



## Overview of NACE and International CO<sub>2</sub> Targets – Background paper for the Senate Inquiry into the Motor Vehicle Standards (Cheaper Transport) Bill 2014

### 1.0 Overview of NACE and International CO<sub>2</sub> Targets

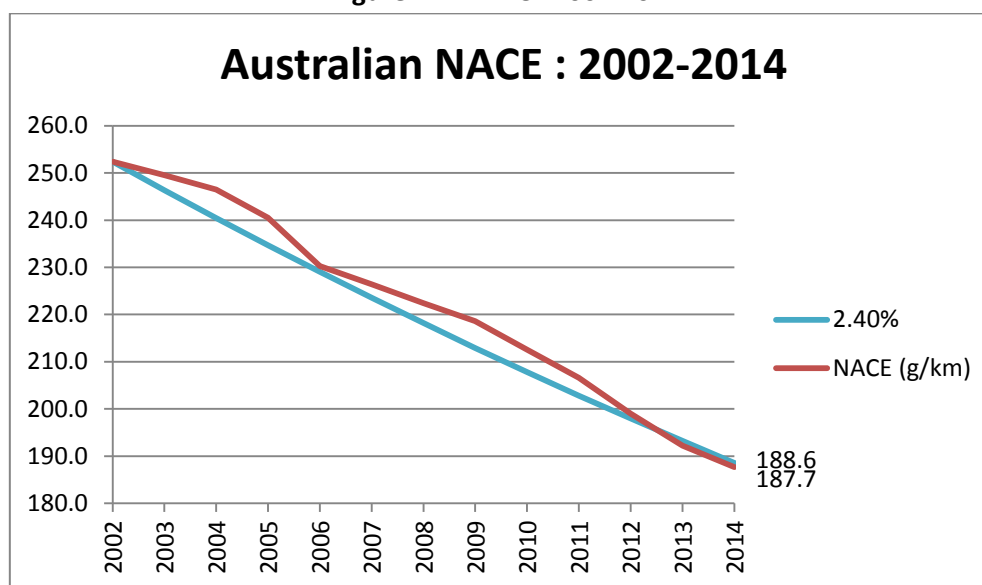
Following is an overview of the main features of the Australian NACE and both the EU and the US approaches to evaluating CO<sub>2</sub> emissions.

### 2.0 Australian National Average Carbon Emissions (NACE)

The NACE calculated annually by the FCAI and the National Transport Commission is a simple sales weighted average of CO<sub>2</sub> emissions reported by each brand as part of the vehicle certification process. A weighted-average calculation is similar to an arithmetic average (the most common type of average), but instead of each data point contributing equally to the final average, some data points contribute more than others. In this case, the average was weighted to vehicle sales.

The carbon dioxide emissions for vehicles are calculated using the method described in the Australian Design Rule 81/02 – Fuel Consumption Labelling for Light Vehicles (ADR 81/02) and expressed in grams of carbon dioxide per kilometer (gCO<sub>2</sub>/km). The CO<sub>2</sub> from each model is determined during that ADR 81/02 certification test (which harmonised with the United Nations Regulation 101 (UN R101)). This test cycle is commonly referred to as the New European Drive Cycle (NEDC).

Figure 2.1 – NACE 2002-2014



For reporting of sales data, the FCAI classifies motor vehicles into four main classes: passenger cars, sport utility vehicles (SUVs), light trucks and heavy trucks. These four classes are then broken down into subclasses; for example, the subclasses of SUVs are compact, medium, large and luxury.

The NACE is calculated for all light vehicles up to 3.5 tonnes GVM and includes;

