

# Vehicle NO<sub>x</sub> emissions

## Reducing health impacts

Vehicles produce several harmful emissions while driving, including oxides of nitrogen (NO<sub>x</sub>), which directly impact human health and contribute to the formation of other harmful pollutants. The Australian Government estimates that, nationally, motor vehicles could contribute as much as 60-70 per cent of total NO<sub>x</sub> emissions<sup>1</sup>. Globally, governments are urgently looking at ways to reduce the impact of NO<sub>x</sub> and other harmful vehicle emissions to create cleaner and healthier air, and we must act too.

In the five years to 2020, the total motor vehicle fleet (including trucks and buses) in Australia grew by 10 per cent<sup>2</sup>, causing motor vehicles to be an increasing source of harmful emissions. Across the same period the proportion of diesel vehicles increased from 20 per cent to 25 per cent<sup>3</sup>. Diesel vehicles produce a disproportionately higher level of NO<sub>x</sub> than petrol, and electric vehicles.

In 2020, the world was impacted by the COVID-19 pandemic. During the lockdown periods, major cities saw significant reductions in traffic, improvements in local air quality, and decreases in localised air pollution. Across Europe, China and India, the European Space Agency reported significant nitrogen dioxide (NO<sub>2</sub>) reductions during these periods. Reductions of as much as 40 to 50 per cent in NO<sub>2</sub> levels were observed across major international cities including Rome, Madrid, Paris, Mumbai and Delhi<sup>4,5,6</sup>. Perth did experience a substantial decline in traffic volumes due to COVID-19 restrictions, which are likely to have impacted air quality. However, with the easing of restrictions, people increasingly returning to the office and the move away from public transport that has been witnessed, traffic returned to exceed pre-COVID levels by June and continued to increase towards the end of the year<sup>7</sup>.

### What is in our vehicle emissions?

During fuel combustion, vehicles emit a range of airborne pollutants such as NO<sub>x</sub>, carbon dioxide (CO<sub>2</sub>), hydrocarbon emissions (including methane, benzene, toluene, xylene, and benzo[a]pyrene), carbon monoxide (CO), oxides of sulfur (SO<sub>x</sub>)

and particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) that impact human health, as well as our environment. NO<sub>x</sub> collectively refers to nitrogen oxide compounds, predominantly nitric oxide (NO) and NO<sub>2</sub>. NO<sub>x</sub> reacts with hydrocarbons to create photochemical smog such as ozone (O<sub>3</sub>)<sup>8</sup> and PM<sub>2.5</sub>. It also reacts with substances in the atmosphere to form acid rain<sup>9</sup>.

#### What influences NO<sub>x</sub> formation?

The type and age of the vehicle and the fuel used (with diesel producing more NO<sub>x</sub> than petrol fuelled cars), the sulfur content in fuel, catalytic converters and particulate traps (devices designed to reduce the impact of the vehicle's emissions), oils and additives<sup>10</sup>, the number of kilometres driven, servicing and maintenance, as well as driving conditions and habits such as accelerating rapidly all impact NO<sub>x</sub> formation.

### Health impact of NO<sub>x</sub> emissions

Adverse effects of inhaling NO<sub>x</sub> include direct irritation and inflammation of the respiratory system, development or exacerbation of pre-existing asthma, as well as decreased immunity to respiratory infections such as colds, flu, and bronchitis, cardio-pulmonary disease, cardiovascular disease, allergies and organ inflammation<sup>11</sup>.

<sup>1</sup> Australian Government, 2016. Vehicle emissions standards for cleaner air, Draft Regulation Impact Statement December 2016. Accessed at [https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle\\_NOxious\\_Emissions\\_RIS.pdf](https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle_NOxious_Emissions_RIS.pdf)

<sup>2</sup> ABS, 2020. Motor vehicle census 2020, Cat. 93090, Table 1. Accessed at <https://www.abs.gov.au/AUSSTATS/abs@nsf/DetailsPage/9309031%20Jan%202020?OpenDocument>

<sup>3</sup> ABS, 2020. Motor vehicle census 2020, Cat. 93090, Table 5. Accessed at <https://www.abs.gov.au/AUSSTATS/abs@nsf/DetailsPage/9309031%20Jan%202020?OpenDocument>

