 1,000 for cars emitting more than 255g/km). |
| Cyprus  | 1. The rates of the registration tax (based on engine capacity) are adjusted in accordance with the vehicle’s CO₂ emissions. This adjustment ranges from a 30% reduction for cars emitting less than 120g/km to a 20% increase for cars emitting more than 250g/km.  
  2. The rates of the annual circulation tax (based on engine capacity) are reduced by 15% for cars emitting less than 150g/km.  
  3. A premium of €683 is granted for the purchase of a new car when its CO₂ emissions are below 120g/km. For the purchase of hybrid and flexible fuel vehicles, the premium amounts to €1,196. |
| Denmark | 1. The annual circulation tax is based on fuel consumption.  
  - Petrol cars: rates vary from 520 Danish Kroner (DKK) for cars driving at least 20 km per litre of fuel to DKK 18,460 for cars driving less than 4.5 km per litre of fuel.  
  - Diesel cars: rates vary from DKK 160 for cars driving at least 32.1 km per litre of fuel to DKK 25,060 for cars driving less than 5.1 km per litre of fuel.  
  2. Registration tax (based on price): An allowance of DKK 4,000 is granted for cars for every kilometre in excess of 16 km (petrol) respectively 18 km (diesel) they can run on one litre of fuel. A supplement of DKK 1,000 is payable for cars for every kilometre less than 16 km (petrol) respectively 18 km (diesel) they can run on one litre of fuel. |
| Finland | 1. The registration tax is based on CO₂ emissions. Rates vary from 10% for cars emitting 60g/km or less to 40% for cars emitting 360g/km or more. The system is fully linear and technologically neutral.  
  2. The annual circulation tax (currently based on weight) will be based on CO₂ emissions from 2010 onwards. Rates will vary from €20 to €605 per year. |
| France  | 1. Under a bonus-malus system, a premium is granted for the purchase of a new car when its CO₂ emissions are below 130g/km. The maximum premium is €5,000 (below 60g/km). A “super-bonus” of €300 is granted when a car of at least 15 years old is scrapped simultaneously. A tax is payable for the purchase of a car when its CO₂ emissions exceed 160g/km. The maximum tax amounts to €2,600 (above 250g/km). The different thresholds are strengthened by 5g/km every two years.  
  2. The regional tax on registration certificates (“carte grise”) is based on fiscal horsepower, which includes a CO₂ emissions factor. Tax rates vary between €25 and €46 per horsepower according to the region. |

<table>
<thead>
<tr>
<th>Country</th>
<th>CO₂/Fuel Consumption Taxes/Charges</th>
</tr>
</thead>
<tbody>
<tr>
<td>France (cont.)</td>
<td>3. The company car tax is based on CO₂ emissions. Tax rates vary from €2 to €19 for each gram for cars emitting 100g/km or less to €19 for each gram emitted for cars emitting more than 250g/km.</td>
</tr>
<tr>
<td>Germany</td>
<td>The Federal Government has announced its intention to change the basis of the annual circulation tax from cylinder to CO₂ emission as from 1 January 2009. The system should be linear. Cars with CO₂ emissions below 100g/km should be exempt.</td>
</tr>
<tr>
<td>Ireland</td>
<td>1. As from 1 July 2008, the registration tax will be based on CO₂ emissions. Rates will vary from 14% for cars with CO₂ emissions up to 120g/km to 36% for cars with CO₂ emissions above 225g/km. Hybrid and flexible fuel vehicles will benefit from an additional tax relief of €2,500.</td>
</tr>
<tr>
<td></td>
<td>2. The annual circulation tax will also be based on CO₂ emissions. Rates will vary from €100 (up to 120g/km) to €2,000 (above 225g/km).</td>
</tr>
<tr>
<td>Italy</td>
<td>A tax incentive of €800 and a two-year exemption from annual circulation tax is granted for the purchase of a new passenger car complying with the Euro 4 or Euro 5 exhaust emissions standards and emitting not more than 140g of CO₂/km, provided a Euro 0 or Euro 1 car is scrapped simultaneously. The exemption from annual circulation tax is extended to three years for cars with a cylinder capacity below 1,300.</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>The annual circulation tax is based on CO₂ emissions. Tax rates are calculated by multiplying the CO₂ emissions in g/km with 0.9 for diesel cars and 0.6 for cars using other fuels respectively and with an exponential factor (0.5 below 90g/km and increased by 0.1 for each additional 10 g of CO₂/km).</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>1. The rate of the registration tax (based on price) is reduced or increased in accordance with the car’s fuel efficiency relative to that of other cars of the same size (length x width). The maximum bonus is €1,400 for cars emitting more than 20% less than the average car of their size, the maximum penalty is €1,600 for cars emitting more than 30% more than the average car of their size. Hybrid cars benefit from a maximum bonus of €6,400. Cars emitting more than 232g/km (petrol) respectively 192g/km (diesel) pay an additional tax supplement of €110 per gram emitted in excess of these thresholds.</td>
</tr>
<tr>
<td></td>
<td>2. The annual circulation is reduced by 50% for cars with CO₂ emissions up to 110g/km (petrol) respectively 95g/km (diesel).</td>
</tr>
<tr>
<td>Portugal</td>
<td>The registration tax is based on engine capacity and CO₂ emissions. The CO₂ component is calculated as follows: • Petrol cars emitting less than 120g pay [(€5 x g/km) – 475] • Diesel cars emitting less than 100g pay [(€15 x g/km) – 1,100] The highest rates are for petrol cars emitting more than 210g [(€115 x g/km) – 19,285] and for diesel cars emitting more than 180g [(€160 x g/km) – 21,190].</td>
</tr>
<tr>
<td>Spain</td>
<td>The registration tax is based on CO₂ emissions. Rates vary from 0% (below 120g/km) to 14.75% (above 200g/km).</td>
</tr>
<tr>
<td>Sweden</td>
<td>1. The annual circulation tax for cars meeting the Euro 4 exhaust emission standards is based on CO₂ emissions. The tax consists of a basic rate (360 Swedish Kroner) plus SEK 15 for each gram of CO₂ emitted above 100g/km. This sum is multiplied by 3.15 for diesel cars registered for the first time in 2008 and by 3.3 for other diesel cars. For alternative fuel vehicles, the tax is SEK 10 for every gram above 100g/km. 2. A premium of SEK 10,000 is granted for the purchase of “environmentally-friendly cars”: • Petrol/diesel/hybrid cars with CO₂ emissions up to 120g/km • Alternative fuel/flexible fuel cars with a maximum consumption of 9.2 l (petrol)/8.4 l (diesel)/9.7cm/100 km (CNG, biogas) • Electric cars with a maximum consumption of 37 kWh/100 km</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1. The annual vehicle excise duty (VED) is based on CO₂ emissions. Rates range from £0 (up to 100g/km) to £300 (petrol, diesel)/£285 (alternative fuels) for cars emitting more than 225 g/km. 2. Company car tax rates range from 15% of the car price for cars emitting less than 140g/km to 35% for cars emitting more than 240g/km. Diesel cars pay a 3% surcharge.</td>
</tr>
</tbody>
</table>
The United Kingdom was one of the first countries to link vehicle taxes to CO₂ emissions, with the establishment of a number of vehicle excise duty rates based on specified CO₂ emission ranges. In 2006 the environmental incentives were strengthened by the UK Government. The current scheme is illustrated in Figure 25.

![Figure 25: UK CO₂-based Vehicle Excise Duty Rates](image)

In its 2008 budget, the UK Government announced a major revision of its Vehicle Excise Duty (VED) rates to further encourage the purchase of low CO₂ emitting vehicles. This includes the introduction from 2010 of a different set of rates for the first year, which imposes a substantially greater penalty for the higher emitting vehicles. The 2010–11 VED rates are illustrated in Figure 26.

![Figure 26: 2010–11 UK Vehicle Excise Duty (VED) Rates for Cars](image)

Note: Chart only illustrates rates up to CO₂ emissions of 300 g/km, but same rates apply to all cars over 255g/km.

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110 Extracted from European Conference of Ministers of Transport, 2007, Cutting Transport CO₂ Emissions – What Progress?
Key Issues

Scope of Amended Scheme

A threshold decision relates to the scope of any differential registration/stamp duty scheme – it could be considered for both new vehicles and vehicles already registered and in-service. Limiting the scheme to new vehicles is easier to implement and potentially raises fewer equity issues. However excluding older vehicles may encourage retention of high emitters, producing a potentially adverse outcome in terms of CO₂ emissions. On balance, the complexity and data availability problems with including older vehicles suggests that differential registration charging should initially only be applied to vehicles purchased from the date of any scheme’s introduction, or at the earliest from the year that CO₂ emissions data was available in a consistent format.

Nature of Charges

For registration purposes, heavy vehicles are classified as those with a GVM in excess of 4.5t. However fuel economy/emissions data is only available for vehicles up to 3.5t GVM. Special consideration may therefore be required for vehicles that sit in the 3.5–4.5 tonne range, perhaps by applying some form of a “default” provision.

The ECMT concludes that “CO₂ differentiated vehicle taxes are only likely to be cost-effective, from a societal perspective, if they are introduced in a revenue neutral fashion.”\(^{112}\) In addition, should the scheme’s design mean that it actually becomes revenue positive for the government over time (even if intended to be revenue neutral), the government risks being accused of repackaging revenue-raising activities as environmental measures.\(^{113}\)

Registration costs represent a bundle of annual charges that include compulsory third-party insurance, duty and registration fees. Each of these charges is also subject to variation – vehicles registered in rural locations pay less insurance than for metropolitan areas, and discounts on registration fees are available for health-care card holders such as pensioners. These dimensions would need to be appropriately considered in any amendments to charges based on CO₂ emissions.

Assuming that third-party insurance costs are excluded from the discounting regime, the minimum registration cost may actually be relatively low. If the scheme is designed to be revenue-neutral, this would entail that the ‘low emission vehicle’ discount is also low. This limited price signal may therefore limit the scheme’s effectiveness.

Insurance charges are already scaled according to vehicle type, with ‘environmentally-friendly’ models occasionally enjoying lower premiums. A prominent example of this is the 10% saving on comprehensive car insurance offered for a range of fuel efficient vehicles by NRMA Queensland.\(^ {114}\) There exists the possibility therefore for insurance discounts to be incorporated into the reduced registration charges such that the overall registration cost to the consumer is reduced.

Design of Scheme

In designing the criteria under which any scheme could operate, the charging system could be scaled against an absolute figure (e.g. CO₂ emissions, or a surrogate such as fuel consumption), or against a ratings scheme (e.g. the Green Vehicle Guide’s star rating or its separate greenhouse rating) – refer to Figures 27 and 28 below for indicative outlines of the two approaches.\(^ {115}\)

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\(^{115}\) Any scheme utilising Green Vehicle Guide data could only be effective from 2005 models onwards, as 2005 was the first full year of the GVG’s operation.
In addition, the relationship between the emissions measure and the charge may be either linear, or stepped/banded as per Figure 27 below. The design of any scheme should be periodically reviewed to reassess whether it retains sufficient differential across the market to induce behavioural change. Indeed, over time it would need to evolve as the fleet structure changed, rendering original CO₂ categories less relevant. Another possible approach is that used in the new VED charges, the UK approach of setting a different rate in the first year to strengthen the fiscal signal at time of initial purchase, may also be worth considering.

![Figure 27: Schematic illustrating possible pricing framework, with the cost of stamp duty/registration scaled against CO₂ values, using a stepped/banded or a linear relationship](image)

Harmonisation of different schemes nationally is an issue in terms of its effect on vehicle manufacturers. As was alluded to in the description of the stance of the European automotive industry (refer ‘Other Costs’ above), consistency in the system design provides greater certainty
for vehicle manufacturers as well as potentially minimising vehicle development costs. This is a challenging objective when viewed in the face of differences between the various legislative and administrative system designs which are the basis for the differential charging schemes, as is illustrated by the diversity of system designs within the EU (refer to Table 10).

