



Australian Government

Department of Climate Change, Energy,
the Environment and Water

Better fuel for cleaner vehicles

Draft Regulation Impact Statement for
consultation

November 2022



© Commonwealth of Australia 2022

Ownership of intellectual property rights

Unless otherwise noted, copyright (and any other intellectual property rights) in this publication is owned by the Commonwealth of Australia (referred to as the Commonwealth).

Creative Commons licence

All material in this publication is licensed under a Creative Commons Attribution 4.0 International Licence, save for content supplied by third parties, logos, any material protected by trademark or otherwise noted in this publication, and the Commonwealth Coat of Arms.

Creative Commons Attribution 4.0 International Licence is a standard form licence agreement that allows you to copy, distribute, transmit and adapt this publication provided you attribute the work. A summary of the licence terms is available from <https://creativecommons.org/licenses/by/4.0/>

The full licence terms are available from <https://creativecommons.org/licenses/by/4.0/legalcode>



Cataloguing data

This publication (and any material sourced from it) should be attributed as: *Better fuels for cleaner vehicles: Draft regulation impact statement for consultation*, Department of Climate Change, Energy, the Environment and Water, Canberra, 2022. CC BY 4.0.

This publication is available at <https://consult.dcceew.gov.au/better-fuel-for-cleaner-vehicles>

Department of Climate Change, Energy, the Environment and Water

GPO Box 3090 Canberra ACT 2601

Telephone 1800 900 090 Web dcceew.gov.au/about/publications

Disclaimer

The Australian Government acting through the Department of Climate Change, Energy, the Environment and Water has exercised due care and skill in preparing and compiling the information and data in this publication. Notwithstanding, the Department of Climate Change, Energy, the Environment and Water, its employees and advisers disclaim all liability, including liability for negligence and for any loss, damage, injury, expense or cost incurred by any person as a result of accessing, using or relying on any of the information or data in this publication to the maximum extent permitted by law.

Acknowledgement of Country

We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.

Contents

1. About this draft Regulation Impact Statement	1
1.1 Making a Submission.....	1
2. Executive summary	2
2.1 The problem: Australia’s petrol quality may not enable Euro 6d standards	2
2.2 Why is Government action needed?.....	3
2.3 Policy objectives	4
2.4 Cost benefit analysis.....	4
2.5 The Department’s preferred option.....	4
3. What problem is the Government trying to solve?	5
3.1 Australia’s current petrol standards do not align with international best practice.....	6
3.2 Fuel security and fuel quality	12
4. Why is Government action needed?	13
4.1 Improving fuel quality could address health and environmental externalities	13
4.2 Improvements to Australia’s fuel can unlock the benefits of Euro 6d.....	13
5. What policy options are under consideration?	14
5.1 Business as usual	14
5.2 Option 1 (91 RON: 35% maximum aromatics, 95 RON: 35% grade average)	14
5.3 Option 2 (95 RON: 35% maximum aromatics)	14
5.4 Option 3 (35% maximum aromatics limit across all grades).....	15
5.5 Technical pathways to reduce aromatics in 98 RON considered but not costed	15
5.6 Option 4: Diesel.....	16
6. What are the likely net benefits of each option?	17
6.1 Petrol	17
6.2 Diesel (Option 4).....	19
6.3 Consumer price impact of the options.....	20
6.4 Regulatory burden measurement	21
6.5 Unquantified benefits	22
7. Consultation	23
7.1 Stakeholders.....	23
7.2 Regular consultation	23
7.3 Issues raised	23
8. The Department’s proposed approach	25
8.1 What is the best option from those considered?	25
8.2 Petrol	26
8.3 Diesel.....	26
8.4 Regulatory burden of the best option.....	27
8.5 What the Department's preferred option would achieve	27
9. Implementation of the preferred option	28
9.1 Changes for motorists	28
9.2 Changes for vehicle importers	29

9.3 Changes for service stations.....	30
9.4 Changes for refineries	30
9.5 Changes for fuel importers.....	30
9.6 Assessing compliance with improved fuel quality standards	31
9.7 Shifts in petrol demand by grade	31
9.8 Evaluation.....	32
10. Privacy and submissions	33
11. Appendix A - Further information on the cost benefit analysis.....	34
11.1 Costs associated with using ethanol as an octane enhancer for 98 RON in Option 3.....	34
11.2 Benefits from reduced health costs.....	35
11.3 Unquantified benefits	36
11.4 CBA sensitivity analysis	37
11.5 Distributional impact analysis.....	38
11.6 Sources.....	40
11.7 Assumptions.....	41
Appendix B - Stakeholder groups consulted	45
Appendix C - List of consultation questions.....	46

Tables

Table 1 Key petrol specifications in Australia and comparable countries	6
Table 2 Australian fuel quality sampling data 2021–22.....	7
Table 3 Key diesel specifications in Australia and comparable countries.....	10
Table 4 Australian diesel quality sampling data 2021–22	10
Table 5 Net present value of costs and benefits of petrol options to 2040.....	17
Table 6 Net present value of costs and benefits of diesel options to 2040 (Option 4)	19
Table 7 Import price parity increase for each option	20
Table 8 Regulatory burden estimate summary (\$m/year)	22
Table 9 Outcomes from consultation	24
Table 10 Summary of the policy assessment criteria outcomes	25
Table 11 Discount rate sensitivity analysis.....	37
Table 12 Impact of different BaU cases with a 7% discount rate	38
Table 13 Key assumptions.....	42