<sup>4</sup> European Space Agency, 2020. Coronavirus lockdown leading to drop in pollution across Europe. Accessed at [https://www.esa.int/Applications/Observing\\_the\\_Earth/Copernicus/Sentinel-5P/Coronavirus\\_lockdown\\_leading\\_to\\_drop\\_in\\_pollution\\_across\\_Europe](https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Coronavirus_lockdown_leading_to_drop_in_pollution_across_Europe)

<sup>5</sup> European Space Agency, 2020. Nitrogen dioxide emissions over China. Accessed at: [http://www.esa.int/Applications/Observing\\_the\\_Earth/Copernicus/Sentinel-5P/COVID-19\\_nitrogen\\_dioxide\\_over\\_China](http://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/COVID-19_nitrogen_dioxide_over_China)

<sup>6</sup> European Space Agency, 2020. Air pollution drops in India following lockdown. Accessed at: [https://www.esa.int/Applications/Observing\\_the\\_Earth/Copernicus/Sentinel-5P/Air\\_pollution\\_drops\\_in\\_India\\_following\\_lockdown](https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Air_pollution_drops_in_India_following_lockdown)

<sup>7</sup> Based on Main Roads WA Traffic Data API (accessed on April - October 2020: <https://portal-mainroads.opendata.arcgis.com/datasets/ed270d2c2ef649ac99172d14879283fd>) traffic volumes on the state road network in Perth fell by 29 per cent below baseline levels (the median value for the corresponding day of the week, based on data for the 5-week period from 2 January to 6 February 2020) on a typical weekday (and as much as 40 per cent on a weekend day) in April 2020 when restrictions were at the toughest, exceeded baseline levels again by mid-June and continued to rise to 18 per cent above in late October 2020 (24 per cent for a weekend day).

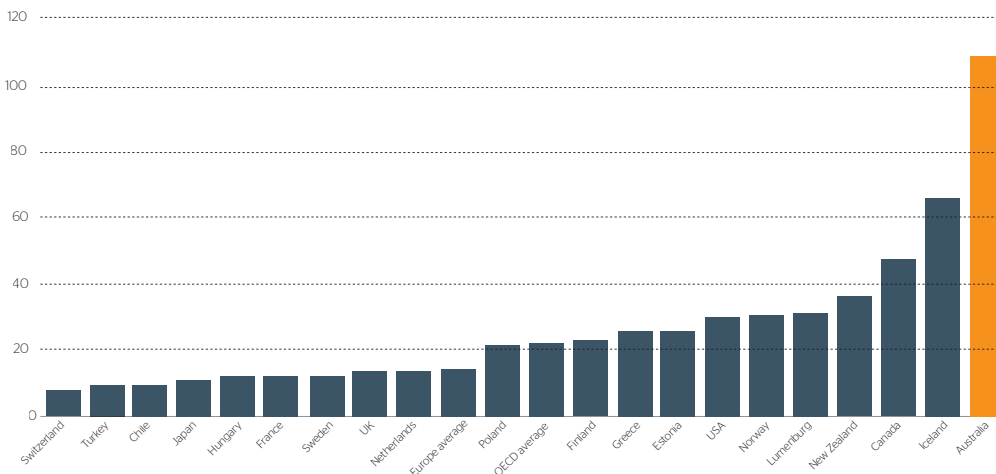
<sup>8</sup> Australian Government, Vehicle Emissions Discussion Paper 2016 at page 3. Accessed at [https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle\\_Emissions\\_Discussion\\_Paper.pdf](https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle_Emissions_Discussion_Paper.pdf)

<sup>9</sup> Tox Town US National Library of Medicine What are Nitrogen Oxides. Accessed at <https://toxtown.nlm.nih.gov/chemicals-and-contaminants/nitrogen-oxides>

<sup>10</sup> Phys.org, NO<sub>x</sub> gases in diesel car fumes: why are they so dangerous? Accessed at <https://phys.org/news/2015-09-NOx-gases-diesel-car-fumes.html>

<sup>11</sup> USA Environmental Protection Agency, 2016. Integrated Science Assessment (ISA) For Oxides of Nitrogen - Health Criteria (Final Report, 2016). Accessed at [http://ofmpub.epa.gov/eims/eimscmm.getfile?p\\_download\\_id=526855](http://ofmpub.epa.gov/eims/eimscmm.getfile?p_download_id=526855)

Figure 1: Global NOx emissions per capita (kgs) in 2017.