- passenger cars

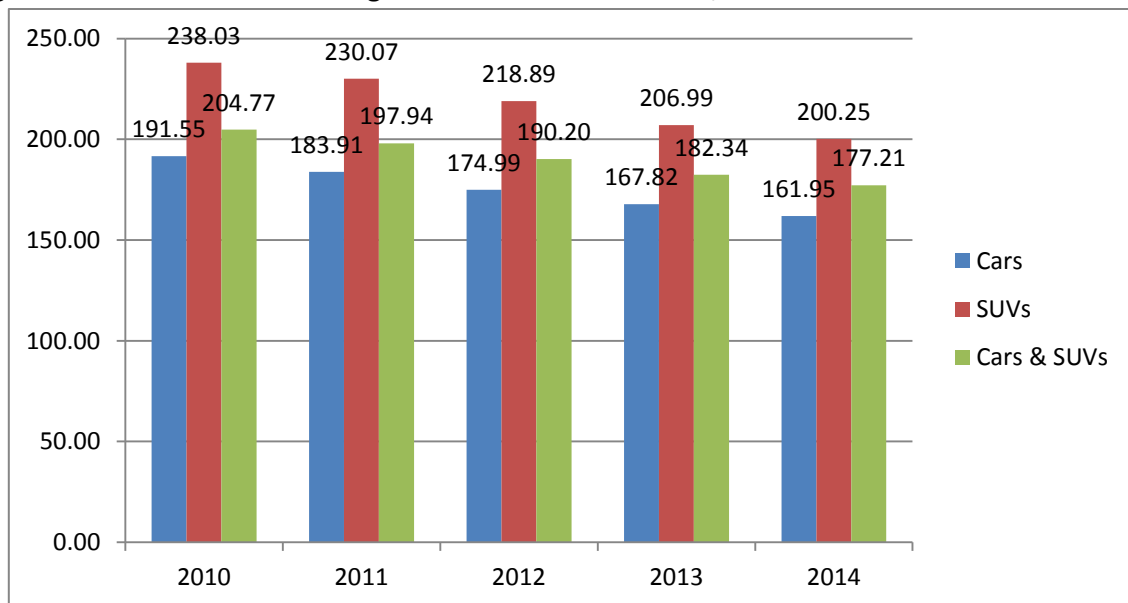
- SUVs
- light commercial vehicles (light trucks, light vans and light buses )up to 3.5 tonnes GVM.

### 3.0 International Comparison

The average annual reduction in NACE of 2.4 per cent (for all light vehicles) is comparable to the annual CO<sub>2</sub> reduction of passenger cars in other developed countries. The average annual CO<sub>2</sub> reduction in the Australian new light vehicle market is even more comparable (and better in some cases) when considering only passenger cars or passenger cars and SUVs to provide a like-for-like comparison.

Using the data presented by the NTC in their Information Papers in 2011<sup>1</sup>, 2012<sup>2</sup>, 2013<sup>3</sup> and 2014<sup>4</sup> the CO<sub>2</sub> reductions from 2010 to 2014 for passenger cars and SUVs can be calculated (Figure 3.1 and Table 3.1).

**Figure 3.1 – Australian Sales Weighted CO<sub>2</sub> for Cars and SUVs; 2010-2014**



The European Commission reported that new cars sold in the EU in 2014 emit on average 2.6 per cent less CO<sub>2</sub> than those sold in 2013, when using the results from the European drive cycle (the same test as used for the NACE). Over the period from 2010 to 2014, CO<sub>2</sub> emissions from new cars have decreased by 12 per cent, which is an average annual reduction of 3 per cent.<sup>5</sup>

Over the same period CO<sub>2</sub> emissions from new passenger cars in Australia decreased by more than 15 per cent and by more than 13 per cent for cars and SUVs combined (see Table 3.1).

<sup>1</sup> National Transport Commission, 2012, Carbon Dioxide Emissions from New Australian Vehicles 2011; Information paper, March 2012

<sup>2</sup> National Transport Commission, 2013, Carbon Dioxide Emissions from New Australian Vehicles 2012; Information paper, March 2013

<sup>3</sup> National Transport Commission, 2014, Carbon Dioxide Emissions from New Australian Vehicles 2013; Information paper, May 2014

<sup>4</sup> National Transport Commission, 2015, Carbon Dioxide Emissions Intensity for New Australian Light Vehicles 2014; Information paper, April 2015

<sup>5</sup> European Commission, Climate Action, Reducing CO<sub>2</sub> emissions from cars, [www.ec.europa.eu/clima/policies/transport/vehicles/cars](http://www.ec.europa.eu/clima/policies/transport/vehicles/cars) [accessed 22 April 2015]

**Table 3.1 - CO<sub>2</sub> Reductions (%) for Cars and SUVs sold in Australia; 2010-2014**

Year	Cars	SUVs	Cars & SUVs
2011	-3.99	-3.34	-3.34
2012	-4.85	-4.86	-3.91
2013	-4.10	-5.44	-4.13
2014	-3.50	-3.26	-2.81
Total	-15.45	-15.87	-13.46
Average	-4.11	-4.22	-3.55

The ICCT reported that the average CO<sub>2</sub> emission levels for cars in Europe reduced by 17 per cent between 2006 and 2012; an average annual reduction of 2.8 per cent.<sup>6</sup>

The annual reduction of CO<sub>2</sub> emissions from new light vehicles in Australia is comparable to other developed countries when compared on a like-for-like basis, i.e. exhaust emissions measured in a drive cycle test across the same market segments.