Figures

Figure 1 Links between fuel quality, vehicle technology and noxious emissions.....	2
Figure 2 Maximum aromatics limit in petrol per country – 2021.....	7
Figure 3 Maximum aromatics content for the global light duty vehicle fleet	8
Figure 4 Real petrol price increase for motorists under various petrol options.....	21
Figure 5 Option 1 – 91 RON distributional analysis total cost and benefits (NPV) to 2040.....	39
Figure 6 Option 2 – 95 RON distributional analysis total cost and benefits (NPV) to 2040.....	39
Figure 7 Option 3 – 91/95/98 RON distributional analysis total cost and benefits (NPV) to 2040 ...	39
Figure 8 Option 4 – Diesel quality distributional analysis total cost and benefits (NPV) to 2040.....	40
Figure 9 Estimated refinery expenditure for each option	44

List of abbreviations and select glossary

91 RON	unleaded petrol which has a RON of at least 91
95 RON	premium unleaded petrol which has a RON of at least 95
98 RON	premium unleaded petrol which has a RON of at least 98
ADR	Australian Design Rules
BaU	business as usual
BCR	benefit-cost ratio
CBA	cost benefit analysis
CO ₂	carbon dioxide
cpl	(Australian) cents per litre
DCN	derived cetane number
DI	direct injection (engine)
Department	Department of Climate Change, Energy, the Environment and Water
DITRDCA	Department of Infrastructure, Transport, Regional Development, Communications and the Arts
draft RIS	draft Regulation Impact Statement
E10 98 RON	premium unleaded petrol which has a RON of at least 98, and which contains up to 10% ethanol
EN 228	European Committee for Standardisation (CEN) Automotive fuels – Unleaded Petrol – Requirements and Test Methods
EN 590	German Institute for Standardization (DIN) Automotive fuels – Diesel – Requirements and Test Methods
ETBE	ethyl tertiary butyl ether (an octane enhancer)
Euro 6d standards	Euro 6d vehicle noxious emissions standards
Euro 6d vehicles	vehicles that are capable of meeting Euro 6d noxious emissions standards
EV	electric vehicle
IPP	import parity price
MTBE	methyl tertiary butyl ether (octane enhancer)
NMA	N-methyl aniline (octane enhancer)
NPV	net present value
OBPR	Office of Best Practice Regulation
PAH	polycyclic aromatic hydrocarbons
PM	particulate matter (a noxious emission)
PPF	petrol particulate filter
ppm	parts per million by weight
PULP	premium unleaded petrol (which has a RON of at least 95)
RON	Research Octane Number
RULP	regular unleaded petrol (which has a RON of at least 91)
RVP	Reid vapour pressure
ULP	unleaded petrol

1. About this draft Regulation Impact Statement

The Department of Climate Change, Energy, the Environment and Water (the Department) has prepared this draft Regulation Impact Statement (draft RIS) for consultation. The draft RIS seeks feedback on the policy options to improve fuel quality to implement Euro 6d light vehicle noxious emissions standards (Euro 6d standards). The Department is seeking to implement an option that would allow introduction of Euro 6d standards at the lowest cost to consumers and without compromising Australia's fuel security.

This draft RIS is a consultation document. The Office of Best Practice Regulation (OBPR) has not approved this document. This document does not represent a Government decision nor formal Government policy. The Department is undertaking this stakeholder consultation to inform a final Regulation Impact Statement (final RIS) which will help to provide:

- feedback on assumptions used in the cost benefit analysis modelling from the Government's fuel quality standards review
- information on implementation complexities of the Department's preferred option.

After consulting on this draft RIS, the Department and the Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA) will develop a final RIS. The final RIS will consider both improved fuel quality standards and introducing Euro 6d standards. The OBPR will assess the final RIS. This will provide Government with a clear understanding of the costs and benefits of introducing these changes together so an informed decision can be made.

1.1 Making a Submission

The Department seeks views and further evidence regarding the policy options, including the preferred option outlined in Section 8. This will provide the Government with up-to-date information about the benefits and impacts of making changes to Australia's fuel quality standards.

Throughout this draft RIS and consolidated at [Appendix C](#), there are questions to consider in your submission. There is no obligation to answer any or all of the consultation questions, and there is no limit on the length of submissions. You may also provide any additional comments or information.

This draft RIS was published on <https://consult.dcccew.gov.au/better-fuel-for-cleaner-vehicles>. Stakeholders with an evident interest in the consultation process have been notified by the Department.

Following the public consultation period, the Department will consider your feedback. Feedback will inform the preferred policy option before the Department gives further advice to Government.

How to make a submission

We invite your views on the goals, aims and actions for improving Australia's fuel quality standards. You can make submissions via our Consultation Hub by clicking the *Make a Submission* button. The Department will publish submissions online after the consultation closes. You can request that your submission remain confidential and not published.

This consultation period will close on **Friday, 16 December 2022**.

2. Executive summary

The Australian Government regulates the quality of petrol and diesel sold in Australia to:

- reduce noxious emissions from vehicles
- allow the introduction of better vehicle technologies
- allow effective operation of engines.

Poor fuel quality can damage the environment, vehicles and our health. Fuel quality and vehicle noxious emissions^a standards are closely linked as fuel quality is critical to vehicle engine performance and effective emissions controls.