Summary

Although there is a lack of direct empirical evidence, modelling and outcomes from analogous fiscal incentive schemes (such as the UK company car tax) indicates that the measure has the potential to be an effective means of improving vehicle fuel efficiency. Should it be pursued, design and implementation may need to vary between jurisdictions due to revenue implications and the character of the existing legislative and administrative frameworks. A large variation in system design is found among those in operation internationally. For reasons of simplicity and data availability, the focus of any scheme (at least initially) could be on new vehicles registered after the commencement of any scheme.

An assumption of revenue neutrality in system design would appear to be an appropriate starting point for this work. It would potentially simplify the decision making processes of governments. Any significant variation in the net revenue of governments, either upward or downward, raises broader issues that governments may need to consider.

In considering likely costs, it would appear that costs to consumers and/or industry would be limited.

Your Views

• Would a stamp duty differential charging scheme be an effective means of encouraging consumers to purchase more fuel efficient vehicles?

• Would a registration differential charging scheme be an effective means of encouraging consumers to purchase more fuel efficient vehicles?

• Of the range of basic system models outlined above, which would be the most effective at improving vehicle fuel efficiency and most understandable to the average motorist?

• What other considerations should be made in the design of any system?
Category 2: Measures to Increase Demand for low emission vehicles

2.2 Provision of direct financial incentives/disincentives based on vehicle CO₂ emissions

Proposal

Encourage consumer uptake of low emission vehicles by establishing a balanced set of direct financial incentives and disincentives based on the CO₂ emissions performance of a vehicle.

Such offsetting incentives are frequently described as “feebates”, and this term is used in the remainder of the discussion of measure 2.2. A feebate scheme would provide a direct financial incentive toward the purchase of new vehicles with low CO₂ emissions, and also impose a financial penalty on the purchase of new vehicles with high CO₂ emissions.

Means of Implementation

The measure could be implemented through the creation of a feebate which is applied as a once-off transaction at the time the vehicle is purchased. The feebates could be applied at the consumer, dealer or manufacturer level.

A sliding scale schedule of surcharges and rebates could be developed based on vehicle CO₂ emission ratings as measured for the Fuel Consumption Label and reported in the Green Vehicle Guide. This is a standardised process which allows comparison across all light vehicles, regardless of fuel type.116

A simple model for implementing such a scheme could be based on the specification of two parameters: the rate ($ / g-CO₂/km) and the division (pivot point) between those who pay a surcharge and those who are paid a rebate.

![Diagram of feebate structure and parameters](image)

Figure 29: Diagram of feebate structure and parameters

Adapted from: McManus, W, 2007, *Economic analysis of feebates to reduce greenhouse gas emissions from light vehicles for California*, University of Michigan Transportation Research Institute

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116 The fuel consumption label is a mandatory Australian Design Rule – ADR81/02 *Fuel Consumption Labelling for Light Vehicles*. 
The basic structure may be modified to include the replacement of the pivot point with a range of emission ratings that are not subject to a surcharge or payment of a rebate. This would mean that only those consumers purchasing high or low emission vehicles would be affected by the program.

Caps on feebate values for vehicles at either end of the scale may also be applied to avoid onerous surcharges or over generous rebates.

The scheme would apply to any vehicle technology. High efficiency diesel, petrol and alternative fuel vehicles, as well as hybrid and electric vehicles would all be potentially eligible candidates for rebates. It may also be necessary to specify compliance with the new Euro 5 emission standards for vehicles obtaining rebates to ensure that the rebate would not lead to increased emissions of particulate emissions from diesel and direct injection petrol engines.117

The scheme parameters (pivot point and rate) would need to be reviewed periodically as the vehicle market changes.

This measure could be developed in close alignment with any light vehicle CO\textsubscript{2} emissions target (see measure 1.1). Any future final target and interim targets could inform decisions on the feebate rate. This measure could also be developed to be consistent with any measure on differential stamp duty and registration charges (see measure 2.1).

**Timeframe for Implementation**

For a feebate scheme to operate effectively, there will need to be considerable effort in examining and evaluating the design parameters for the scheme. This would likely take 18 months – 2 years to complete.

There may be merits in aligning the timing of the feebate scheme with the possible introduction of other measures discussed in this paper, including mandatory or voluntary CO\textsubscript{2} targets and differential stamp duty and registration charges.

**Benefits**

Modelling undertaken in relation to a proposed feebate scheme in the US State of California suggests that a feebate scheme could lead to significant improvement, over time, in the overall fuel efficiency of the light vehicle fleet. The modelling suggests that a hypothetical feebate scheme could deliver as much as a 26% improvement in the overall fuel efficiency of the light vehicle fleet over a fourteen year period.118, 119

**Costs**

A “feebate” approach could be designed to ensure the scheme is revenue neutral, with the value of rebates paid for low emission vehicles (as defined) being offset by the fees on high emission vehicles. As the average emissions of new vehicles falls over time, the scheme parameters (pivot point(s) and rate) would need to be adjusted periodically to maintain overall revenue neutrality. The design of the scheme will have an impact on the administration costs, with more complex schemes, such as those based on class based rebates, likely to incur higher costs. The application point (consumer, dealer or manufacturer) for the feebate is also likely to impact on the costs.

117 The particulate emission limits in Euro 5 are very stringent and effectively force the use of highly efficient particulate traps/filters. Euro 5 has not yet been adopted into the Australian emission standards, but consistent with existing practice, the Australian Government will consider the case for adoption of such international (UNECE) standards in to the ADR framework.
118 Relative to 2002, light vehicle average fuel efficiency.
The application of a fee to vehicles with high CO₂ emissions is expected to increase the purchase price of these vehicles for consumers, unless the manufacturer chooses to absorb the fee. The impact on manufacturers, will be variable, with those focused on producing higher emitting vehicles (including Australian manufacturers) likely to incur greater costs, potentially through reduced sales of their vehicles.

**State of Play in Australia**

There are currently no schemes in Australia that provide a direct financial payment to vehicle purchasers based on a vehicle’s emissions performance. There are a number of vehicle based financial incentives measures in place for LPG vehicles as set out below.

The Australian Government currently provides a rebate of $1000 on the purchase by private owners of new factory fitted LPG passenger vehicles and a rebate of $2000 for aftermarket conversion. Individual owners can only receive the grant once every three years irrespective of how many vehicles they own. As at 15 June 2008, 135,764 grants had been provided for the conversion option, while 1074 grants had been provided for factory-fitted LPG cars. The stated policy objective of this scheme was to reduce fuel costs for motorists, rather than any environmental outcome.

The Western Australian Government also offers a $1000 subsidy for the conversion of existing licensed vehicles or toward the registration of a new LPG vehicle. This scheme is restricted to vehicles registered as “family” vehicles.

**International Experience**

Internationally, there are a number of countries which provide fiscal incentives for the purchase of low emission vehicles, and to a lesser extent, financial penalties for high emitters. However, that the Working Group is not aware of any country that currently applies a structured feebate scheme in precisely the manner discussed here.

The EC has concluded that fiscal incentives are a powerful mechanism to encourage the supply of low emission vehicles and has argued for the definition of a “Light duty Environmentally-Enhanced Vehicle (LEEV)” as the basis for any incentives. It suggests that a LEEV should meet the next stage of noxious emission standards and meet a specified CO₂ target (currently 120g/km) which is subject to regular review.

As noted in the table of EU vehicle taxation measures linked to CO₂ emissions in measure 2.1, the approach predominantly favoured in the EU is to use differential annual registration (circulation) charges on all passenger vehicles according to some measure of vehicle efficiency (e.g. CO₂ emissions, engine size). Nevertheless, a number of countries – including Austria, Belgium, France and the Netherlands offer a range of one-off tax benefits for vehicles based on their CO₂ emissions. For example, the Belgian government provides a tax reduction of up to 15% of the vehicle price (maximum €4350) to individuals who purchase cars with emissions of less than 105g CO₂/km and up to 3% of the vehicle price (maximum €810) for cars with emissions of between 105 and 115g CO₂/km.

The United States operates an Energy Tax Credits scheme for hybrid vehicles. The scheme was introduced in 2006 and will run to 2010, however the credit amounts begin to phase out for a particular manufacturer once it has sold over 60,000 eligible vehicles. By way of example, the credit timeline for Toyota’s Prius is shown in Table 11. Some US states offer additional tax credits or other benefits for hybrids, e.g. use of high occupancy lanes.

121 For context, it is also worth noting that these countries also raise significantly greater levels of public revenue (mainly taxes) as a share of GDP, than is the case in Australia.
122 http://www.fueleconomy.gov/feg/tax_hybrid.shtml, viewed 1 May 08
Table 11: US Energy Tax Credit scheme history for Toyota Prius

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Tax Credit</td>
<td>$3150</td>
<td>$1575</td>
<td>$787.50</td>
<td>$0</td>
</tr>
</tbody>
</table>

The US also addresses the penalty end of the spectrum through the application of a “gas guzzler” tax to vehicles which fail to meet the 22.5mpg minimum fuel efficiency standard. Table 12 illustrates the current tax penalties which have been in place since 1991. The tax does not apply to minivans, sport-utility vehicles, or pick-ups.\(^\text{123}\) The US EPA has analysed trends in new light-duty vehicle fuel consumption since 1975 to the present day, concluding that the outcomes illustrate no effect of the tax in either direction.\(^\text{124}\)

Table 12: US Gas Guzzler tax penalty (current rates as per charging model introduced in 1991)

<table>
<thead>
<tr>
<th>Combined Fuel Efficiency</th>
<th>Tax Rate ($USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>at least 22.5 mpg (10.5 L/100km)</td>
<td>No tax</td>
</tr>
<tr>
<td>at least 21.5 (10.9 L/100km), but less than 22.5 mpg (10.5 L/100km)</td>
<td>$1,000</td>
</tr>
<tr>
<td>at least 20.5 (11.5 L/100km), but less than 21.5 mpg (10.9 L/100km)</td>
<td>$1,300</td>
</tr>
<tr>
<td>at least 19.5 (12.1 L/100km), but less than 20.5 mpg (11.5 L/100km)</td>
<td>$1,700</td>
</tr>
<tr>
<td>at least 18.5 (12.7 L/100km), but less than 19.5 mpg (12.1 L/100km)</td>
<td>$2,100</td>
</tr>
<tr>
<td>at least 17.5 (13.4 L/100km), but less than 18.5 mpg (12.7 L/100km)</td>
<td>$2,600</td>
</tr>
<tr>
<td>at least 16.5 (14.3 L/100km), but less than 17.5 mpg (13.4 L/100km)</td>
<td>$3,000</td>
</tr>
<tr>
<td>at least 15.5 (15.2 L/100km), but less than 16.5 mpg (14.3 L/100km)</td>
<td>$3,700</td>
</tr>
<tr>
<td>at least 14.5 (16.2 L/100km), but less than 15.5 mpg (15.2 L/100km)</td>
<td>$4,500</td>
</tr>
<tr>
<td>at least 13.5 (17.4 L/100km), but less than 14.5 mpg (16.2 L/100km)</td>
<td>$5,400</td>
</tr>
<tr>
<td>at least 12.5 (18.8 L/100km), but less than 13.5 mpg (17.4 L/100km)</td>
<td>$6,400</td>
</tr>
<tr>
<td>less than 12.5 mpg (20.5 L/100km)</td>
<td>$7,700</td>
</tr>
</tbody>
</table>

Japan has a different approach that is integrated with their vehicle fuel efficiency standards. Vehicles which exceed the “Top Runner” fuel efficiency target for their weight class by at least 5% receive reductions on purchase taxes of around A$1900.