It is estimated air pollution<sup>12</sup> caused approximately 2,566 deaths in Australia in 2015, or 1.6 per cent of all deaths that year, with a greater impact on the elderly (65+)<sup>13</sup>. Further, air pollution is estimated to contribute to approximately 4.6 per cent of all cardiovascular disease, 1.6 per cent of all respiratory disease and 0.2 per cent of cancers<sup>14</sup>. Air pollution is the deadliest environmental risk factor Australians are exposed to<sup>15</sup>.

### How Australia compares

As shown in Figure 1, in 2017, Australia recorded the highest total NOx emissions per capita – over 108 kilograms – of all OECD countries; this is three times New Zealand’s per capita NOx emissions, over three and a half times the USA figure and over seven and a half times greater than the European average<sup>16</sup>.

NOx emissions continue to rise. If the increasing trend experienced since 2010 in Australia was to continue, road transport related NOx emissions could potentially increase by around 70 per cent from 2010 to 2030<sup>17</sup>.

Australia’s total NOx emissions from motor vehicles for 2018-19 was estimated to be 340,000 tonnes<sup>18</sup> - or roughly the weight of 20,000 Transperth buses<sup>19</sup>.

Under the current Australian regulations (the Australian Design Rules Standard 79/04), new diesel passenger vehicles being sold in Australia can emit three times the allowable NOx emissions limit for petrol passenger vehicles (180mg/km and 60 milligrams of NOx per km (60mg/km) respectively<sup>20</sup>), and new diesel light commercial vehicles are permitted to produce three and a half times the limit for comparative petrol vehicles<sup>21</sup>.

Australia’s NOx emission limits for new light vehicles, are based on Euro 5 standards. However, countries across Europe began phasing out Euro 5 standards and replacing them with more stringent Euro 6 limits in 2014. Euro 6 standards limit new light vehicle diesel NOx emissions at 80mg/km<sup>22</sup> - less than half of Australia’s current NOx limits. Further, ‘final stage’ more stringent Euro 7 emissions standards are in the planning stage, with implementation expected from late 2021<sup>23</sup>.

With diesel vehicles releasing significantly higher NOx emissions than petrol vehicles and with the number of registered diesel vehicles increasing to 25.6 per cent of the Australian fleet in 2019<sup>24</sup>, this will continue to be a challenge well into the future.

In WA, the situation is very similar, with diesel vehicles also increasing at a much greater rate. From 2015 to 2020, the total diesel vehicle fleet in the State increased by 21 per cent. In contrast, the total unleaded petrol vehicle fleet decreased by one per cent, and the overall vehicle fleet only increased by a total of four per cent – driven by the significant increase in diesel vehicles<sup>25</sup>.