2.1 The problem: Australia's petrol quality may not enable Euro 6d standards

An estimated 620 Australians died because of transport-related air pollution in Australia in 2015, which cost our economy approximately \$9.2 billion.¹ There is a substantial public health benefit (with a net present value (NPV) of \$4.9 billion from 2025 to 2050²) in implementing Euro 6d standards by reducing the noxious emissions released by light vehicles. It also would provide Australians access to the latest petrol engine technology. There is a risk for consumers that Australia's current fuel quality may impact the operability of new vehicles that meet Euro 6d standards (Euro 6d vehicles).

Figure 1 Links between fuel quality, vehicle technology and noxious emissions



^a Noxious emissions are pollutants that can impact on air quality and health, such as particulate matter, carbon monoxide and oxides of nitrogen and sulfur.

Australia's petrol standards differ from those in most Organisation for Economic Co-operation and Development (OECD) nations on two key parameters: sulfur and aromatics.

- Australia's standards allow up to 150 parts per million sulfur in regular unleaded petrol, and 50 parts per million sulfur in premium unleaded petrol. The Government recently announced that from 15 December 2024, the sulfur limit in Australia's petrol standard will reduce to 10 parts per million (ppm) across all grades. This will align sulfur in Australian petrol with international best practice.
- Australia's maximum limit of aromatic hydrocarbons (aromatics) in petrol is 45%, with a maximum pooled average content of 35%.^b 85% of the global light vehicle fleet is sold in countries that have a maximum petrol aromatics content of 35%. The reduction of aromatics is the main consideration of this draft RIS.

The Federal Chamber of Automotive Industries (FCAI) represents the views of light vehicle importers in Australia. The FCAI have stated that vehicle importers cannot import the latest vehicle technology into the Australian market without higher quality fuels being available. This is because Euro 6d vehicles require ultra-low sulfur, low aromatics (35% maximum) and high octane (minimum 95 RON) to achieve the best performance and longevity.³

Australia represents around 1% of the global vehicle market. Larger vehicle markets, such as Europe, the US and China, drive vehicle technology development through their regulatory decisions. These markets use petrol limited to 35% aromatics, and require noxious emissions standards and fleet fuel efficiency standards to be met.

There is limited scientific evidence on whether the higher aromatics in Australian petrol would cause problems in Euro 6d vehicles. Closer harmonisation with international standards, where practical, would reduce the risk to consumers of vehicle operability issues using Australian fuel. It would also allow vehicle importers to provide Euro 6d vehicles without additional testing for our relatively small vehicle market.

Australia's diesel standard is also not aligned with the EU standard. The analysis investigated whether the quality of Australia's diesel impacts the operability of Euro 6d light duty diesel vehicles.

2.2 Why is Government action needed?

Market pressures alone will not improve fuel quality. The price of fuel does not account for the costs of health and environmental impacts caused by the release of noxious emissions from the fuel's combustion. In economic terms, this is a negative externality. Noxious emissions are also not front of mind for many motorists considering buying a new vehicle. This means there is minimal market demand for vehicle importers to take a risk on operability and warranty issues by providing Euro 6d vehicles in Australia. There is also little incentive for fuel retailers to provide better quality fuel than mandated. Government intervention is the first step towards achieving the benefits of improved fuel quality.

None of the changes to Australian fuel standards being considered will require motorists to change the fuel they use in existing vehicles. Changes to standards will only impact the fuel required for new vehicles if Euro 6d standards commence.

^b This is the average amount of aromatics in all batches of petrol across all grades manufactured in Australia, or imported, by a supplier in each 12 months starting on 1 January.

2.3 Policy objectives

The Department considered four assessment criteria when developing the policy options:

- facilitating fuel quality standards that enable the implementation of Euro 6d standards
- ensuring the most effective operation of engines
- minimising regulatory burden
- maximising net national benefits, with a focus on minimising costs to consumers.

2.4 Cost benefit analysis

In 2021, the Government completed a cost benefit analysis (CBA) to identify the costs and benefits of lowering the aromatics limit in petrol and changing the diesel specifications. The CBA includes a detailed analysis of the costs and benefits for:

- individuals (including motorists)
- non-government organisations
- businesses (including fuel suppliers).

Implementing the policy reforms would have cost impacts on Australia's petroleum refining industry, so the CBA also looked at wider considerations around fuel security.

The Department analysed three petrol options and one diesel option.

1. Option 1 has the lowest implementation cost but does not reduce the maximum aromatics limit of 95 RON and 98 RON. This option would not enable Euro 6d standards.
2. Option 2 is the Department's preferred option. Reducing aromatics in 95 RON to 35% maximum is the lowest cost option that produces the greatest net benefit if the Government implements Euro 6d standards.
3. Option 3 would enable all grades of petrol to meet the requirements for Euro 6d standards. The costs for option 3 are around six times more than the preferred option and could not be implemented until 2027. It would also result in a price increase for all petrol grades.
4. Option 4 would align key diesel parameters to European standards. Consultation with industry and analysis determined that no changes to the diesel standard are required to enable Euro 6d standards.