The Canadian government introduced the EcoAuto rebate scheme in March 2007.\(^\text{125}\) The scheme provides a sliding scale of rebates of between $1000 and $2000 for the purchase of low emission vehicles. The scheme applies to eligible vehicles in a range of classes such as small cars, larger cars, minivans, SUV’s and other light trucks. Eligibility criteria are based on the greenhouse emission performance of vehicles rather than specific technologies. Thresholds for each vehicle class are reviewed periodically. The maximum rebate is available for the smallest most efficient vehicles, whilst smaller rebates are available for eligible larger vehicles. At this stage, the Canadian Government has not made a commitment to extend the scheme beyond 2009.

Several Canadian provincial governments (for example Ontario) also offer sales tax rebates, which complement the federal government system.

Key Issues

The lack of practical experience with feebate schemes means that real world data is not available of their effectiveness in reducing emissions. However, the available analyses suggest that a feebate scheme has the potential to improve fuel economy and lower emissions by addressing

\(^{123}\) http://www.epa.gov/fueleconomy/guzzler/420f06042.htm, viewed 1 May 08
\(^{124}\) http://www.epa.gov/otaq/cert/mpg/fetrends/420s07001.htm, viewed 1 May 08
\(^{125}\) Transport Canada website – http://www.tc.gc.ca/programs/environment/ecotransport/ecoauto.htm
consumer undervaluation of fuel savings, raising consumer awareness of the link between fuel consumption and CO₂ emissions and providing direct incentives for manufacturers to produce lower emission vehicles. A feebate scheme, directly linked to CO₂ emissions performance, also has the advantage of transparency and a clear relationship between the rebate and the outcome.

In the consideration of a feebate for low emission vehicles, there is a challenge in balancing the objective of maximising emission reductions and maintaining the rebate and surcharge components at a reasonable level. This is strongly linked to the feebate design parameters (the rate and division(s)).

As an alternative approach, the feebate scheme could be designed around a series of pivot points based on “vehicle class”. The transport needs and consumer preferences of vehicle owners ensure there will continue to be a demand for a range of passenger vehicles. These include small, medium and large cars, as well as SUV's. In order to encourage fuel efficiency improvements across the full range of vehicles, the feebate scheme could encourage “best in class” performance across vehicle categories (e.g. small, medium, large, SUV).

A class-based feebate scheme would potentially reduce any adverse impact on vehicle manufacturers who primarily manufacture larger, less fuel efficient vehicles. However, a class-based approach would need to be carefully evaluated, as it has the potential to create anomalies across and between classes. Moreover, any definition of class is arbitrary and multiplicity of alternate approaches could be applied. Also, as noted by Langer (2005) “While a multiple point approach might mitigate some manufacturer objections, a class-based system has a serious drawback, namely that it could promote the purchase of a higher-emitting vehicle in one class at the expense of a lower-emitting vehicle in another.” The implementation and administration of a class-based scheme is also likely to be more complex than the single pivot point approach.

It is also inevitable that there will be some level of economic inefficiency, because some of the rebates would be effectively “wasted” as they would be paid to consumers who would have bought the low emission vehicle anyway. For example, in 2007, around 4000 of the two hybrid models meeting a very low CO₂ emissions level of 110g/km were sold in Australia in the absence of any financial incentive from Government. Similarly, a number of the beneficiaries of the LPG conversion grants noted earlier would have undertaken the conversion in any event.

When the human factors around purchasing behaviour are factored into this process, it is clear that this is a complex issue and feebates need to be carefully designed to ensure they are cost effective. Assessing their effectiveness is further complicated by vehicle manufacturers pricing strategies which could impact on the strength of the market signal provided by the rebate or fee.

Langer’s 2005 analysis appears to suggest that the dominant effect of a feebate would be on manufacturers moving to improve vehicle fuel economy, rather than leading to significant changes in consumer purchasing behaviour.

The timing of any scheme would need to give consideration to the time for the vehicle industry to reassess current and future models in terms of greenhouse emissions and, if applicable, the proposed vehicle class thresholds applicable to the feebate. This is particularly the case for the local vehicle manufacturing industry which is currently committed to the production of a limited number of models.

The Working Group considers that the fundamental eligibility criterion for any feebate should be its CO₂ emissions in g/km as reported in ADR81/02 Fuel Consumption Labelling for Light Vehicles. This approach provides a technology neutral and objective basis for assessing the performance of vehicles and is directly linked to the desired outcome of reducing CO₂ emissions. As noted earlier,
to avoid any undesirable air pollution outcomes, diesel engine and direct injection petrol engine vehicles meeting the rebate threshold should also be required to be certified to the *Euro 5* emission standards.

**Conclusions**

The Working Group considers that a feebate scheme has the potential to encourage the purchase of low emission vehicles. It notes, however, that the design and delivery of such an approach would raise matters of some complexity, requiring further assessments of its capacity to deliver improved fuel efficiency and the likely cost of such improvements.

**Your Views**

- Is there evidence that direct rebate for low emission vehicles is an effective measure to improve overall vehicle fuel efficiency?

- If so, do you consider that the cost of rebates should be offset with fees on high emission vehicles (i.e. a feebate scheme)?

- Do you agree that any scheme should be based on CO$_2$ emissions and not linked to particular technologies?

- If a scheme was to be introduced, would you support it being based on a single threshold, or do you support a range of “class” based thresholds? What do you consider are the advantages and disadvantages of such approaches?
Category 2: Measures to Increase Demand for Low Emission Vehicles

2.3 Develop fleet purchasing frameworks that incorporate greenhouse reduction objectives

Proposal
A voluntary scheme that supports the adoption of best practice fuel efficiency strategies in government and business light vehicle fleets. The measure could include:

1. Provision of comprehensive information and advice on greenhouse abatement strategies to government and business fleet operators.

2. A national fleet accreditation process which supports government and business fleet operators to set and achieve voluntary, enterprise-level fleet greenhouse emission targets. This process would relate to all aspects of fleet procurement and management.

The benefits of a national scheme to improve the fuel efficiency of government and business fleets would assist in underpinning future investment decisions by vehicle manufacturers surrounding the Green Car Challenge and the Green Car Innovation Fund.

Means of Implementation
Under item 1. information and advice could be made available to fleet operators through the development and maintenance of a website containing practical information on strategies to reduce fleet greenhouse emissions. This resource would complement the Green Vehicle Guide, and could be developed and maintained as a component of the Green Vehicle Guide.

Under item 2. there are several options available for the implementation of a voluntary national fleet accreditation process, including:

1. Enhancing an existing national greenhouse abatement program, such as Greenhouse Challenge Plus, to provide additional support to government and business fleet operators to reduce fleet greenhouse emissions.

2. Developing a dedicated, fleet accreditation scheme to support fleet operators to reduce fleet greenhouse emissions. The primary focus of such a scheme would be the reduction of greenhouse emissions. The scheme would include an advice and information service, certification process, and ongoing monitoring of the progress of member organisations toward the achievement of voluntary emission reduction targets. The scheme could be auspiced through relevant State/Territory agencies or alternatively, a non-government or private service provider could be engaged to manage the program nationally.

The marketing and branding aspects of any future scheme would be a key consideration. Such a scheme will be attractive to fleet operators if it offers access to a level of goodwill from the wider community. This will depend upon a public recognition and understanding of the scheme and its objectives.

Timeframe for Implementation
An on-line information resource linked to the Green Vehicle Guide could be developed and accessible within twelve months of a decision.

The development of a dedicated fleet accreditation scheme could be operational within eighteen months to two years of a decision. Preparatory work will include:

- development of program delivery framework,
- development of certification process and standards,
- engagement of program delivery agents.
Benefits

In 2007, new vehicles for the government and business markets represented 45% of new vehicle sales (excluding heavy commercial vehicles), or around 514,000 vehicles.130 Experience from the United Kingdom’s “Motorvate” scheme suggests that an average 15% fuel efficiency improvement can be achieved by each participating fleet over a three year period. Whilst this will lead to an immediate improvement in fuel efficiency within participating fleets, it is anticipated there will be ongoing benefits as fuel efficient fleet vehicles enter the secondhand vehicle market.

It is expected fleet operators would continue to purchase low emission vehicles beyond the initial three year involvement in the Scheme.

Costs to Government

The development and updating of resource materials to provide information and advice to fleet operators could be undertaken in-house at minimal additional cost. The Green Vehicle Guide could potentially provide the platform for delivering the required information – it already has the vehicle and emissions data.

A national fleet accreditation scheme would incur a greater level of costs to cover its establishment and ongoing operations. The scheme could operate in each State and Territory and may require a staff presence in each jurisdiction to adequately provide advice and support to scheme participants. Economies of scale (staffing, accommodation and resources) could potentially be achieved by partnering with organisations.

Other Costs

There may be increased upfront costs to business and government if it required amended procurement practices, however, it is expected a scheme would lead to long term savings through improved fuel efficiency and vehicle maintenance.

State of Play in Australia

Each jurisdiction has adopted a policy aimed at reducing government fleet greenhouse emissions over time. Whilst, in general terms, each jurisdiction is moving toward an improvement in the overall fuel efficiency of their vehicle fleets there are diverse arrangements across government schemes in relation to both the level of improvement sought and the mechanisms for achieving improvements in fuel efficiency. Jurisdictions generally also have additional performance or policy objectives associated with the choice of fleet vehicles, such as vehicle safety. Current policy approaches are summarised in Table 13.131

The Local Government sector has been pursuing fleet greenhouse emission improvements through participation in the Cities for Climate Protection (CCP) program. CCP Australia is part of the CCP international program, delivered in Australia in partnership with the Australian Government (through the Department of the Environment, Water, Heritage and the Arts) and the International Council for Local Environmental Initiatives (ICLEI). CCP works with local government organisations to develop and implement organisation-wide greenhouse abatement strategies. A total of 221 Councils participated in the program in 2006/07. Vehicle fleet actions measures have been popular amongst participating Councils, with more than 50% of Councils reporting activity in this area since 2006.