#### 4.0 EU CO<sub>2</sub> Targets<sup>7,8,9,10</sup>

Cars are responsible for around 12% of the EU's total CO<sub>2</sub> emissions.

The current (2015) EU CO<sub>2</sub> targets are:

- 130 gCO<sub>2</sub>/km by 2015 for passenger vehicles:
  - with a phase-in of 65 % in 2012, 75 % in 2013, 80 % in 2014 and 100 % from 2015 to 2019
  - flexibilities (credits and incentives) provide up to 10 g and means this target is close to 140 gCO<sub>2</sub>/km.<sup>11</sup>
- 175 gCO<sub>2</sub>/km for light commercial vehicles.

The 2020 EU CO<sub>2</sub> targets were introduced in 2014;

- Cars have a target of 95 gCO<sub>2</sub>/km; There is a one year phase in with;
  - 95% of sales need to comply in 2020
  - 100% of sales need to comply in 2021
- Light commercial vehicles (LCVs) have a target of 147 gCO<sub>2</sub>/km;
  - Note: LCVs comprise only 5% of EU light vehicle market.

The EU uses the New European Drive Cycle (NEDC) to measure the CO<sub>2</sub> emissions of each model/variant as part of the certification process (Figure 4.1).

<sup>6</sup> International Council on Clean Transport (ICCT), 2014, Policy Update, *EU CO<sub>2</sub> Emission Standards for Passenger Cars and Light-Commercial Vehicles*, January 2014

<sup>7</sup> International Council on Clean Transport (ICCT), 2014, Policy Update, *EU CO<sub>2</sub> Emission Standards for Passenger Cars and Light-Commercial Vehicles*, January 2014

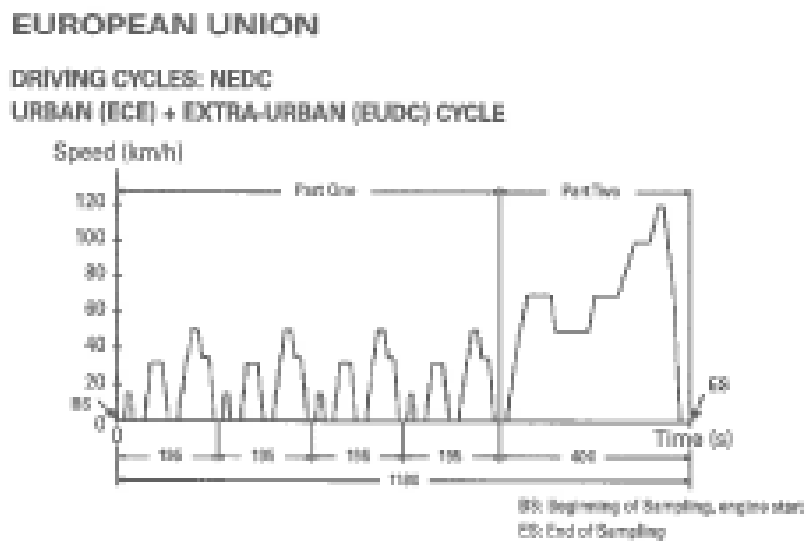
<sup>8</sup> European Commission, Climate Action, Reducing CO<sub>2</sub> emissions from cars, [www.ec.europa.eu/clima/policies/transport/vehicles/cars](http://www.ec.europa.eu/clima/policies/transport/vehicles/cars) [accessed 22 April 2015]

<sup>9</sup> Regulation (EU) No 333/2014 of the European Parliament and of the Council of 11 March 2014

<sup>10</sup> Regulation (EC) No 443/ of the European Parliament and of the Council of 23 April 2009