2.5 The Department's preferred option

Based on consideration of the policy assessment criteria and the results of the CBA, the Department's preferred option for petrol is to introduce a 35% aromatics limit for 95 RON. Reducing the maximum aromatics content of 95 RON to 35% would:

- maintain access to all petrol and diesel vehicles, and enable sale of the cleanest engines and newest technology in Australia
- have no cost impacts for anyone who currently uses 91 RON or 98 RON petrol or diesel
- mitigate risks of vehicle operability issues for more than 99% of new vehicles through aligning the 95 RON grade with international best practice
- enable an NPV of up to \$4.9 billion to 2050 by reducing health costs through introducing Euro 6d standards.

The Department is recommending no changes to the diesel fuel standard. The current diesel quality is not a barrier to the implementation of Euro 6d standards. A change to current settings would increase refinery production costs, as well as the price paid by consumers and the road transport sector.

3. What problem is the Government trying to solve?

Australia's fuel quality and noxious emissions standards:

- affect emissions from our vehicles
- impact the quality of the air we breathe
- influence the type and range of vehicles supplied to Australian consumers.

Australia's current fuel standards could lead to Australian fuel occasionally having adverse impacts on the operation of vehicle emission control systems. This could result in increased noxious and greenhouse gas (GHG) emissions and vehicle operability issues. This presents a barrier to the implementation of world leading Euro 6d standards. Closer alignment of Australia's petrol quality standards with best-practice international standards would ensure that the latest vehicle emission control systems operate effectively. It would also provide access to more advanced vehicle technologies with better emission control systems and more fuel-efficient engines.

In 2020, the then Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) released a draft RIS on the introduction of Euro 6d standards from 2027. When compared to Euro 5 standards, Euro 6d imposes stricter limits on nitrogen oxides (NO_x) and particulate matter (PM) and on-board diagnostic thresholds. Euro 6d standards also require more robust emissions-testing arrangements. To meet these standards, vehicle importers design Euro 6d vehicles with advanced fuel efficiency and emission control systems. In 2021, DITRDCA also evaluated the costs and benefits of a possible 2025 introduction. This analysis will be published in the final RIS.

Fuel quality and vehicle emission control systems

Exhaust Emissions Controls

Vehicle emissions control technologies are components of a vehicles exhaust system designed to limit noxious emissions released into the environment. Globally, emissions regulations and fuel standards have evolved in tandem because fuel quality and emissions control technologies function as a system to reduce emissions. Improved fuel quality has allowed the development of new technologies that take advantage of the cleaner fuel. Also, as emissions systems have improved, better fuel quality is required because some components of fuel can interfere with emissions control systems.

Engine Technology for Emissions Reduction - Catalytic Converters

Light duty petrol cars use 'Three Way Catalytic Converters' to convert pollutant gases formed during combustion into less harmful compounds. A catalytic converter can reduce emissions of carbon monoxide, unburnt hydrocarbons and nitrogen oxides (NO_x). Sulfur in fuel can reduce the efficiency of a catalyst, leading to increased emissions of these pollutants. Prolonged use of high sulfur fuel can reduce the life of a catalyst. Sulfur can interfere with the on-board diagnostic system of catalysts, leading to a false indication that the catalyst is malfunctioning.

Petrol particulate filters (PPFs) in Euro 6d vehicles

Most vehicles designed to meet the latest Euro 6d standards come equipped with a PPF to meet strict particle emissions limits. PPFs are a device within a vehicle's exhaust system that reduces exhaust emissions by trapping fine particles. This prevents their release into the atmosphere. When exhaust gasses make their way through the device, the honeycomb filter traps excess nitrous oxide, carbon monoxide and hydrocarbon particulates. Due to the high temperature of the filter, these are all burned off, giving off water, nitrogen and carbon dioxide in the process. PPFs are highly efficient, capturing more than 90% of airborne particulates. Very few vehicles currently sold in Australia are fitted with a PPF. This is mainly due to Australia's current standards not requiring the use of PPFs, and vehicle importer concerns around Australia's high sulfur levels clogging these filters. There are also concerns around the impacts of high levels of aromatics in petrol.⁴

Changes to fuel quality standards would have impacts on a diverse mix of stakeholders. These include the community (through environmental factors such as air quality), motorists, refineries, and the petroleum supply chain. The Department developed the options assessed in the CBA through consultation with key stakeholders using tailored questions, literature reviews and commissioned studies (see section 7 for further details). The Department seeks to engage with stakeholders on any potential impacts through consultation on this draft RIS.

3.1 Australia's current petrol standards do not align with international best practice

Australia's petrol standards do not align with international best practice in two key parameters: sulfur and aromatics (see table 1).

Sulfur in petrol can interfere with a vehicle's catalytic converter, decreasing the efficiency, effectiveness and lifetime of the part. Sulfur is also a contaminant for petrol particulate filters (PPFs), which are generally used in Euro 6d vehicles. From 15 December 2024, Australia's sulfur limit will align with international best practice at 10 ppm. Further consideration of the sulfur specification is out of scope for this analysis.