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130 VFACTS data, December 2007
131 As indicated in the table, a number of jurisdictions are using GVG data to underpin their fleet purchasing policies. The Australian and NSW Governments are using the overall ratings which are a combination of the greenhouse and air pollution ratings (score out of 20). The ACT is also using the overall rating, but is using the star ratings derived from that score out of 20. Queensland and Tasmania are using the GVG’s greenhouse rating only (score out of 10).
Table 13: Current Policy Approaches to Greenhouse Gas Minimisation in Vehicle Fleets

<table>
<thead>
<tr>
<th>State</th>
<th>Policy Approach</th>
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<tbody>
<tr>
<td>Aust Govt</td>
<td>Preference for Australian-made vehicles, or if vehicle has under 2 litre engine, imported by an Australian manufacturer. Aim to increase the proportion of vehicles with overall scores in the top half of the <em>Green Vehicle Guide</em> (10.5/20 or greater) from 18% to 28%, while maintaining the Australian-made proportion of the fleet. The proportion of vehicles with a GVG rating of 10.5 or greater has increased from 23% in March 2006 to 35% in March 2008.</td>
</tr>
<tr>
<td>Qld</td>
<td>Annual emissions from fleet will be reduced stepwise to 50% of 2007 levels by 2017. Vehicle selection policy is based on emissions performance. Target sets a minimum GVG greenhouse rating of 5.5/10 for passenger vehicles and a minimum of 3.5/10 for light commercial vehicles. An environmental program was introduced for Queensland government fleets in 2000. Since that time the proportion of 6-cylinder vehicles in the fleet has dropped from 60% to 30%.</td>
</tr>
<tr>
<td>NSW</td>
<td>Each agency is required to achieve an average score for their vehicles, calculated from the GVG overall rating of 12/20 by end 2007/08. V8 vehicles cannot be purchased except in specific circumstances. Target of 20% reduction in emissions by June 2008.</td>
</tr>
<tr>
<td>ACT</td>
<td>6-cylinder vehicles that are not required for operational reasons will be progressively replaced with 4-cylinder vehicles. 10% of the fleet will comprise fuel-efficient, low-emission vehicles – defined as GVG overall rating of four stars or higher (≥15/20) by 2008. Has a small fleet of hybrids. From September 2007 to March 2008 the proportion of 4-cylinder vehicles in the ACT fleet increased from 74% to 83%.</td>
</tr>
<tr>
<td>VIC</td>
<td>Passenger vehicles must be substantially manufactured in Australia. Passenger vehicles that travel greater than 30,000 km per year must either be 4-cylinder or LPG vehicles. Commitment to maintain a fleet of 150 hybrid vehicles in the Government fleet from the start of 2008.</td>
</tr>
<tr>
<td>TAS</td>
<td>All passenger vehicles to meet GVG greenhouse rating of 5.5/10 or better by 2010. All light commercial and 4WD vehicles must meet greenhouse rating of 3.5/10 or better by 2010.</td>
</tr>
<tr>
<td>SA</td>
<td>Preference for Australian-made vehicles. Aim to have 50% of cars on alternative fuels by 2010, primarily LPG. Has a small fleet of hybrids.</td>
</tr>
<tr>
<td>WA</td>
<td>Agencies are required to select 4-cylinder vehicles except where a clear case can be made for a 6 cylinder model. 25% of 6-cylinder vehicles are to be LPG powered where available. A new strategy is being developed. The Western Australian Government fleet purchasing policies in favour of four cylinder vehicles is estimated, to have reduced CO₂ emissions by around 4,200 tonnes CO₂ a year compared to what would have been emitted by the 2002 fleet.</td>
</tr>
<tr>
<td>NT</td>
<td>Aim to reduce greenhouse gas emissions from the NT Government’s passenger vehicle fleet by 5% per kilometre travelled by the end of June 2007, compared to emission levels in 2003/04. The Northern Territory Government is developing a revised fuel efficiency policy for fleet vehicles. This is expected to be considered by NT Parliament in the second half of 2008.</td>
</tr>
</tbody>
</table>
Actions have included changing to vehicles with smaller engines, conversion to alternative fuels and the introduction of hybrid cars. It is estimated that around 5,000t CO$_2$-e was abated by participating Councils in the 2006/07 financial year through changes to vehicle fleets.\(^{132}\)

In 1999/2000 the Energy Efficiency Best Practice Program (EEBP) of the then Department of Industry, Science and Resources funded a study of energy efficiency opportunities in the light vehicle fleet management sector. Following the sector study, a pilot project for a vehicle fleet efficiency program, Fleet First, was undertaken involving 30 fleets in South East Queensland.

In early 2002 the Australasian Fleet Managers Association (AfMA) with support from EEBP launched a national fleet efficiency program called Greener Motoring, based on the outcomes of the pilot project. EEBP ceased in June 2003. At that time, Greener Motoring had reached more than 57% of fleet managers, or 660 fleets representing 687,000 vehicles. AfMA surveys indicated that 324 organisations had implemented the Greener Motoring principles and had consequently changed their fleet management practices. An independent evaluation of Greener Motoring was not undertaken before EEBP concluded. AfMA no longer maintains the Greener Motoring program due to lack of funding, but information materials from the program are still available to its members. Fuel switching to LPG was seen as a key measure by AfMA to improve the environmental and economics of fleet management. The apparent focus of this scheme was on the economics of fleet management rather than directly improving emissions levels.

The Greenhouse Challenge Plus program managed by the Department of Environment, Water, Heritage and the Arts enables companies to form voluntary partnerships with the Australian Government to reduce their greenhouse gas emissions. Participants develop and implement action plans to reduce their emissions and report annually about their progress. Emission inventory reports from businesses include emissions from fuel use. Businesses may choose to include improvements in the fuel efficiency of their fleet in their action plans. Around 750 large and small businesses and industry associations are currently in the program.

**International Experience**

The Working Group has identified a number of fleet programs operating in Europe and North America aimed at improving fleet fuel efficiency. There are likely to be others.

The UK Motorvate program promotes fleet management practices that seek to reduce greenhouse emissions. The program, funded by the Department for Transport has been operating since 2000 and utilises a non-government partner organisation (Energy Saving Trust, or EST) to operate a fleet certification scheme. Scheme members identify a voluntary target and are supported by EST to develop strategies to reach this target. EST undertakes ongoing monitoring and provides advice to scheme members, including such items as a telephone hotline for expert fleet management advice (e.g. on new vehicle selection). A core target of 12% fleet emission reduction over three years provides a base target for scheme members.\(^{133}\)

FleetSmart is operated by the Canadian Government. The scheme provides practical advice to business fleet operators on energy efficient vehicles and fleet management practices. Information is provided via a website, a newsletter and regular training and workshops. The Government of Canada is targeting a 15% reduction in greenhouse gas emissions per vehicle-kilometre from 2002–03 levels. Federal departments now have about 1,400 alternative fuel and hybrid vehicles in use, and vehicles purchased for the federal fleet must be capable of operating on alternative fuels, where cost-effective and operationally feasible.\(^{134}\)

ICLEI (Cities for Climate Protection) supports programs in the US and Europe which specifically target improvements in the greenhouse performance of local government fleets (e.g. GreenFleets programs in the USA).\(^{135}\)

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\(^{133}\) http://www.energysavingtrust.org.uk/fleet/organisations/motorvate/

\(^{134}\) http://fleetsmart.nrcan.gc.ca/

\(^{135}\) http://www.iclei.org/
SmartWay Partnerships is a voluntary fleet improvement program operated by the US EPA in partnership with freight fleet operators. It aims to establish incentives for fuel efficiency improvements and greenhouse gas emissions reductions. By 2012, this initiative aims to reduce between 33 and 66 Mt CO₂ per year. There are three primary components of the program: creating partnerships, reducing all unnecessary engine idling, and increasing the efficiency and use of rail and intermodal operations.136

The New Zealand Ministry for the Environment coordinates the Govt³ program, which offers assistance to government agencies to undertake sustainable initiatives. The program focuses on four key areas: recycling/waste minimisation, buildings, office consumables and transport. The Govt³ program also engages in less formal partnerships within the public and private sectors.137

Key Issues
Given the heavy reliance of the local manufacturers on fleet sales, opportunities exist to encourage the production of more fuel efficient and low emission vehicles through fleet purchasing policies. The Australian Government has made a commitment to the local vehicle industry through the Green Car Challenge, pledging to purchase hybrid or other value-for-money, environmentally-friendly vehicles for the Commonwealth fleet if they are produced in Australia.

Should a fleet accreditation scheme be implemented, the scheme would be most effective from a CO₂ reduction perspective if it is designed around the primary goal of reducing greenhouse emissions. As lower greenhouse emissions and improved fuel consumption are directly related, the scheme would offer financial benefits to participants, and such benefits would be even greater in a CPRS that includes transport.

Conclusions
Government and business fleet operators represent a significant market for new vehicle sales in Australia. The procurement choices of fleet operators are eventually reflected in the overall profile of the Australian light vehicle fleet, as vehicles subsequently enter the second hand car market, often quite early in their life.

There is significant potential to improve the fuel efficiency of the light vehicle fleet over the long term by supporting fleet operators to procure more efficient vehicles. There are commercial benefits for fleet operators by reducing costs through improved fuel efficiency.

The measure outlined would enable Governments to work in partnership with fleet operators to improve the overall fuel efficiency of fleet vehicles.

Your Views
- Do you consider fleet operators would be motivated to participate in a national fleet accreditation process to improve the fuel efficiency of their fleet?
- If you do, what benefits do you consider fleet operators would expect to result from participation in such a scheme?
- Do you think that an accreditation scheme should have the sole goal of improving fleet fuel efficiency? Should additional goals be considered (such as air quality)?
- Are you aware of fleet fuel efficiency schemes operating within Australia or overseas? Has there been an analysis of the effectiveness of these schemes?

136 http://www.epa.gov/smartway/
4.3 Measures to Improve Consumer Awareness

There is broad international agreement that information strategies aimed at improving consumer understanding of the greenhouse performance of vehicles are a key element in any program aimed at reducing CO₂ emissions from the vehicle fleet. Such measures will primarily seek to reduce the effects of information barriers on vehicle purchasing decisions.

As noted in the 2008 UK King Review (Part II) “Technology achieves nothing if it is not adopted – consumers must be engaged in order to realise fully the potential for reducing CO₂ from road transport”. ¹³⁸ In addition, King notes, that in the UK context, consumers choosing a lower CO₂ emitting vehicle by using a “best in class” approach could reduce emissions by around 25%.¹³⁹ The Australian vehicle class comparisons presented in Section 2.1 of this paper indicate that such an approach in Australia could deliver similar outcomes. The European Commission has also identified consumer information as one its three policy pillars necessary to achieve CO₂ reduction targets.¹⁴⁰

In Australia, the key consumer information measures are the mandatory fuel consumption label and the Green Vehicle Guide (GVG) website. As noted in Section 2.3, both these measures have recently been updated to improve the quality of information provided to consumers. The Working Group notes that the Australian Government will continue to monitor the operation of these measures, and particularly in the case of the GVG, look to enhance its performance and usability as required to assist consumers.

The measures being presented under this section relate to the inclusion of fuel consumption and CO₂ information in vehicle advertising (Measure 3.1), consideration of standards and labelling of non-engine components (Measure 3.2), and assisting commercial vehicle operators with information on low emission technologies (Measures 3.3 and 3.4).

The advertising proposal is considered directly complementary to the existing fuel consumption label and the GVG as it is presenting the same information in a different context.

The proposal regarding non-engine components represents a mix of information provision and technical standards. For convenience it is presented in the information section.

The proposal for developing a heavy vehicle environmental rating scheme would provide a basis for vehicle purchasers to access objective data on the relative performance of a range of heavy vehicle technologies.

The technology demonstrations scheme would seek to demonstrate and provide independent information to operators of light commercial and heavy vehicles regarding emerging low emission technologies.

Category 3: Measures to Improve Consumer Awareness

3.1 Including fuel consumption data in vehicle advertisements

Proposal
Require standard fuel consumption and CO₂ data to be provided in vehicle advertisements to reinforce the current fuel consumption and greenhouse information provided to consumers via the current fuel consumption label and the Green Vehicle Guide. The measure is aimed at improving fuel efficiency by providing consumers with a capacity to choose better performing models from among those models that meet their needs.

Means of Implementation
There are two broad options which could be used to deliver the proposal:

1. A non-regulatory mechanism via an agreement between the Australian government and industry; or
2. A set of mandatory requirements delivered via regulation.

In relation to non-regulatory measures, a potential approach may be to expand the scope of the Federal Chamber of Automotive Industries’ (FCAI) vehicle advertising code of practice which currently provides guidance to manufacturers regarding “appropriate standards for the portrayal of images, themes and messages relating to road safety”.

A regulatory approach would appear to require the amendment of existing legislation, or the introduction of new legislation.

Timeframe for Implementation
If the measure could be negotiated with the FCAI to incorporate or addend it to the existing code of practice, then it could take effect within 12 months of a decision to proceed. A legislative approach would be likely to take a longer period, depending on the nature of legislative changes required.

Benefits
It is not feasible to confidently quantify estimates of the likely impact of this measure on fuel efficiency, in isolation from normal market developments or from other measures designed to encourage consumers to purchase more fuel efficient vehicles. When measures of this nature were agreed in Europe as part of a broader information package on CO₂ emissions from vehicles, the European Commission was not able to separate the benefits of the information package from those expected from the overall new car CO₂ strategy. Nevertheless, if viewed in isolation, the benefits in reduced CO₂ emissions from this advertising measure are likely be relatively low.