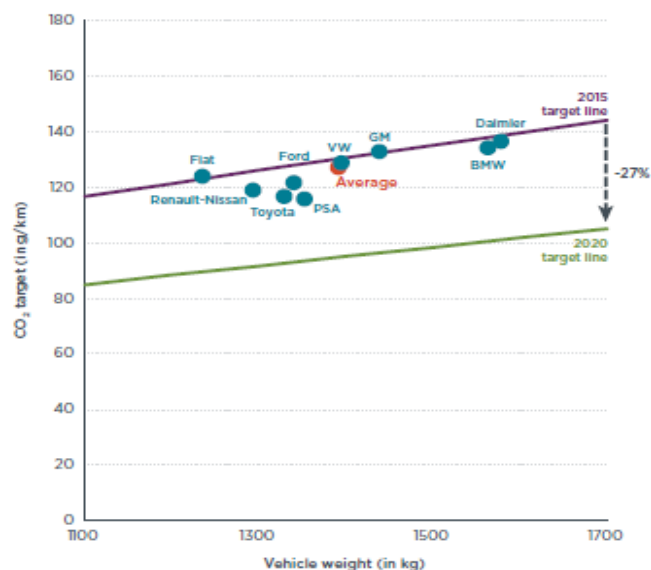
<sup>11</sup> European Federation for Transport and Environment (T&E), 2015, *How clean are Europe's cars? An analysis of carmaker progress towards EU CO<sub>2</sub> targets in 2014*, [www.transportenvironment.org](http://www.transportenvironment.org) [accessed 7 July 2015]

**Figure 4.1 – New European Drive Cycle<sup>12</sup>**



CO<sub>2</sub> targets for each vehicle model are set according to the mass of each vehicle by a limit value curve. The curve is set in such a way that the targets set for new cars fleet average emissions are achieved.

**Figure 4.2 – EU Passenger Car Limit Value Curve<sup>13</sup>**



**Figure 2:** 2013 actual performance of the top-selling EU passenger car manufacturers, including 2015 and 2020 (effectively 2021) target lines.

Individual manufacturer targets (specific emission targets)<sup>14</sup> are calculated for each brand and include credits or incentives, (i.e. 'derogations') as defined in EC 443/2009;  
Article 3 Definitions;

- (g) 'specific emissions target' means, in relation to a manufacturer, the average of the specific emission of CO<sub>2</sub> permitted in accordance with Annex 1 in respect of each

<sup>12</sup> Delphi, 2015, Worldwide Emissions Standards for Passenger Cars and Light Duty Vehicles

<sup>13</sup> The International Council on Clean Transportation (ICCT), 2014, CO<sub>2</sub> Emissions from New Passenger Cars in the EU: Car Manufacturers Performance in 2013, June 2014

<sup>14</sup> Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009

new passenger car of which the manufacturer or, where the manufacturer is granted a derogation under Article 11, the specific emissions target determined in accordance with that derogation.

The method for calculating the relevant brand target (Annex 1);

SPECIFIC EMISSIONS TARGETS.

The specific emissions of CO<sub>2</sub> for each new passenger car, measured in grams per kilometer, shall, for the purposes of the calculations in this Annex, be determined in accordance with the following formulae:

(a) From 2012 to 2015:

Specific emissions of CO<sub>2</sub> =  $130 + a \times (M - M_0)$

Where: M = mass of the vehicle in kilograms

M<sub>0</sub> = 1 372.0 kg

a = 0.0457

The limit value curve means that heavier cars are allowed higher emissions than lighter cars. Only the fleet average is regulated, so manufacturers are still able to make vehicles with emissions above the curve provided these are balanced by vehicles below the curve.

The EU includes flexibilities to encourage the introduction of new technologies;

- Eco-innovations;
  - Innovative technologies can help cut emissions, but in some cases it is not possible to demonstrate the CO<sub>2</sub>-reducing effects of a new technology during the test procedure used for vehicle type approval.
  - To encourage eco-innovation, manufacturers can be granted emission credits equivalent to a maximum emissions saving of 7g/km per year for their fleet if they equip vehicles with innovative technologies, based on independently verified data.
- Super Credits;
  - The Regulation gives manufacturers additional incentives to produce vehicles with extremely low emissions (below 50g/km). Each low-emitting car is counted as;
    - 3.5 vehicles in 2012 and 2013
    - 2.5 in 2014
    - 1.5 in 2015
    - 1 from 2016 to 2019.
  - Super-credits will also apply in the second stage of emission reductions, from 2020 to 2023. Each low-emitting car will be counted as
    - 2 vehicles in 2020
    - 1.67 in 2021
    - 1.33 in 2022
    - 1 from 2023.
  - For this second step, there will be a cap on the scheme's contribution to the target of 7.5g/km per manufacturer over the three years.
- Pooling;

- Manufacturers can group together and act jointly to meet the emissions target.
- In forming a pool, manufacturers must respect the rules of competition law. The information they exchange should be limited to average specific emissions of CO<sub>2</sub>, their specific emissions targets, and their total number of vehicles registered.