Aromatic hydrocarbons (aromatics) are a natural part of crude oil. Aromatics are an important element in petrol blending because it is a key source of highly valued octane. When combusted in an engine, aromatics in fuel generate particulate matter. At high levels, this can impact vehicle operability and human health. Australia's current aromatics limit allows 45% maximum aromatics and a 35% maximum pooled average.^c

Table 1 Key petrol specifications in Australia and comparable countries

	Australia ^d	South Korea ^e	Japan ^f	EU ^g	US ^h
Aromatics (max)	35% pool average with a max of 45%	22%	Not specified (Real world average around 25%) ⁱ	35%	35% California Not specified in US standards (The US Renewable fuel mandates ethanol blending, which lowers aromatics)
Sulfur (max)	RULP: 150 ppm PULP: 50 ppm From 2024: 10 ppm ^j	10 ppm	10 ppm	10 ppm	10 ppm (annual refiner average)

^c This is the average amount of aromatics in all batches of petrol across all grades manufactured in Australia, or imported, by a supplier in each 12 months starting on 1 January.

^d Australia, Fuel Quality Standards Act 2000: Fuel Standard (Petrol) Determination, Fuel Standard (Automotive Diesel) Determination.

^e South Korea, Clean Air Conservation Act: 2010.

^f Japan, TransportPolicy.net webpage: Japan: Fuels: Diesel and Gasoline | Transport Policy.

^g European Union, Directive 98/70/EC as amended, EN 228:2012.

^h USA, Petrol: Title 40 Part 1090 Subpart C - Code of Federal Regulations (ecfr.io); USA, Diesel - 40 CFR § 1090.305 ULSD standards - Code of Federal Regulations (ecfr.io).

ⁱ Hart, International Fuel Quality Standards and Their Implications for Australian Standards (Final Report), 2014.

^j Regular unleaded petrol (RULP), parts per million by weight (ppm) and premium unleaded petrol (PULP). Australia has already committed to reducing the maximum concentration in all grades of unleaded petrol to 10 ppm in 2024.

Table 2 provides average values for key petrol quality parameters. The data comes from fuel samples taken at service stations around Australia in 2021–22. It shows that Australia’s real world petrol quality is significantly better than the regulated minimum standards. However, our real world quality still fails to meet international best practice on maximum limits of aromatics and sulfur.

Table 2 Australian fuel quality sampling data 2021–22^k

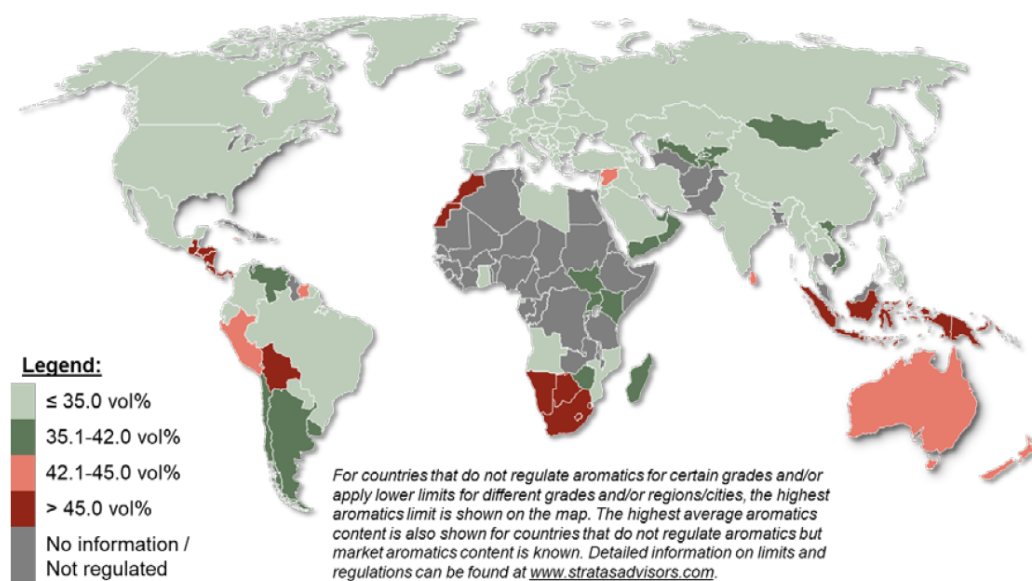
Grade	91 RON	95 RON	98 RON	E10
Average aromatics (%)	26.2	32.6	37.0	23.9
Maximum aromatics (%)	44.3	42.0	44.6	40.6
Average sulfur (ppm)	43.4	19.7	15.4	32.2
Maximum sulfur (ppm)	169	50	64	132