Costs
It is equally difficult to assess the incremental cost to industry (which would ultimately be borne by consumers). However, costs could be expected to be low under both non-regulatory and regulatory approaches, as the information to be included is already available and the principal cost would likely relate to establishing administrative arrangements to ensure that the information is made available to the advertising agency preparing the advertisement. Costs would be minimised if
manufacturers and advertisers were given adequate time to put any necessary new administrative arrangements into place. Manufacturers may incur some increases in advertising costs if the space requirements for the required information necessitated larger advertisements.

State of Play in Australia

There are no measures of this type currently operating in the vehicle sector in Australia. Some manufacturers voluntarily include fuel consumption and/or CO₂ information in some advertisements where they perceive this to be a marketing advantage for the advertised vehicle. In such circumstances, there is usually a footnote linking the data to the Australian Design Rule (ADR) for fuel consumption labelling (ADR81/01).

International Experience

There is a European Directive (1999/94/EC) regarding consumer information on fuel efficiency and CO₂ emissions. One element of the Directive requires manufacturers to ensure that fuel consumption and CO₂ emissions data is provided in all “promotional literature” produced by the manufacturers to market specific models of new cars.

In 2001, the UK adopted this Directive into legislation and defined “promotional literature” as “all printed matter used in the marketing, advertising and promotion of a new passenger car for sale or lease to the general public”. Other EU members are also required to implement these requirements. The Working Group is not aware of any other non-EU countries mandating such information in vehicle advertising.

While the Working Group is not aware of any specific reviews of the impact of including fuel consumption and CO₂ in advertising, the 2008 King Review (Part II) has recommended strengthening the current requirements to ensure the information is provided in a “more consistent and prominent” manner, and called on the government to work with the advertising industry to review available evidence with a view to improving the information provided to consumers. The European Parliament has also called for 20% of vehicle advertising space to be devoted to information on CO₂ emissions, but this has no legislative force. On 2 June 2008 the EC launched a public consultation process on the need for additional information to consumers regarding CO₂ emissions from vehicles, including advertising requirements. The EC has also decided to work with the vehicle industry to develop a code of practice on car marketing and advertising to promote “sustainable consumption patterns”.

Key Issues

While this measure could operate on a stand alone basis, its essential benefit would be to operate as a complementary measure to the other key information tools already in place via the GVG and the ADR for fuel consumption labelling (now ADR81/02).

Costs and Benefits

Any effort to estimate the emissions benefits directly attributable to information measures such as this are problematic as it is not possible to isolate their influence from other factors. Nevertheless, there is broad international agreement that information strategies aimed at improving consumer understanding of the greenhouse performance of vehicles are a key element in any strategy aimed...
at improving the CO₂ emissions performance of the vehicle fleet. The 2008 UK **King Review** (Part II) considered that advertising is a key element in reaching consumers and the current UK advertising requirements should be strengthened.\(^{146}\)

There is no evidence available at this stage to demonstrate that there will be any significant costs associated with this measure, but the Working Group would welcome any evidence of the costs or benefits. It also needs to be acknowledged that requiring information to be published effectively “appropriates” some of the space previously committed to the advertiser’s preferred message. Clearly if the minimum text requirements were to be significant, the manufacturer may have to increase the size (and cost) of the advertisement or redesign it to match the existing space (also involving less value for money).

**Implementation**

As noted earlier, there would appear to be two broad implementation routes:

- Regulation via existing or new legislation; or
- A code of practice agreed between Government and industry.

Best practice regulatory approaches seek to avoid unnecessary regulation if an effective non-regulatory mechanism can deliver the desired outcomes. The existing FCAI advertising code of practice would appear capable of amendment to meet the objectives of this proposal, and analysis commissioned by the Australian Transport Safety Bureau concluded that the code had been effective.\(^ {147}\) This code is administered by the Advertising Standards Bureau, which is an industry self-regulatory body.

If a regulatory requirement was considered necessary, the Working Group is not aware of any national legislation currently in place that could be used as the basis for the necessary regulations. The **Trade Practices Act 1974** does address advertising of products to consumers, but only to the extent of prohibiting misleading or deceptive conduct. It does not prescribe the provision of specific information as would be required under this measure. The **Motor Vehicle Standards Act 1989** enables the setting of standards for vehicles, including those relating to the “saving of energy”, but advertising would appear to be outside the scope of the Act. Subject to further advice, a legislative approach would appear to require a new Act or the amendment of an existing Act to enable the making of suitable regulations to implement the measure.

The Trade Practices Act also provides mechanisms for industry codes of practice, which can be voluntary or mandatory. Under such a code, the form and content of relevant information may be prescribed, making compliance mandatory for all businesses operating within the specified industry.

**Scope**

Once the implementation method is agreed, the key issue would appear to be defining the scope of advertising and media covered by the requirement. The existing FCAI code of practice for vehicle advertising provides some guidance by providing suitable definitions and setting out compliance arrangements. However, the text of the current code is less prescriptive in its wording than that needed to deliver specific fuel consumption and CO₂ data in advertisements. Regardless of whether a regulatory or non-regulatory route was chosen, the requirements would need to be precisely defined and specify relative and/or minimum text size requirements.

The scope of the media to be included in the requirements also needs to be considered. The alternatives are to include information in all forms of vehicle advertising in both electronic and print media (as favoured by the European Parliament), or to limit the requirements to printed material.

\(^{146}\) **King (2008)** *The King Review of low carbon cars Part II – recommendations for action* at: [http://www.hm-treasury.gov.uk/budget/budget_08/reviews/bud_bud08_king.cfm](http://www.hm-treasury.gov.uk/budget/budget_08/reviews/bud_bud08_king.cfm)

only. The UK legislation is currently limited to printed “promotional” material, including advertise­ments, brochures, showroom posters etc (see Figure 30).

**Interpretation**

“promotional literature” means all printed matter used in the marketing, advertising and promotion of a new passenger car for sale or lease to the general public.

**Dealers’ and Suppliers’ duties in respect of promotional literature**

9. – (1) The supplier of a model of passenger car shall ensure that all promotional literature for that model which is published or made available by him complies with the requirements specified in Schedule 4.

(2) A dealer shall ensure that all promotional literature which is published or made available by him in respect of any model of new passenger car displayed or offered for sale or lease by him complies with the requirements specified in Schedule 4.

**SCHEDULE 4**

**REQUIREMENTS FOR PROMOTIONAL LITERATURE**

1. Subject to paragraph 2, the official fuel consumption and official specific emissions of CO₂ figures for the model in question shall be provided in the promotional literature.

2. If the promotional literature applies to more than one model of the same make, there shall be provided either the official fuel consumption and official specific CO₂ emissions figures for all the models covered, or the range between the worse and best official fuel consumption and official specific CO₂ emissions figures.

3. The fuel consumption figures shall be expressed in miles per gallon (mpg) and in either litres per 100 kilometres (1/100 km), or kilometres per litre (km/l) or an appropriate combination of these.

4. The official specific emissions of CO₂ shall be quoted to the nearest whole number in grams per kilometre (g/km) and all other numerical data shall be quoted to one decimal place.

5. All information on the official fuel consumption and official specific emissions of CO₂ shall be easy to read and easily understandable and shall be no less prominent than the main part of the information provided in the promotional literature.

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**Figure 30: Extracts from UK Fuel Consumption and CO₂ Emissions Information Regulations regarding “Promotional Literature”**


The UK’s print-based approach appears sensible, as there would be little or no value in a quick visual or verbal delivery of fuel consumption data in a television or radio advertisement. However, it may be reasonable to consider inclusion of internet advertisements, subject to practical considerations. The provisions would need to be carefully designed to ensure both practicality, clarity and maximum effectiveness.

**Conclusions**

The Working Group considers that although the benefits of this measure are difficult to quantify, its introduction could help reinforce the information provided on the Green Vehicle Guide and the fuel consumption label, by providing key information to consumers who may not visit or be aware of the GVG website, or not see the label until they visit a showroom.

Subject to advice from stakeholders, the Working Group’s initial assessment is that the cost for manufacturers in complying with this measure would be limited and likely to be less than community benefits.
The Working Group considers that the most effective and quick way to implement the measure would be to negotiate amendments to the FCAI's current *Code of Practice for Motor Vehicle Advertising* – that is to adopt a voluntary approach in the first instance. If such a course is followed, it would be appropriate to monitor the degree to which industry observed the code of practice in their advertising. If there was not effective take up from the voluntary approach, then this measure would need to be reconsidered.

### Your Views

- Do you consider there is a case for including fuel consumption and CO₂ emissions data in vehicle advertising?
- If so, what do you think would be the best way to implement it?
- Are there any matters not identified which would facilitate or impede the introduction of this measure? We are particularly interested in any published material you can point to.
- What do you consider are the costs and benefits of the measure, and their likely magnitude? What is the basis of your views on this question?
- Are you aware of any other countries implementing similar measures, and whether there has been any analysis of their effectiveness?
Category 3: Measures to Improve Consumer Awareness

3.2 Standards/labelling requirements for non-engine components which impact on fuel consumption

Proposal

Introduce standards or labelling requirements for non-engine components – such as tyres, tyre pressure monitors and vehicle air conditioning units – which impact on vehicle fuel consumption and CO₂ emissions.

Means of Implementation

The means of implementation would vary, depending on the nature of the component. The Motor Vehicle Standards Act 1989 – under which the ADRs are enforced – could conceivably be used for on-vehicle tyre pressure monitoring systems for example, and even components such as tyres. However, this Act has not been used to date to set standards for replacement components such as tyres supplied in the aftermarket. State based product standards may be required to implement mandatory requirements for replacement components, or alternatively, industry codes of practice may be effective for some measures. Reducing air conditioning energy consumption may be best achieved by factoring air conditioning operation into the standard fuel consumption test regulations which are adopted in the relevant ADRs (such as ECE Regulation 101 adopted in ADR81/01 – the fuel consumption labelling standard).

Timeframe for Implementation

There are strong reasons for Australia to maintain its policy approach of following international practice and not seek to establish unique domestic requirements. Consequently, the timing for any measures would be linked to finalisation of international standards. As noted in the following discussion on international practice, the most well developed measure is in relation to standards for low rolling resistance tyres. Recent advice from the IEA suggest that standards may be completed within 2 years, and Australia could consider adopting these requirements soon after. Other measures, particularly those being considered for possible inclusion in the UNECE standards on which the ADRs are based, would potentially be available for uptake in 3–5 years.

Benefits

The IEA and a 2006 report commissioned by the European Commission (EC) examined the potential CO₂ reductions from a range of technologies, including non-engine technologies. As indicated in Table 14 below, the estimated benefits from some key measures range from 1.5% to 4%. A 2007 IEA paper concluded that measures to encourage the development and use of low rolling resistance tyres and on-board tyre pressure monitoring systems offer the most potential in this field of non-engine components and should be accorded the highest priority. The EC has noted research which indicates that the combination of these two technologies in a vehicle producing around 130 g CO₂/km would reduce those emissions by more than 7 g/km. This EC analysis has also estimated that if low rolling resistance tyres were phased in by 2012, it would lead to a total...
reduction of CO₂ emissions from passenger cars in Europe of 1.45% in 2020. Under the same timeframe, tyre pressure monitoring systems are estimated to lead to total CO₂ reductions of 1.6% in 2020, and 2.3% in 2030. It noted that other measures such as air conditioning and lighting also offered considerable potential, but further analysis was required to develop these measures.