The different operating and economic factors in Europe<sup>15</sup> include:

- The EU has different targets for passenger cars and light commercial vehicles.
- Europeans tend to prefer smaller passenger cars with manual transmissions and smaller engines than Australian new car buyers.
- Vehicles have different specifications for the Australian market, e.g. larger engines and automatic transmissions for longer distance travel and towing under extreme (hot) conditions.

## **5.0 US CO<sub>2</sub> Targets for Cars and Light Trucks<sup>16</sup>**

The US CO<sub>2</sub> targets for cars and light trucks are a combination rules issued by both the US Environmental Protection Agency (EPA) and the US Department of Transportation's National Highway Traffic Safety Administration (NHTSA);

- The EPA established GHG emission standards
- NHTSA established Corporate Average Fuel Economy (CAFE) standards.

The US has set separate targets for passenger cars and light trucks (note: SUVs are considered to be light trucks). Table 5.1 summarises the US targets in both grams of CO<sub>2</sub> per mile (g/mi) and grams of CO<sub>2</sub> per km (g/km). The conversion was undertaken using a calculator developed by the ICCT.<sup>17</sup>

Figures 4.1 and 4.2 below are extracts from the US Rule showing the CO<sub>2</sub> targets for passenger cars and light trucks (note: light trucks include SUVs).

The EPA GHG standard includes provisions for both compliance flexibility and provides incentives for manufacturers to introduce advanced technologies;

- Credit banking and trading. To provide flexibility in planning and introduction of new vehicles, credits may be carried forward for 5 years or back for 3 years to cover a deficit from a prior year.
- Incentives for introduction of electric vehicles, plug-in hybrid vehicles, fuel cell vehicles and other advanced fuel/energy platforms (see Figures 5.1 and 5.2).
- Provisions for small volume manufacturers.

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<sup>15</sup> See the National Transport Commission's Information Paper, "Carbon Dioxide Emissions from New Australian Vehicles 2013", Section 5 Case Study; Why do European countries have new cars with lower average carbon dioxide emissions compared with Australia?.

<sup>16</sup> US Environmental Protection Agency, 2012, Regulatory Announcement Information Sheet, *EPA and NHTSA Set Standards to Reduce Greenhouse Gases and Improve Fuel Economy for Model Years 2017-2025 Cars and Light Trucks*, EPA-420-f-12-051

<sup>17</sup> ICCT Conversion Tool, available from [www.theicct.org/info-tools/global-passenger-vehicle-standards](http://www.theicct.org/info-tools/global-passenger-vehicle-standards)

**Figure 5.1 – US EPA CO<sub>2</sub> Targets for Passenger Cars<sup>18</sup>**

**TABLE III-1—EPA PROJECTIONS FOR FLEETWIDE TAILPIPE EMISSIONS COMPLIANCE WITH CO<sub>2</sub> STANDARDS—PASSENGER CARS<sup>401</sup>**  
[Grams per mile]

Model year	Projected CO <sub>2</sub> compliance target	Incentives <sup>402</sup>		Projected achieved CO <sub>2</sub>	Credits			Projected 2-cycle CO <sub>2</sub>
		Advanced technology multiplier	Intermediate volume provisions		Off cycle credit	A/C refrigerant	A/C efficiency	
2016 (base) .....	225 <sup>403</sup>	0	0	225	0.4	5.4	4.8	235
2017 .....	212	0.6	0.1	213	0.5	7.8	5.0	226
2018 .....	202	1.1	0.3	203	0.6	9.3	5.0	218
2019 .....	191	1.6	0.1	193	0.7	10.8	5.0	210
2020 .....	182	1.5	0.1	183	0.8	12.3	5.0	201
2021 .....	172	1.2	0.0	173	0.8	13.8	5.0	193
2022 .....	164	0.0	0.0	164	0.9	13.8	5.0	184
2023 .....	157	0.0	0.0	157	1.0	13.8	5.0	177
2024 .....	150	0.0	0.0	150	1.1	13.8	5.0	170
2025 .....	143	0.0	0.0	143	1.4	13.8	5.0	163