3.1.1 International aromatics limits

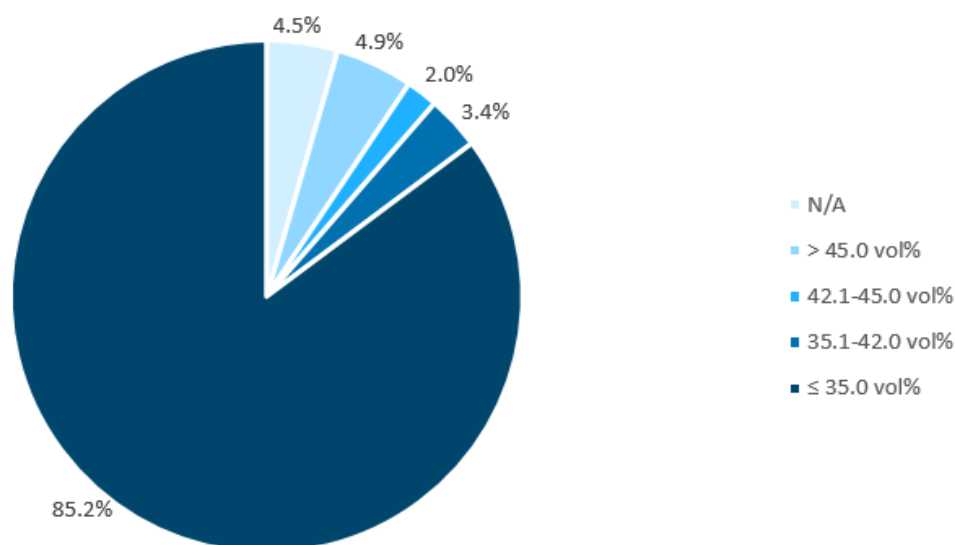
Research undertaken for this study suggests that approximately 85% of the global light duty vehicle fleet is in countries with maximum petrol aromatics content of 35% (see Figure 2 and Figure 3).⁵ Of the 195 countries and 28 territories with vehicle markets, 174 have petrol specifications in place. Of these, 134 have either an aromatics limit in place or available market information on their maximum aromatics content. Eighty-seven (64.9%) have set a 35% aromatics limit or have market content of 35% aromatics or lower. Top petrol car markets including the US, China, Japan, Brazil, Russia, Germany, Mexico, Canada, India and the United Kingdom, have set a 35% aromatics limit or have market content of 35% aromatics or lower. Figure 2 shows aromatics content in petrol globally.⁶

The global regulation of aromatics has implications for the vehicle market in Australia. Euro 6d vehicles are designed and tested for lower aromatics petrol and sold to markets with lower aromatics content in petrol. As a result, vehicle importers are hesitant to introduce Euro 6d vehicles to countries with higher aromatics, such as Australia, where there is a higher potential for engine operability issues.

Figure 2 Maximum aromatics limit in petrol per country – 2021



^k Unpublished data from the National Measurement Institute.

Figure 3 Maximum aromatics content for the global light duty vehicle fleet⁷

3.1.2 Why are aromatics a problem for petrol vehicles?

The automotive industry, through the FCAI, has advised that an aromatics limit of 35% for petrol is necessary for vehicles to meet Euro 6d standards for gasoline direct injection engines.¹ FCAI has advised that most light petrol vehicles introduced into Australia between now and 2030 will have this type of engine.

FCAI has suggested that petrol with high aromatics levels can cause issues for these vehicles. These issues include higher emissions than certified, in-service issues such as false positives from malfunctioning indicator lights, and potential operability issues that could damage brand reputation. The petroleum industry disagrees, citing insufficient evidence that Euro 6d vehicles require maximum 35% aromatics petrol to operate effectively. However, some vehicle importers have advised that they are unwilling to introduce the latest model Euro 6d vehicles to the Australian market unless aromatics content is reduced.

Most vehicle importers currently sell models that meet Australia's existing Euro 5 standards. Some importers offer vehicles that meet the Euro 6b standard, which is less stringent than Euro 6d. Vehicle importers prioritise Euro 6d models – that often include newer, more efficient engines and PPFs – for other markets.

The Department identified a small number of high performance models available within the Australian market that use PPFs and effectively meet Euro 6d standards. These vehicles require 95 RON or 98 RON petrol. For instance, media reports suggest vehicles from Audi, Peugeot-Citroen, BMW, Mini, Mercedes and some Volkswagen Group vehicles sold in Australia meet Euro 6d standards.⁸

There is little conclusive evidence on the issue of the maximum threshold of aromatics for these vehicles. Most countries have operated with a 35% limit for some time, and there has been minimal testing of Euro 6d engine operability on Australian petrol. The Department commissioned a literature review in 2021 on the impact of higher aromatics petrol on Euro 6d engines. The analysis suggests that if Australia maintains the current 45% aromatics limit, Euro 6d petrol cars fitted with

¹ Gasoline direct injection engines are engines where fuel is injected into the combustion chamber. This is distinct from manifold fuel injection systems, which inject fuel into the intake manifold. As a result, these engines are generally more efficient.

PPFs may experience a higher rate of in-service problems compared to Europe. These potential problems include:

- blocked PPFs due to increased production of particulate matter
- higher than normal fuel consumption
- possibly reduced drivability or throttle response due to increased deposits fouling fuel injectors.⁹

The analysis was unable to quantify the probability of these outcomes. If these problems were to occur, the cost to motorists could be significant.

Consultation question

The Department is seeking to gather further evidence from vehicle importers on the impacts of aromatics levels higher than 35% and Euro 6d vehicle operability, given there are already some vehicles sold in Australia that are Euro 6d compliant.

Is there further quantitative evidence available that demonstrates aromatics content above 35% impacts operability or necessitates more regular servicing or part replacement of Euro 6d emissions controls?

3.1.3 Diesel

The regulation of diesel parameters varies from country to country, making it difficult to identify a single 'international standard' (see Table 3). Australian diesel standards do not align with EU standards with respect to three diesel parameters that affect vehicle operability and noxious emissions.

- **Cetane** is a chemical compound found naturally in diesel, and it ignites easily under pressure. Because of its high flammability, it serves as the industry-standard measure for evaluating fuel combustion quality.
- **Polycyclic aromatic hydrocarbons (PAH)** are a class of chemicals that occur naturally in coal, crude oil and fuel. PAH are organic compounds that typically contain from two to eight aromatic rings. They form during the incomplete combustion of organic compounds and are released and dispersed whenever natural biomass is burned (including, but not limited to, diesel fuel). In Australia, diesel fuel must not contain more than 11% mass by mass (m/m) PAH.
- **Density** is measured as the weight of fuel (in kg) per m³ at 15°C. Denser fuel has higher energy content. Density that is too low can reduce fuel efficiency and impact engine operability. Density that is too high can increase PM emissions.