<sup>12</sup> Attributed to a range of harmful pollutants emitted from all sources, not just NOx vehicle emissions.  
<sup>13</sup> Australian Government - Australian Institute of Health and Welfare, 2019, Australian Burden of Disease Study Impact and causes of illness and death in Australia 2015. Accessed at <https://www.aihw.gov.au/getmedia/c076f42f-61ea-4348-9c0a-d996353e838f/aihw-bod-22.pdf.aspx?inline=true>  
<sup>14</sup> Australian Government - Australian Institute of Health and Welfare, 2019, Australian Burden of Disease Study Impact and causes of illness and death in Australia 2015. Accessed at <https://www.aihw.gov.au/getmedia/c076f42f-61ea-4348-9c0a-d996353e838f/aihw-bod-22.pdf.aspx?inline=true>  
<sup>15</sup> Australian Government - Australian Institute of Health and Welfare, 2019, Australian Burden of Disease Study Impact and causes of illness and death in Australia 2015. Accessed at <https://www.aihw.gov.au/getmedia/c076f42f-61ea-4348-9c0a-d996353e838f/aihw-bod-22.pdf.aspx?inline=true>  
<sup>16</sup> OECD Data Air and GHG emissions. Accessed at <https://data.oecd.org/air/air-and-ghg-emissions.htm#indicator-chart>  
<sup>17</sup> RAC calculations based on Department of Industry, Science, Energy and Resources, Australian Petroleum Statistics, August 2020. Accessed at: <https://www.energy.gov.au/publications/australian-petroleum-statistics-2020>  
<sup>18</sup> Department of Environment and Energy, 2018/2019 data within Australia - Oxides of Nitrogen from Motor Vehicles. Accessed at: <http://www.npi.gov.au/hpdata/action/load/emission-by-source-result/criteria/substance/69/destination/ALL/source-type/DIFFUSE/subthreshold-data/Yes/substance-name/Oxides%20of%20Nitrogen/airshed-source/1/year/2019#>  
<sup>19</sup> Transperth, Get on Board. Accessed at <http://getonboard.transperth.wa.gov.au/Kids/Weird-and-wonderful-facts#--text=Did%20you%20know%20a%20busas%20heavy%20as%2011%20hippos>.  
<sup>20</sup> Australian Government, 2016. Vehicle emissions standards for cleaner air, Draft Regulation Impact Statement December 2016. Accessed at [https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle\\_NOxious\\_Emissions\\_RIS.pdf](https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle_NOxious_Emissions_RIS.pdf)  
<sup>21</sup> Australian Government, 2016. Vehicle emissions standards for cleaner air, Draft Regulation Impact Statement December 2016. Accessed at [https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle\\_NOxious\\_Emissions\\_RIS.pdf](https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle_NOxious_Emissions_RIS.pdf)  
<sup>22</sup> Australian Government, 2016. Vehicle emissions standards for cleaner air, Draft Regulation Impact Statement December 2016. Accessed at [https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle\\_NOxious\\_Emissions\\_RIS.pdf](https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle_NOxious_Emissions_RIS.pdf)  
<sup>23</sup> European Commission, 2020. Development of post-Euro 6/VI emission standards for cars, vans, lorries and buses. Accessed at: <https://ec.europa.eu/info/law/better-regulation/>  
<sup>24</sup> ABS, 2020. Motor vehicle census 2020, Cat. 93090, Table 5. Accessed at <https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/93090.031%20Jan%202020?OpenDocument>  
<sup>25</sup> ABS, 2020. Motor vehicle census 2020, Cat. 93090, Table 5. Accessed at <https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/93090.031%20Jan%202020?OpenDocument>

A WA State Government air emissions study, undertaken in Perth in 2011-12, showed vehicles were responsible for 39 per cent of all NOx emissions across the Perth metropolitan area, with NOx emissions heavily concentrated along major freeways and highways<sup>26</sup>.

The lack of availability of air quality and emissions monitoring and data in Australia is of concern. Given the projected increases in emissions and the impact on our health, access to monitoring and information is vital for assessing and implementing change.

### Where we stand

RAC is committed to ensuring safe, sustainable and connected mobility for all Western Australians through our social impact activities which seek to:

- » Save lives and serious injuries occurring on our roads.
- » Reduce harmful vehicle emissions for cleaner, healthier air.
- » Ensure well-planned communities and transport that connects people and places.

Australia is facing a huge challenge in tackling harmful vehicle emissions, which is why we need a roadmap from government on how we can accelerate the transition to cleaner transport through policy, investment and incentives.

RAC encourages the Australian Government to continue the progression of the Ministerial Forum on Vehicle Emissions (Ministerial Forum). The Ministerial Forum was established in 2015 *“to coordinate a whole-of-government approach to addressing emissions from motor vehicles”*<sup>27</sup>.

The Ministerial Forum began reviews of several important pieces of work relating to reducing vehicle emissions including improving the efficiency of new light vehicles; strengthening noxious emissions standards for light and heavy vehicles; and improving fuel quality standards. Only fuel quality standards have been finalised by the Ministerial Forum, however government should consider implementing the decrease in allowable sulfur content in fuel, from 150ppm to 10ppm earlier than the anticipated start date of 2027 to align with the current limit in jurisdictions such as Europe, North America and China. Each element of the Ministerial Forum is vital to reducing the impact of vehicles on the environment and our health.