**Figure 5.2 – US EPA CO<sub>2</sub> Targets for Light Trucks<sup>10</sup>**

**TABLE III-2—EPA PROJECTIONS FOR FLEETWIDE TAILPIPE EMISSIONS COMPLIANCE WITH CO<sub>2</sub> STANDARDS—LIGHT TRUCKS<sup>404</sup>**  
[Grams per mile]

Model year	Projected CO <sub>2</sub> compliance target	Incentives <sup>405</sup>		Projected achieved CO <sub>2</sub>	Credits			Projected 2-cycle CO <sub>2</sub>
		Pickup mild HEV + strong HEV	Intermediate volume provisions		Off cycle credit	A/C refrigerant	A/C efficiency	
2016 (base) .....	406 298	0	0.0	298	0.7	6.6	4.8	310
2017 .....	295	0.1	0.2	295	0.9	7	5	308
2018 .....	286	0.2	0.3	287	1.0	11	5	304
2019 .....	277	0.3	0.2	278	1.2	13.4	7.2	299
2020 .....	269	0.4	0.2	270	1.4	15.3	7.2	294
2021 .....	249	0.5	0.0	250	1.5	17.2	7.2	276
2022 .....	237	0.6	0.0	238	2.2	17.2	7.2	264
2023 .....	225	0.6	0.0	226	2.9	17.2	7.2	253
2024 .....	214	0.7	0.0	214	3.6	17.2	7.2	242
2025 .....	203	0.8	0.0	204	4.3	17.2	7.2	233

**Table 5.1 US CO<sub>2</sub> 2017 and 2025 Targets in g/mi (g/km<sup>19</sup>)**

	MY 2017	MY 2025	Total %Δ (2017-25)
Passenger cars	212 (135)	143 (86)	-32.5%
Light Trucks	295 (194)	203 (129)	-31%
Combined	243 (157)	163 (101)	-33%

The US CO<sub>2</sub> targets include credits for air-conditioning gas with a low GWP and also incentives from introduction of low emission vehicles. In summary;

- Total credits in 2025 targets (comprise approx. 14% of targets);
  - Cars: 20 g/mi (12.4 g/km)
  - Light Trucks: 30 g/mi (18.6 g/km)
  - Combined: 23 g/mi (14.3 g/km)
- Air conditioning credits included in 2025 targets;
  - Cars: 18.8g/mi (11.7 g/km)

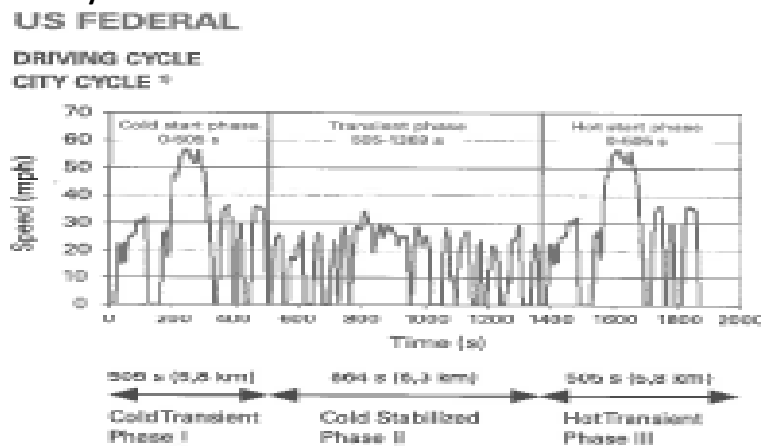
<sup>18</sup> US Federal Register/Vol. 77, No. 199/ Monday, October 15, 2012/ Rules and Regulations, pp. 62623-63200. Environmental Protection Agency 40 CFR Parts 85, 86 and 600, pp. 62771-62772

<sup>19</sup> Conversion undertaken using ICCT calculator available from [www.theicct.org/info-tools/global-passenger-vehicle-standards](http://www.theicct.org/info-tools/global-passenger-vehicle-standards)

- Light Trucks: 24.4g/mi (15.2 g/km)
- Off-cycle credits for technologies that achieve CO<sub>2</sub> reductions, but are not reflected in the test procedures included in 2025 targets;
  - Cars: 1.4 g/mi (0.87 g/km)
  - Light Trucks: 4.3 g/mi (2.67 g/km)

The NTSA CAFE standards (and US EPA standards) are based on the US FMVSS test drive cycle that is substantially different to the drive cycle used in the UN R101 (i.e. used by Australia and the EU).