Australian automotive diesel already meets international best practice in many key parameters, such as sulfur limits. Australia has had a 10 ppm sulfur limit on diesel since 2009.

Table 3 Key diesel specifications in Australia and comparable countries

	Australia ^m	South Korea ⁿ	Japan ^o	EU ^p	US ^q
PAH (max)	11% m/m	5 wt%	Not specified	8 wt%	Not specified
Sulfur (max)	10 ppm	10 ppm	10 ppm	10 ppm	15 ppm
Derived or actual cetane number (min)^r	Not specified for mineral diesel	52	45 / 50 (depends on grade)	51	40
Cetane index (min)	46	Not specified	45 / 50 (depends on grade)	Not specified	40 (or max aromatics content of 35%)
Density (kg/m³)	820-850	815-835	860 max	820-845	Not specified

Monitoring undertaken in 2021–22 by the Government showed that Cetane and PAH levels in Australian diesel on average would meet European standards (Table 4). The data is derived from fuel samples taken from service stations around Australia.

Table 4 Australian diesel quality sampling data 2021–22^s

Parameter	
Average Cetane Index	51.9
Minimum Cetane Index	46.2
Average PAH	3.0%
Maximum PAH	6.9%

Diesel quality was not reported as an issue for implementing Euro VI standards for heavy vehicles, such as large trucks and buses. The Government has announced plans to phase in Euro VI standards over 12 months starting from 1 November 2024.¹⁰ Heavy vehicle companies support changes that align Australia's diesel standard with EU standards. They have also acknowledged that there were no objections to the current fuel and were sensitive to any increase in price.

The analysis assessed whether any changes to diesel quality were necessary to enable improved noxious emissions standards for light vehicles. There are around 70 diesel light vehicle models sold in Australia that meet Euro 6 (including Euro 6d) standards.¹¹ These include models from Ford, Volkswagen, Audi, Land Rover and Mercedes. Vehicle importers have not indicated any known issues with operation of these vehicles using diesel that meets Australian specifications.

3.1.4 Health and environmental impacts

3.1.4.1 Health impacts

By world standards, Australia has very clean air. However, there are challenges to maintaining and improving our air quality, including population growth, a growing demand for energy and transportation and an increasing push for domestic manufacturing. As Australia is an urbanised

^m Australia, Fuel Quality Standards Act 2000: Fuel Standard (Petrol) Determination, Fuel Standard (Automotive Diesel) Determination.

ⁿ South Korea, Clean Air Conservation Act: 2010.

^o Japan, TransportPolicy.net webpage: Japan: Fuels: Diesel and Gasoline | Transport Policy.

^p European Union, Directive 98/70/EC as amended, EN 228:2012.

^q USA, Petrol: Title 40 Part 1090 Subpart C - Code of Federal Regulations (ecfr.io); USA, Diesel - 40 CFR § 1090.305 ULSD standards.

^r Derived Cetane Number and Cetane index represent different methods to determine cetane of a fuel. Derived Cetane Number is measured using a test engine, whereas the cetane index is calculated based on the properties of the diesel.

^s Unpublished data from the National Measurement Institute.

country, a large proportion of the population is exposed to noxious emissions from vehicles in our cities.

Air pollution is a major contributor to illness and premature death among Australians. The two air pollutants of concern to health experts are fine emissions of particulate matter (PM_{2.5}) and ground-level ozone. The effects of exposure to noxious emissions include reduced lung function, ischemic heart disease, stroke, respiratory illness and lung cancer.¹² There is also a link between noxious emissions and bladder cancer¹³ and breast cancer.¹⁴ Air pollutants can also cause or aggravate a range of cardio-respiratory illnesses such as asthma, chronic obstructive pulmonary disease and bronchitis.^{15,16,17}

Noxious emissions from vehicles are one of the major causes of air pollution. They contribute up to 70% of emissions of NO_x and carbon monoxide, 28% of volatile organic compound (VOC) emissions and 30% of PM_{2.5}.¹⁸ Ozone forms through chemical reactions of NO_x emissions with VOCs in hot and sunny weather conditions. Without action, some noxious emissions (such as PM emissions) are expected to continue increasing, and health costs are expected to remain a concern. This is because of the ongoing increase in population density and ageing, and the health impacts caused by earlier exposure to noxious emissions.

Ground-level ozone not only damages human health but also affects the environment. Studies undertaken in the US have found that ground-level ozone impacts forests, trees and ecosystems, reduces tree growth and productivity, and leads to increased tree mortality¹⁹. Ground-level ozone is a threat to crop production, as it hinders crop growth and impacts pollinators, leading to reduced yield.

Improving fuel quality standards would enable the implementation of Euro 6d standards. Euro 6d standards would reduce air pollution by reducing PM emissions by over one third to 2050. It will also reduce NO_x emissions. Vehicles that meet Euro 6d standards can reduce air pollution as they are fitted with PPFs. PPFs sit within a vehicle's exhaust system and capture more than 90% of airborne particulates, which would otherwise be released into the air. Implementing Euro 6d standards from 2025 will provide an estimated NPV of \$4.9 billion by 2050 to the Australian community through avoided health costs.