Table 14: Potential CO₂ Benefits and Estimated Costs* of Non-engine Vehicle Technologies

<table>
<thead>
<tr>
<th>Technology Measure</th>
<th>Cost per Vehicle (A$)</th>
<th>CO₂ Abatement Cost** (AUD/tonne CO₂) Oil Cost @ A$60/bbl</th>
<th>Oil Cost @ A$125/bbl</th>
<th>CO₂ Reduction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low rolling resistance tyres (LRRT)</td>
<td>83</td>
<td>185</td>
<td>25</td>
<td>2-4%</td>
</tr>
<tr>
<td>Tyre pressure monitoring systems (TPMS)</td>
<td>98</td>
<td>-34</td>
<td>-166</td>
<td>2.5%</td>
</tr>
<tr>
<td>Gear shift indicators (GSI) (manual vehicles only)</td>
<td>29</td>
<td>-85</td>
<td>-217</td>
<td>1.5%</td>
</tr>
</tbody>
</table>

* Costs are reported in A$ and are rounded conversions from € estimates in the source report. Cost calculations assume 13 year life for TPMS and GSI; 2.5 years for LRRT.
** CO₂ Abatement cost = (investment – NPV(lifetime fuel cost savings))/Lifetime CO₂ reduction
Where abatement cost is described as net costs to society per unit of CO₂ avoided.


Costs

As indicated in Table 14 above, the per vehicle costs and the costs in terms of CO₂ emission reduction vary considerably, with the latter strongly dependent on the assumed price of oil. The initial investment costs of some measures are more than offset by the savings in fuel costs over the life of the vehicle (even at oil prices below current rates). The authors of the report prepared for the EC advises that the abatement costs quoted in Table 14 are based on real world fuel consumption and include well to tank greenhouse emissions.

State of Play in Australia

None of these measures are in place in Australia.

International Experience

Consideration is being given overseas to efficiency labelling schemes and testing standards for non-engine components which impact on vehicle fuel efficiency. Key components under investigation are tyres, air conditioning units and lighting. The 2007 OECD report Cutting Transport CO₂ Emissions – What Progress? identified the testing and labelling of such components as a potentially effective way to improve vehicle fuel efficiency.154

The most well developed measures are in relation to tyres. A 2006 IEA paper indicates that work is progressing on standards for tyres in Europe and the US, including the development of an ISO standard to measure rolling resistance of tyres.155 The IEA also nominated the deployment of fuel efficient tyres, together with measures to promote proper inflation, as one of its two recommended transport sector energy efficiency measures to the G8 Summit in June 2007.156 The EC’s Action Plan for Energy Efficiency also recommends a standard for low rolling resistance tyres, tyre

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labelling and mandatory tyre pressure monitoring systems for new vehicles as measures for improving vehicle fuel efficiency.\textsuperscript{157} A US report concludes that low rolling resistance tyres should be able to be supplied with no compromise in safety or performance.\textsuperscript{158} The UNECE World Forum for Harmonisation of Vehicle Regulations has also established a working group to consider standards for tyre pressure monitoring systems.

On 23 May 2008, the EC announced its intention to introduce mandatory standards for low rolling resistance tyres and tyre pressure monitoring systems from 2012.\textsuperscript{159} In relation to tyres, the mandatory standard would set limit values on rolling resistance measured in accordance with the relevant ISO standard (28580 – draft) and would include after market tyres as well as those supplied with new vehicles. A grading and labelling scheme for tyres would be agreed later. In relation to tyre pressure monitoring systems, the EC analysis concluded that it was necessary to establish technical standards and require mandatory fitment to vehicles.\textsuperscript{150, 161} California has committed to introduce labelling and efficiency standards for aftermarket tyres from 1 July 2008.

The IEA and EC are also working on standards for vehicle air conditioning systems, and proposals to include energy consumption from air conditioners within the standard fuel consumption test procedure.

**Key Issues**

The manufacture of vehicles and vehicle components is an international activity and Australia is a relatively small consumer in the international context. As such, there would appear to be little merit – and indeed potentially significant costs – if Australia acts unilaterally on these issues, particularly as processes are already underway to consider standards and labelling requirements. The recent proposals for new EU regulations for tyre rolling resistance and tyre pressure monitoring systems are of particular relevance, as EC vehicle standards are frequently reflected in UNECE regulations, and Australia has a commitment to adopt UNECE standards as the basis for our emissions and safety standards, where we consider there is a case for applying such standards in Australia. It would continue to be appropriate to base any consideration of new Australian requirements on UNECE standards (or their EC Directive precursors), rather than other national standards such as those being developed in the US.

Once suitable standards are finalised by the EC or UNECE, Australia could consider the merits of applying those standards here, complying, of course, with the usual regulatory assessment processes. In the interim, it would be appropriate to monitor progress on these issues. There may also be merit in preliminary discussions with affected Australian stakeholders to assess their reaction to the possible introduction of the measures being considered in Europe.

**Conclusions**

There are a range of non-engine technologies that could deliver incremental benefits in CO\textsubscript{2} emissions from new vehicles, and in the case of low rolling resistance tyres, in both new and existing vehicles. Some of these would appear to be cost effective over the life of the vehicle.

Australia needs to maintain its existing policy approach of harmonisation with international standards rather than taking any unilateral action that would impose significantly higher costs on Australian consumers. Thus, in relation to component standards or labelling, it would be appropriate to wait for international work (particularly that being undertaken in Europe) to be


\textsuperscript{160} Available at: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=44770

completed. In the interim, there may be value in seeking the views of stakeholders on possible future standards and/or labelling requirements, and how they might be applied in Australia.

Your Views

- Do you consider that measures in relation to non-engine components are worth pursuing?
- Do you agree with the Working Group’s assessment that Australia should move quickly to assess/establish within Australia any measures agreed to internationally?
Category 3: Measures to Improve Consumer Awareness

3.3 Heavy vehicle environmental rating scheme

Proposal
To provide guidance for heavy-vehicle buyers in relation to fuel efficiency.

Means of Implementation
Three delivery models/methods could potentially be used to deliver fuel efficiency information on heavy vehicles as follows:

1. Develop web-based qualitative information about heavy vehicle fuel efficiency incorporating a printable guide, printable checklist and an on-line step-through purchasing guide.
2. Develop web-based tools to assist fleet operators to benchmark their fleets and lower their fleet fuel use through recording and analysing their fuel use and implementing operational changes. This could build on the static information provided under item 1.
3. Establish – when feasible – a Heavy Vehicle Environmental Rating Scheme similar to the light vehicle model delivered by the Green Vehicle Guide.

Timeframe for Implementation
Option 1. could be completed within twelve months, as the material is already well documented.

Option 2. involving more substantial fleet management guides and tools would take 2–3 years and dedicated resources to develop. “Standard” clauses for use in tender documentation to seek disclosure of emissions and fuel efficiency information of heavy vehicles could be developed in a shorter time frame.

Option 3. is currently not feasible as there is not a common data set on which to base a rating scheme. When the United Nations Economic Commission for Europe (UNECE) adopts globally harmonised heavy-duty vehicle emission test standards, they could be considered for adoption into the Australian Design Rules and then utilised for rating heavy vehicles in terms of noxious and greenhouse emissions. This is currently not expected in the UNECE before 2011, with the inclusion of requirements to report fuel consumption of vehicles expected to follow in 2012.

Benefits
In 2005, heavy vehicles emitted 26 Mt CO$_2$-e, with 27.7 Mt CO$_2$-e predicted for 2008. Road freight is projected to increase by around 3.6% per year in the next decade. Table 15 indicates the significant projected growth in the freight sector to 2020.

Table 15: Projected growth in tonne-kilometres of freight 2007–2020

<table>
<thead>
<tr>
<th>Freight Type*</th>
<th>Total Projected Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interstate non-bulk</td>
<td>62%</td>
</tr>
<tr>
<td>Total non-bulk</td>
<td>53%</td>
</tr>
<tr>
<td>Total bulk</td>
<td>33%</td>
</tr>
<tr>
<td>Total freight</td>
<td>40%</td>
</tr>
</tbody>
</table>

* While freight is shared between various modes, road transport carries most of the non-bulk freight.

Source: adapted from BTRE Report 112 Freight Measurement and Modelling In Australia

Under Business As Usual (BAU) conditions, CO$_2$-e emissions are expected to increase to 36.4 Mt CO$_2$-e in 2020.
It is not feasible to confidently quantify the improvement in fuel efficiency and CO₂ emissions performance arising from this measure in isolation from normal market developments. A recent international forum reported that the UK’s Freight Best Practice program (discussed later) assisted participants to improve fuel efficiency, which led to a reduction of 65,500 tonnes of CO₂ emissions over a four year period. In addition to this, heavy vehicles can have a useful life of up to 32 years. Thus improvements in fuel efficiency of the fleet can take a long time to materialise, however are retained for a similarly long time.

**Costs**

Developing a simple static guide on emissions and fuel use of a specific range of heavy vehicles could be completed in-house, and costs would be low. Development of more substantial fleet management guides and tools would require dedicated resources and funding. The costs would depend on the extent of the tools to be developed.

Costs and resources to develop a comprehensive heavy vehicle rating system have not been assessed, but based on the experience with the light vehicle Green Vehicle Guide, IT establishment costs would be less than $500,000 (as noted above, however, this is currently not a feasible option).

**State of Play in Australia**

Environmental rating of light vehicles has been established in Australia through the use of emissions standards and data from the Australian Design Rules to develop and publish ratings in the Green Vehicle Guide.

Consultation undertaken by the NSW Government showed strong support for greater availability of information about the environmental performance of heavy vehicles. However, it should be noted that in the commercial road transport sector, operators already have a strong interest in fuel consumption as a business cost and this would undoubtedly be factored into their purchasing negotiations with vehicle suppliers and their ultimate decisions.

The NSW Government runs the Clean Fleet and Fleet Wise programs to assist fleet managers improve the environmental performance of their fleets. These programs, primarily targeting urban air pollution, appear to have been well received.

**International Experience**

There appears to be growing international focus, albeit from a limited base, in improving heavy vehicle fuel consumption. Major truck manufacturers have stressed the importance of a global approach to reducing vehicle greenhouse emissions and have agreed to study the feasibility and prospects for harmonised methods for assessing CO₂ emissions. Much of the international thinking is still at a developmental stage although a limited number of countries have programs in place to promote greater fuel efficiency of heavy vehicle fleets. At this stage, only Japan has set fuel efficiency standards for heavy vehicles.

The UK “Freight Best Practice” program web delivers guides, case studies, newsletters, DVDs and software tools showing how to:

- reduce fuel use;
- develop staff skills;

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166 Improving the Fuel Economy of Heavy-Duty Fleets http://www.theicct.org/meetings_live.cfm

• select and use the best equipment and systems; and  
• measure, monitor and achieve targets for operational performance.

The materials provided include video demonstrations of best practice. The program has been supported by the UK freight industry and public sector heavy vehicle operators.

The US has developed the “SmartWay” Transport Partnership to encourage fitting of fuel efficiency and exhaust treatment devices. The Partnership offers SmartWay Upgrade Kits, which include fuel efficiency and emission control devices, thus providing a cost saving to the truck owners through reduction in fuel use. The major innovation of the SmartWay Transport partnership has been the collaboration between Government and industry to make loans available to purchase SmartWay Upgrade Kits.168

The Japanese Heavy Vehicle Fuel Efficiency Standards 2005169 use simulation, including vehicle parameters and an engine map, and an urban (JE05) and inter-urban test cycle to evaluate fuel efficiency. Results are reported as km/L and vehicles must conform to the relevant heavy vehicle class limits.

The UNECE World Forum for Harmonisation of Vehicle Regulations has a Working Party on Pollution and Energy (GRPE) that is working on a world-wide harmonised heavy duty certification procedure170 (WHDC) for pollutant emissions. Test cycles have been finalised, but agreement has not been reached on all aspects of the procedure. A Global Technical Regulation (GTR 4) has been prepared, and consideration is being given to amending the GTR to include methodology to calculate CO₂ emissions (without setting CO₂ limits). Australia is a signatory to the 1998 Global Agreement governing GTRs and could consider adoption of GTR 4 in Australia. However, as noted above the case for enforcing the GTR in Australia would be based on air quality objectives, not greenhouse gas emissions.