**Figure 5.3 – US Drive Cycle<sup>20</sup>**



The CAFÉ standards use a footprint based approach where the standards (targets) to be met are based on emissions-footprint curves;

- Each vehicle model has a different CO<sub>2</sub> emission compliance target depending on its footprint value (related to the size of the vehicle). Generally, the larger the footprint, the higher the corresponding vehicle CO<sub>2</sub> emissions target.
- Each brand also has its own target based on the footprint curves and targets for each of their models and their annual sales.

<sup>20</sup> Delphi, 2015, Worldwide Emissions Standards for Passenger Cars and Light Duty Vehicles





## 6.0 GFEI Targets

The Global Fuel Economy Initiative (GFEI) is a UK based NGO with a target of halving CO<sub>2</sub> emissions from the global car fleet by 2050.<sup>22</sup>

For new light vehicles, the GFEI target is cut by half the fuel consumption of new passenger light-duty vehicles by 2030 (with a 2005 base year), from 8.3 L/100 km to 4.2 L/100 km.

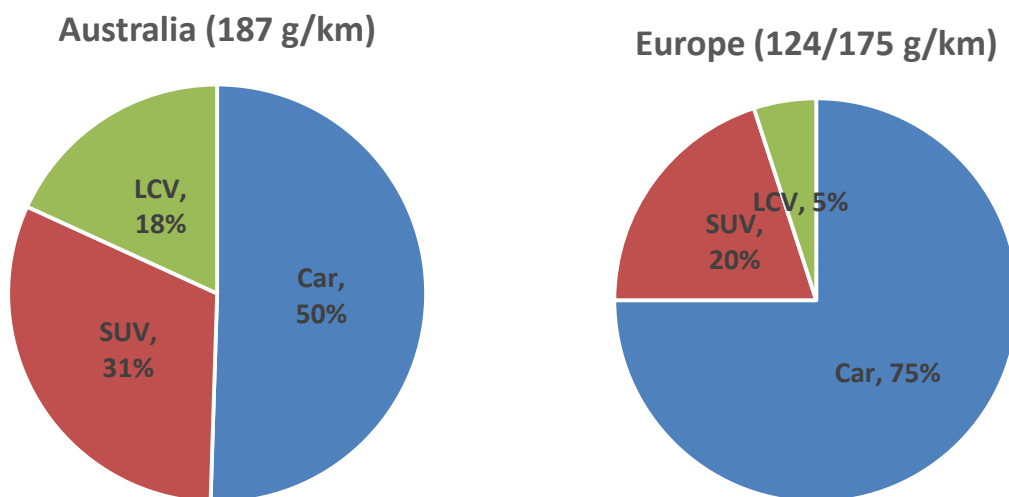
The Global Fuel Economy Initiative (GFEI) analysed the global fuel economy trends in OECD and non-OECD countries. The GFEI found that during the 8 year period of 2005 to 2013 the annual improvement rates were:

- For OECD countries; 2.6 per cent.
- For non-OECD countries; 0.2 per cent.
- Global average; 2.0 per cent.

## 7.0 Market Comparisons

The model mix in Australia is substantially different to that in the EU and is more in line with the US model mix, as shown in Figure 7.1

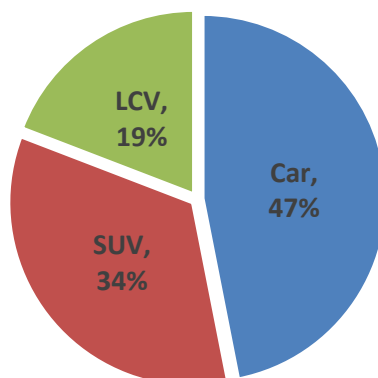
**Figure 7.1 - Model Mix; Aust vs EU & US (2014 sales and Car/LCV CO<sub>2</sub> emissions)<sup>23</sup>**



<sup>22</sup> Korner, A., Cazzola, P., Cuenot, F., (2014), International Comparison of light-duty vehicle fuel economy; Evolution over 8 years from 2005 to 2013, Working Paper 11