Internationally, and most notably in Europe, initiatives to reduce NOx emissions include:

- » Reducing allowable NOx emissions such as through Euro 6 (and similar) regulations for new vehicles<sup>28</sup>.
- » Improving vehicle testing regulations (Worldwide harmonized Light-duty vehicles Test Procedure (WLTP)) to better capture real world emissions of new vehicles<sup>29</sup>.
- » Improving fuel quality regulations, with a focus on reducing allowable sulfur content<sup>30</sup>.
- » Providing policy and incentives to accelerate the transition to cleaner transport, including increasing the uptake of zero and low emission vehicles.
- » Banning the sale of new internal combustion engine (ICE) vehicles - at least 17 countries throughout Europe and Asia, and more than 25 states / provinces and cities have announced bans on the sale of these vehicles from 2025-2040<sup>31,32</sup>.

### RAC supports

- » Improved air quality monitoring in urban and regional areas through an increase in monitoring stations and their locations.
- » The introduction of an impactful national emissions standards for new light vehicles (such as for CO<sub>2</sub> and NOx), bringing Australia in line with the rest of the developed world.
- » Improved fuel quality standards, which generate less CO<sub>2</sub>, NOx, SOx, hydrocarbons, CO, and PM emissions when used.
- » Ensuring a long-term pathway for increasing minimum fuel octane levels in Australia; enabling widespread use of higher octane fuels such as 95 RON and 98 RON, allowing for greater adoption of technologies enhancing engine efficiency, improving fuel economy and lowering emissions.
- » An effective and easy to understand emissions rating system to ensure consumers have access to vehicle emissions and fuel consumption information when making new car purchasing decisions.
- » Appropriate and attractive incentives for low and zero emission vehicles supported by a well-planned transition to appropriate renewable electricity generation.
- » Congestion management and the promotion of public and active transport, as well as planning and design practices to reduce the need to travel so far and so often.

<sup>26</sup> Department of Water and Environmental Regulation, Perth Air Emissions Study 2011-2012: Oxides of nitrogen (NOx). Accessed at [https://www.derwa.gov.au/images/documents/our-work/programs/Perth\\_Air\\_Emissions/Perth\\_Air\\_Emissions\\_Study\\_2011-12\\_-\\_Oxides\\_of\\_nitrogen\\_factsheet.pdf](https://www.derwa.gov.au/images/documents/our-work/programs/Perth_Air_Emissions/Perth_Air_Emissions_Study_2011-12_-_Oxides_of_nitrogen_factsheet.pdf)

<sup>27</sup> Department of Infrastructure, Transport, Regional Development and Communications, Ministerial Forum on Vehicle Emissions. Accessed at <https://www.infrastructure.gov.au/vehicles/environment/forum/index.aspx#:~:text=In%20October%202015%2C%20the%20Australian,addressing%20emissions%20from%20motor%20vehicles.>

<sup>28</sup> Australian Government, 2016. Vehicle emissions standards for cleaner air, Draft Regulation Impact Statement December 2016. Accessed at [https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle\\_NOxious\\_Emissions\\_RIS.pdf](https://www.infrastructure.gov.au/vehicles/environment/forum/files/Vehicle_NOxious_Emissions_RIS.pdf)

<sup>29</sup> ICCT, 2016. NOx emissions from heavy-duty and light-duty diesel vehicles in the EU: Comparison of real-world performance and current type-approval requirements. Accessed at [https://theicct.org/sites/default/files/publications/Euro-VI-versus-6\\_ICCT\\_briefing\\_06012017.pdf](https://theicct.org/sites/default/files/publications/Euro-VI-versus-6_ICCT_briefing_06012017.pdf)

<sup>30</sup> ICCT, 2013. The impact of stringent fuel and vehicle standards on premature Mortality and emissions. Accessed at [https://theicct.org/sites/default/files/publications/ICCT\\_HealthClimateRoadmap\\_2013\\_revised.pdf](https://theicct.org/sites/default/files/publications/ICCT_HealthClimateRoadmap_2013_revised.pdf)

<sup>31</sup> ICCT, 2020. The end of the road? An overview of combustion engine car phase-out announcements across Europe. Accessed at <https://theicct.org/sites/default/files/publications/Combustion-engine-phase-out-briefing-may11.2020.pdf>

<sup>32</sup> Greentech Media, 2018, How Internal Combustion Engines Will Die Out in Eurasia. Accessed at <https://www.greentechmedia.com/articles/read/how-internal-combustion-engines-will-die-out-in-eurasia>