Key Issues

Heavy vehicles are essentially used in business, and given fuel costs can represent a substantial component of operating costs, there is a strong commercial interest in fuel consumption in making heavy vehicle purchasing decisions. This has led to major focus on fuel consumption from vehicle/engine manufacturers and has also triggered the development of increasingly sophisticated tools to assist operators in monitoring fuel use. The Australian heavy road vehicle fleet is also recognised as one of the most fuel efficient in the world, in terms of tonnes of freight carried per kilometre. Thus, at face value, there would appear to be little justification for Government involvement in this arena.

Nevertheless, unpublished analysis commissioned by the NSW Department of Environment and Climate Change suggests that, in the Australian context, obtaining objective and comparable information prior to vehicle purchase can be difficult, particularly for small fleet operators. Larger fleet operators are able to obtain test vehicles to conduct in-service trials of the fuel efficiency and other performance aspects of new models. Smaller operators often have to rely upon limited and subjective evidence from industry contacts or vehicle sellers. This asymmetry in information could be reducing the potential emission reductions that might be delivered in a better informed market.

While there is capacity to develop basic measures along the lines of options 1. and 2., there are significant challenges to the development of a heavy vehicle rating system envisaged under measure 3. As already noted, the principal issue is that, unlike light vehicles, there is not yet a common test cycle or fuel consumption metric used to measure and report fuel consumption from heavy vehicles. In addition, in the articulated vehicle sector, many vehicles are not imported as fully built up vehicles (particularly in the articulated vehicle sector), but are built from a wide range of

168 US EPA “SmartWay Transport Partnership” http://www.epa.gov/smartway/  
engine and transmissions which the purchaser chooses to reflect their needs. Even in an environment of standardised test cycles, these cycles are likely to be based (as now) on the engine itself. The various combinations of transmissions, trailer configurations etc can have a significant impact on fuel consumption. Emissions testing of a final custom built vehicle would be likely to add $5000 to the purchase price.

Thus, in the absence of an internationally standardised CO₂ emissions test, any attempt to rate the fuel efficiency of heavy vehicles would be much more expensive and complex than rating light vehicles. It makes no sense for Australia to develop unique mandatory standards, and would run counter to commitments towards harmonisation of standards. The work of the World Forum for Harmonisation of Vehicle Regulations offers the best prospects to establish agreed international standards through the GTR process.

It will be important for Australia to continue to monitor the outcomes of UNECE work, in particular, the world-wide harmonised heavy duty certification procedure and any further developments relating to measurement of fuel efficiency and/or CO₂ emissions.

Conclusions

As a consequence of the increasing freight task and the predominance of road transport in delivering freight, greenhouse emissions from heavy vehicles are increasing at a faster rate than those of cars, although from a lower base. An environmental rating scheme for heavy vehicles (when feasible) might assist some businesses to make more informed decisions in relation to the fuel consumption and emissions performance of heavy vehicles.

At present there is no international scheme in place to rate heavy vehicles, and consequently there is a lack of consistent, comparable data to underpin an official rating scheme. International action to adopt an emissions test cycle for heavy vehicles is underway and expected in 2011–2012.

In the interim, an internet-based qualitative guide to fuel efficiency and emissions performance could be of assistance to those businesses not able to obtain reliable fuel consumption information from manufacturers.

Your Views

- Do you consider there are gaps/inadequacies in the provision of heavy vehicle fuel efficiency data to business purchasers? Can you identify those deficiencies?

- If deficiencies exist, what do you consider is the most effective way to address these? Do you consider there is a case for web-based fleet management tools, and how should they be funded?

- What do you think would be the most important areas for any tools to address?

- Are you aware of any other countries implementing similar measures and whether there has been any analysis of their effectiveness?

- Are there any additional matters that would facilitate or impede the introduction of fleet management tools? We are particularly interested in any published material you can point to.

- Do you think the development of fuel efficiency guides for fleets would be a cost effective means to reduce fuel use of heavy vehicles?

- Do you consider there is a case for development of a heavy vehicle environmental rating scheme similar to the light vehicle rating scheme? Do you agree with the assessment that any scheme should wait for the finalisation of international emission measurement standards?

- What do you think would be the most important areas for any scheme to address?
Category 3: Measures to Improve Consumer Awareness

3.4 Establish a technology demonstration scheme for Australian road transport fleets linked to achievement of greenhouse outcomes

Proposal
Establish a scheme aimed at assisting road transport operators to evaluate new low emission transport technologies applicable to light commercial vehicles, heavy trucks and buses. This would provide the transport industry with independent information on options to reduce fuel consumption.

Means of Implementation
A funding scheme to support transport operators to undertake operational trials of low emission technologies. Active dissemination of trial results within the road transport sector would be a key aspect of this measure. Low emissions technologies may include hybrid systems, alternative fuels and measures to improve aerodynamic performance or reduce rolling resistance. It may also support trials of low emissions ancillary equipment as part of the package.

Timeframe for Implementation
The development and implementation of a low emission technology trial program could take place within 6 months of a decision to proceed.

The publication and dissemination of trial results could begin within 12–18 months of a decision to proceed with the measure. Information resources relating to existing knowledge of known low emission technologies could be produced earlier.

Benefits
A variety of current and emerging low emission technologies have the potential to deliver substantial improvements in fuel efficiency and reductions in vehicle CO₂ emissions (refer Table 16).

Table 16: Potential Measures to Improve Fuel Efficiency

<table>
<thead>
<tr>
<th>Vehicle Class</th>
<th>Efficiency Measures</th>
<th>Potential Fuel Efficiency Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light commercial vehicles</td>
<td>Non engine (aerodynamics, reduce rolling resistance etc.)</td>
<td>~10%</td>
</tr>
<tr>
<td></td>
<td>Engine improvements (diesel or petrol)</td>
<td>~25%</td>
</tr>
<tr>
<td>Light and medium trucks</td>
<td>Non engine (aerodynamics, reduce rolling resistance, transmission, vehicle mass reduction)</td>
<td>~17%</td>
</tr>
<tr>
<td></td>
<td>Engine improvements (diesel or petrol)</td>
<td>~20%</td>
</tr>
<tr>
<td></td>
<td>Hybrid electric drive train</td>
<td>~40%</td>
</tr>
<tr>
<td>Articulated trucks</td>
<td>Non engine (aerodynamics, reduce rolling resistance, transmission, vehicle mass reduction)</td>
<td>~37%</td>
</tr>
<tr>
<td></td>
<td>Engine improvements (diesel or petrol)</td>
<td>~20%</td>
</tr>
<tr>
<td>Buses</td>
<td>Non engine (aerodynamics, reduce rolling resistance, transmission, vehicle mass reduction)</td>
<td>~17%</td>
</tr>
<tr>
<td></td>
<td>Engine improvements (diesel or petrol)</td>
<td>~20%</td>
</tr>
<tr>
<td></td>
<td>Hybrid electric drive train</td>
<td>~40%</td>
</tr>
</tbody>
</table>

Source: Vyas, Sakr, & Stodolsky, 2002. The Potential Effect of Future Energy-Efficiency and Emissions Improving Technologies on Fuel Consumption of Heavy Trucks, Argonne National Laboratory, USA
Costs
The costs of the measure would be jointly borne by the Australian Government and the transport industry. The transport industry would contribute matching funding toward technology development and trials.

The relative cost effectiveness (fuel efficiency improvement relative to cost) of the range of low emission technologies would need to be carefully considered to ensure the most efficient use of available government and private sector resources.

State of Play in Australia
In 1999 as part of Measures for a Better Environment, the Alternative Fuels Conversion Program (AFCP) was established to provide assistance to heavy vehicle operators to convert to natural gas and LPG. This program ended in June 2008. This program illustrated that purpose built LNG-powered heavy transport vehicles can deliver lower costs to transport operators with improved environmental outcomes, and provided a significant increase in the level of knowledge (transport operators and government) of the actual environmental, operational and economic performance of alternative fuels in heavy vehicles overall.

The Australian Government currently supports research and development to local passenger car manufacturers through the Automotive Competitiveness and Investment Scheme (ACIS), which includes a $150 million Motor Vehicle Producer Research and Development Scheme (MVP R&D Scheme). This Scheme is due for completion in 2010. The MVP R&D Scheme is directed to encourage Australian MVPs to invest in high-end R&D technologies, some of which are directed at improving fuel efficiency. While some of the work under these grants is continuing, to date there is no evidence the scheme has led to substantive reductions in CO₂ emissions from Australian made vehicles.

The Australian Government has also a commitment to a scheme to support innovation in the light vehicle sector, through a 5 year $500 million Green Car Innovation Fund, which is scheduled to commence in 2011. On 10 June 2008, the Australian Government announced that $35 million will be provided to Toyota to support the manufacture of a hybrid Camry in Australia. The Victorian Government has committed a matching $35 million.

International Experience
The US EPA has developed the “SmartWay” Transport Partnership, a voluntary public-private scheme aimed at reducing greenhouse and other emissions in ground freight transport operations (including road transport). A key element of the scheme is a collaboration between Government and industry to provide innovative finance arrangements to support the purchase of SmartWay Upgrade Kits.171 These kits contain a bundle of technologies which improve fuel efficiency and reduce the emission of pollutants. It is estimated that the SmartWay Transport Partnership will lead to abatement of 33-66 M tonne-CO₂ in 2012.

The US 21st Century Truck Partnership, established in 2000, is a joint venture initiative between the US Department of Energy, the EPA and the truck and bus industry.172 The program supports the development and demonstration and dissemination of commercially viable technologies that will reduce fuel consumption and improve air quality. The program is developing prototype production heavy-duty trucks and buses with improved fuel efficiency, reduced emissions, enhanced safety and performance, and lower operating costs. Specific technical goals have been established in the areas of engine systems, heavy duty hybrids, reduction of parasitic losses, and reduction in idling and improved safety.

172 http://www.ornl.gov/sci/eere/transportation_truck.shtml
Key Issues

In most cases, commercial vehicles, including heavy vehicles, are used within a business context. As noted in Measure 3.3, there is a strong commercial motivation to reduce costs by minimising fuel consumption. In this sense, commercial vehicles in Australia may already have a high level of fuel efficiency as operators have taken steps to reduce fuel consumption. This raises the question as to whether the Government has any role to play.

Nevertheless, the adoption of new and emerging low emission technologies presents a level of risk for potential investors, particularly if the costs and benefits of the technology are not clearly demonstrated in an Australian context. This measure would seek to develop a body of evidence to better assess the risks associated with a particular technology. It would also see the Government supporting adoption of proven low emission technologies through a risk sharing arrangement.

The screening process for selection of technologies could be onerous given the large number of fuel saving devices in the marketplace, however restricting trial participants to fleet operators requiring matching private equity and requiring full public disclosure of the trial results should help filter out poor performing technologies.

Conclusion

The proportion of road transport CO₂ emissions, attributable to light commercial vehicles and the heavy vehicle sector is projected to grow over time. In general, there is a commercial imperative by vehicle users in these market segments to reduce fuel costs, through improved fuel efficiency, however operators also face a level of risk in adopting emerging technologies.

At present, there are no measures in place which specifically seek to improve the fuel efficiency of these market segments. The Working Group considers that a measure to encourage the adoption of low emission technologies within the light commercial and heavy vehicle market segments could be worthy of consideration.

Your Views

• Do you consider a subsidy scheme to support the development and trial of emerging low emission technologies is necessary to encourage innovation within the light commercial and heavy vehicle market segments? If so, is it an effective approach?