<sup>23</sup> Data supplied by GM-Holden

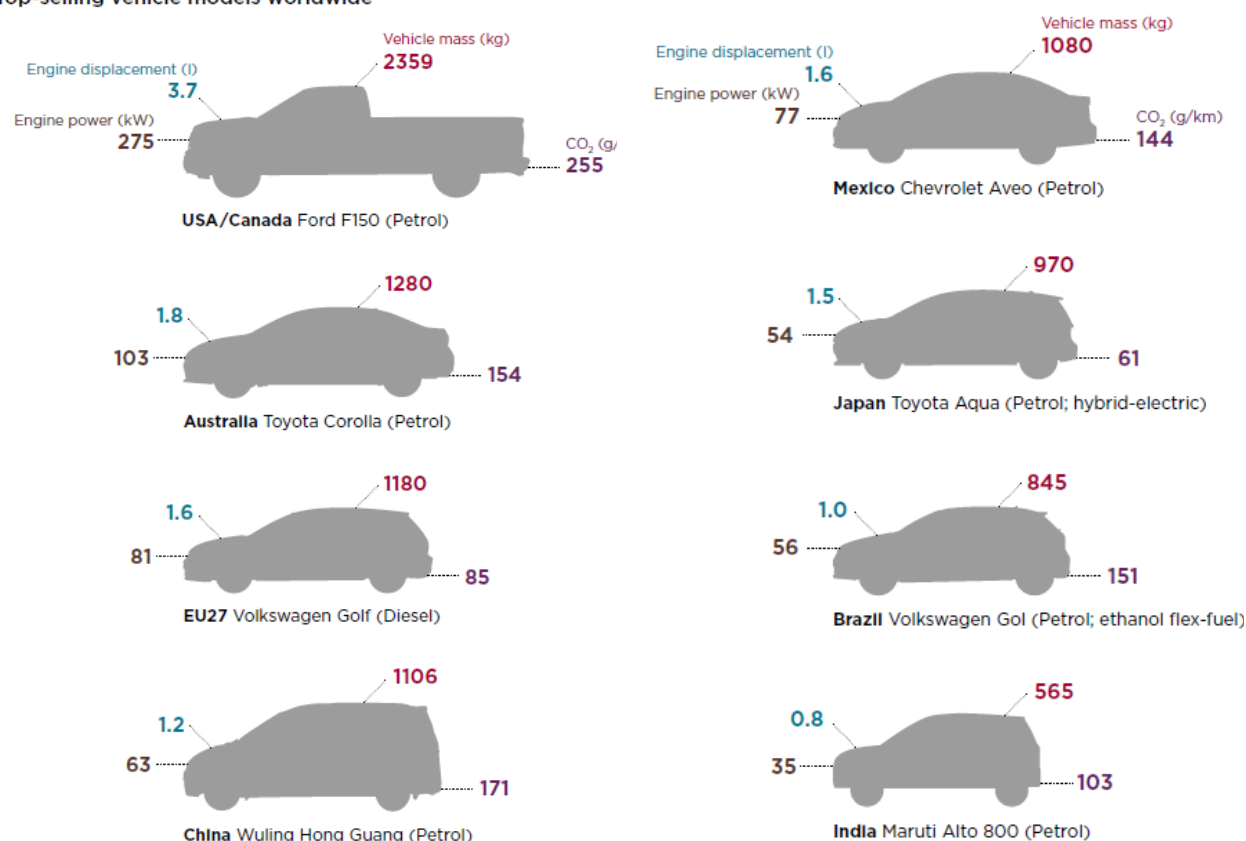
### USA (195/210 g/km)



The ICCT European Vehicle Market Statistics Pocketbook 2014<sup>24</sup> shows the substantial difference in top-selling models in various markets;

**Figure 7.2 – Top-selling models in various markets**

#### Top-selling vehicle models worldwide



<sup>24</sup> ICCT European Vehicle Market Statistics Pocketbook 2014, [www.theicct.org](http://www.theicct.org)

## **8.0 Conclusions**

CO<sub>2</sub> emissions from new light vehicles in Australia have decreased year-on-year and the new light vehicle fleet is now at least 25% more fuel efficient than it was in 2000.

This is comparable to other developed countries when compared on a like-for-like basis, i.e. exhaust emissions measured in a drive cycle test across the same market segments.

The CO<sub>2</sub> standard in both the EU and US include various credits and incentives to achieve their accelerated reductions.

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