• Are there additional (non-financial) barriers to the adoption of proven and emerging low emission technologies within the light commercial and heavy vehicle segments?

• Are you aware of any other countries implementing similar measures and whether there has been an analysis of its effectiveness?
5 Conclusion

The Council of Australian Governments (COAG) requested the Australian Transport Council (ATC) and the Environment Protection and Heritage Council (EPHC) to provide a report on programs and incentives to encourage the uptake of more fuel-efficient and low emission passenger and freight vehicles, and to provide advice on opportunities for reforms to regulations, standards, codes and labelling requirements to improve vehicle fuel efficiency.

Following consideration of an initial report, COAG requested ATC and EPHC to develop jointly a package of vehicle fuel efficiency measures designed to move Australia towards international best practice. In response to that request, this paper presents an analysis of the Australian road transport sector in relation to vehicle fuel efficiency and greenhouse gas emissions, and outlines a range of potential measures which could be implemented to improve vehicle fuel efficiency and CO₂ emissions performance.

It is predicted that there will continue to be strong demand growth in all areas of road transportation into the foreseeable future. This in turn is expected to lead to ongoing growth in CO₂ emissions within the road transport sector.

The Australian Government has committed to cutting total greenhouse gas emissions by 60%, from 2000 levels, by 2050. The primary mechanism for achieving these cuts will be through the development and implementation of the Carbon Pollution Reduction Scheme (CPRS). The scheme will commence operation in 2010.

There may be merit in a set of complementary measures to support the CPRS within the road transport sector, and this paper has considered a range of possible measures. A summary is presented in Table 17. The table identifies measures in the order discussed in this paper and does not assign any rank or priority.

Whilst the paper provides a discussion and indicative assessment of possible costs and benefits associated with each measure, it must be emphasised that this work is not a complete cost-benefit analysis of each measure.

Each of the potential measures outlined in this paper could be implemented as a standalone measure, or be “packaged” to maximise potential benefits.

Several possible package scenarios are identified below:

1. Financial Incentives package
   A strong financial incentive for consumers to purchase low emission vehicles may be created through the combination of Measure 2.1 (Stamp Duty and Registration) and Measure 2.2 (Feebate). This may also act to reduce the commercial risk to manufacturers when introducing low emission technologies. Implementation of Measure 3.1 (Fuel Consumption in Advertising) within this package could provide further support to consumers in choosing a vehicle.

2. Supporting improvement within fleets
   Measure 2.3 (Fleet scheme) may be strengthened by operating in combination with the other demand side measures (Measure 2.1 and Measure 2.2). Measures 3.1 and 3.2 (Standards for non-engine components) would also assist fleet operators in reducing fleet fuel consumption.

3. Supporting a CO₂ emissions standard
   In the light vehicle sector, industry progress toward meeting a future revised CO₂ emission standard (Measure 1.1) could be supported by measures which encourage growth in consumer demand for low emission vehicles (Measures 2.1, 2.2 and 2.3), particularly if demand enhancing measures are operational in the years leading up to the commencement of the standard.

4. Improving heavy vehicles
   A package including Measures 3.3 and 3.4 has the potential to provide improved access to, and awareness of, low emission technologies within the heavy vehicle sector.
Table 17: Summary of Potential Measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>Description</th>
<th>Relative Estimated Total Cost</th>
<th>Relative Estimated Fleet Efficiency Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Measures to Increase the Supply of Low Emission Vehicles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 CO₂ Emission Standards for New Light Vehicles</td>
<td>A revised CO₂ emissions standard for new light vehicles based on the sales weighted average of annual vehicle sales. A standard could be implemented as either a voluntary or mandatory measure.</td>
<td>HIGH-MEDIUM</td>
<td>HIGH</td>
</tr>
<tr>
<td><strong>2 Measures to Increase the Demand for Low Emission Vehicles</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Restructure State registration and stamp duty charges for light vehicles</td>
<td>Development of a framework to realign State and Territory stamp duty and/or registration charges for light vehicles on a sliding scale based on CO₂ emissions. Implementation of the framework would vary in each jurisdiction.</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>2.2 Provision of direct financial incentives/disincentives based on vehicle CO₂ emissions</td>
<td>A balanced set of direct financial incentives (rebates) and disincentives (surcharges) for the purchase of new vehicles, based on the CO₂ emissions performance of a vehicle – referred to as a “feebate”.</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>2.3 Develop fleet purchasing frameworks that incorporate greenhouse reduction objectives</td>
<td>A national fleet accreditation scheme aimed at supporting government and business fleet operators to improve the fuel efficiency of their vehicle fleet. The scheme would be voluntary.</td>
<td>LOW-MEDIUM</td>
<td>LOW-MEDIUM</td>
</tr>
<tr>
<td><strong>3 Measures to Improve Consumer Awareness</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Including fuel consumption data in vehicle advertisements</td>
<td>Require standard fuel consumption and CO₂ emissions data to be presented within vehicle advertising. Implementation of the measure could be on the basis of an agreement between the Australian government and industry. Alternatively a regulatory approach could be adopted.</td>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>3.2 Standards/labelling requirements for non-engine components which impact on fuel consumption</td>
<td>Introduce standards or labelling requirements for non-engine components – such as tyres, tyre pressure monitors and vehicle air-conditioning units – which impact on vehicle fuel consumption and CO₂ emissions.</td>
<td>LOW</td>
<td>LOW-MEDIUM</td>
</tr>
<tr>
<td>3.3 Heavy vehicle environmental rating scheme</td>
<td>The development of information and fuel efficiency rating tools to support heavy vehicle operators to obtain accurate information on the relative fuel efficiency of heavy vehicle models.</td>
<td>LOW-MEDIUM</td>
<td>LOW-MEDIUM</td>
</tr>
<tr>
<td>3.4 Establish a technology demonstration scheme for Australian road transport fleets.</td>
<td>A scheme to support transport operators in the demonstration of low emission technologies for light commercial vehicles and heavy vehicles (trucks and buses).</td>
<td>HIGH-MEDIUM</td>
<td>MEDIUM-LOW</td>
</tr>
</tbody>
</table>
6 Next Steps

The ATC/EPHC Vehicle Fuel Efficiency Working Group will consider the comments and advice received during the consultation process to inform the preparation of a final report to the ATC and the EPHC. It is expected the ATC and the EPHC will consider the final report in early 2009.

7 Your Views

Stakeholders are invited to consider the potential measures outlined in this paper and the Working Group is particularly interested in your views on the questions raised at the end of each measure discussed in Section 4.

While comments are welcome on any aspect within the scope of this paper, your response to those questions, and the following broader questions would greatly assist the Working Group in assessing overall views on key issues.

1. Do you consider the actions of the type outlined in this paper are required, or are current arrangements sufficient?

2. If you consider further actions may be required, which measures, or package of measures, offer the greatest potential to cost-effectively reduce greenhouse emissions from the road transport sector?

3. In your view, are there particular combinations of measures that would enhance the potential benefits of the measures?

4. Are there barriers or challenges to the uptake of low emission transport technologies in Australia which have not been identified in this paper?

5. Are there opportunities to improve vehicle fuel efficiency within the Australian road transport sector which have not been identified in this paper?

6. Do you have views on possible social or economic impacts arising from measures outlined in this paper? How could these impacts best be managed?

Please provide your comments in writing by the due date (see Section 1.4 for details). Late submissions may not be accepted.
8 Glossary

**Australian Design Rules (ADR)**
National standards for vehicle safety, anti theft and vehicle emissions (including CO₂ emissions). Australian Design Rules referred to in this paper relate to vehicle emissions and fuel consumption labelling.

**Alternative Fuels**
A fuel – other than petrol and diesel – used in internal combustion engines. The following fuels fall within this definition: biodiesel, compressed natural gas (CNG), dimethyl ether (DME), ethanol, liquefied natural gas (LNG), liquefied petroleum gas (LPG), and methanol.

**Biofuels**
Fuels produced from renewable organic sources.

**Carbon Pollution Reduction Scheme (CPRS)**
An administrative approach to control emissions by providing economic incentives to reduce greenhouse gas emissions.

**CO₂-e**
The emissions of all greenhouse gases calculated at a rate equivalent to carbon dioxide.

**Differential Charging System**
A scheme that levies a scale of charges or tax based on a particular characteristic of a product (for example, fuel efficiency of a vehicle) that is purchased.

**Feebate**
A balanced set of direct financial incentives (rebate) and disincentives (surcharge) based on a particular characteristic of a product that is purchased.

**Footprint (vehicle)**
The product of a vehicle’s wheelbase and its track width (or equivalent measure of a vehicle’s dimensions).

**Fuel Efficiency**
The proportion of energy released by a fuel combustion process which is converted into useful work. In this report, this term may be used interchangeably with “fuel consumption/economy”.

**Fuel Consumption/Economy**
The amount of fuel required to move a vehicle over a given distance. Measured in L/100km or related units. In this report, this term may be used interchangeably with ‘fuel efficiency’.

**Heavy Vehicle**
Vehicles over 3.5 tonnes in weight. Includes buses and trucks. For registration purposes however, heavy vehicles are those over 4.5 tonnes (this is relevant for Measure 2.1).

**Light Vehicle**
Vehicles under 3.5 tonnes in weight. Includes passenger vehicles, light commercial vehicles and motorcycles.

**Market Failure**
The inefficient use of a resource (in this case vehicles and fuel) arising from the particular characteristics of the market sector.

**Sales Weighted Average**
A sales average that takes into account the proportional relevance of each component.
**Scrappage**
Vehicles which are not re-registered after the registration has expired. These vehicles have been removed from the system.

**Tare weight**
The weight of an empty vehicle.
Appendix A – Notes on CO₂ Emission Standard Scenarios for Measure 2.1

Scenarios
1 – NACE for new vehicles sold in 2015 is 180g CO₂/km
2 – NACE for new vehicles sold in 2015 is 170g CO₂/km
3 – NACE for new vehicles sold in 2015 is 160g CO₂/km
4 – Scenario 2 + NACE for new vehicles sold in 2025 is 115g CO₂/km
5 – Scenario 3 + NACE for new vehicles sold in 2025 is 115g CO₂/km
6 – NACE for new vehicles sold in 2020 is 150g CO₂/km

Assumptions
- Includes all light vehicles up to 3.5 tonnes GVM
- Base year is 2007
- End year is 2030
- NACE for new vehicles sold in base year is 226g CO₂/km (FCAI reported figure)
- Business as usual until 2014 (until 2019 for Scenario 6)
- Under Scenarios 1–3, NACE target is met for new vehicles sold in 2015 and every year thereafter
- Under Scenarios 4&5, NACE target is met for new vehicles sold in 2015 and every year until 2024, new NACE target applies from 2025 and every year thereafter
- Under Scenario 6, NACE target is met for new vehicles sold in 2020 and every year thereafter

BITRE Comments
The estimates are approximate, since so many future unknowns require assumed values to be assigned to them (e.g. the effects of future levels of urban traffic congestion, future petrol prices and their impacts on travel – including the take-up of alternative fuels, durability of new technology etc.)

Even the settings for a ‘BAU’ scenario are somewhat arbitrary, since even if exact macroeconomic assumptions are specified, it is still uncertain what particular vehicle mix would result from the different manufacturers’ and consumers’ decisions. To partially address this, the projections include a second ‘reference’ scenario where average new vehicle efficiency is held constant after 2010.

All the scenarios use the same fleet projections for stock and VKT – i.e. possible rebound effects (where reductions in travel costs, from vehicle efficiency improvements, can result in some extra levels of discretionary travel) are disregarded to simplify the modelling and its evaluation. This means that ‘actual’ fleet CO₂ reductions (from the specified NACE settings) are likely to be slightly lower than for these simplified scenario runs.