3.1.4.2 Greenhouse gas (GHG) emissions

Motor vehicles emit a range of GHG emissions. The principal GHG emitted is carbon dioxide (CO₂). Combusting fuels in motor vehicles can also produce small amounts of nitrous oxide and methane. The National Greenhouse Gas Inventory data shows that the transport sector accounted for 18.1% of Australia's emissions in 2021.²⁰ This makes the sector the third highest emitter in Australia after stationary energy (20.4%) and electricity (32.9%). The proportional contribution of the transport sector has increased by 64% between 1990 and 2018, the largest percentage increase of any sector.

Increasing fuel efficiency is essential to reducing GHG emissions from vehicles. The average fuel efficiency of Australia's vehicle fleet has not been improving at the same rate as other developed markets such as the EU and the US.²¹ Even with a high uptake of EVs in 2030, more than 80% of the fleet is projected to still use internal combustion engines, due to the slow turn-over of the fleet. It is essential to take action on measures that can help bring more fuel-efficient vehicles into Australia. Improving fuel quality will have an indirect impact on fuel efficiency as it would enable standards that require more modern, and more fuel-efficient engine technology onto the market.

Biofuels provide another opportunity to reduce GHG emissions in the transport sector. Bioenergy Australia estimates that ethanol use at up to 10% in all grades of petrol in Australia can reduce total greenhouse gas emissions by up to 2.6 million tonnes CO₂ equivalent per year.²²

3.2 Fuel security and fuel quality

Maintaining Australia's fuel security is an essential consideration of Australian fuel policy. Liquid fuels underpin Australia's economy. More than half of the total energy usage in Australia comes from liquid fuels. Growth in liquid fuel demand in Australia is much higher than that of countries with similar economies. Prior to the COVID-19 pandemic, Australia's demand for liquid fuels grew by an average of 1.8% per year over a 10 year period to 2018–19, outstripping population growth. Over the same period, diesel demand grew by 5.0% per year.²³

Improvements in fuel quality need to be achievable for Australian refineries and should not overly constrain the global sources of supply for importers. Domestic refining capability is important for Australia's fuel security. There are currently two refineries in Australia, Viva Energy Australia in Geelong, Victoria and Ampol in Lytton, Queensland. These supply around a quarter of Australia's liquid fuel. Maintaining a domestic refining capability is valuable for Australia, allowing it to increase its resilience to supply chain shocks.

Support for refineries to produce better fuels

Changes to fuel quality standards can be technically complex, expensive and take years to design and build. The Australian Government has implemented the Refinery Upgrades Program (RUP) to support infrastructure upgrades to produce improved quality petrol at the two remaining domestic refineries. The objective of the program is to assure the domestic production and supply of better quality fuel while maintaining refining capability in Australia. Phase 1 of the RUP provides up to \$125 million per refinery, which is capped at a 50% co-contribution towards project costs, to allow the production of petrol with 10ppm sulfur in 2024. A Phase 2 of the RUP is under Government consideration and depends on the outcomes of the final RIS. Phase 2 would provide a further \$26 million per refinery for infrastructure upgrades needed to produce fuel of a quality that enables the implementation of Euro 6d standards.

4. Why is Government action needed?

Market pressures alone will not improve fuel quality. Most motorists are not considering noxious emissions when buying a vehicle. Other vehicle features, such as performance, price, comfort and safety are the priority. As such, there is minimal market demand for vehicle importers to take a risk on operability issues and provide Euro 6d vehicles in Australia. Government intervention to align Australian fuel quality standards to enable stricter noxious emissions standards will unlock the associated benefits for the community. Australia has fuel standards for each type of fuel, made as legislative instruments under the *Fuel Quality Standards Act 2000 (Cth)* (the Act). The Government can improve the quality of Australian fuel by amending the fuel standards.

4.1 Improving fuel quality could address health and environmental externalities

Externalities arise when the economic activity of one organisation (or person) generates a positive or negative impact for another without there being a market price associated with the impact. In this instance, the costs of health and environmental impacts caused by the release of noxious emissions are not factored into the price of fuel.

The link between fuel quality, noxious emissions and health impacts is not widely publicised and is often not clear to consumers. Other than octane levels, the quality of fuel is not usually advertised by retailers, or considered by fuel purchasers. The human health and environmental impacts from exposure to noxious emissions are a cost to society which are largely beyond the control of communities and individual businesses. This issue is a priority for joint action by governments, businesses and the community.²⁴

Without Government intervention, noxious emissions will continue to increase, as will the associated health and environmental cost burden. Government action to improve fuel quality would provide a pathway to improved air quality and greater certainty that Australians will be protected from noxious emissions.

4.2 Improvements to Australia's fuel can unlock the benefits of Euro 6d

Australia is a vehicle technology taker, and technology development is driven by the regulatory environment of the major markets of Europe, the US and China. These markets all use petrol limited to 35% aromatics, and require noxious emissions standards and fleet fuel efficiency standards to be met. Scientific evidence is scarce about the exact impact of Australian fuel that contains higher aromatics. In the absence of evidence, harmonisation would allow vehicle importers to provide Euro 6d vehicles with no additional testing requirements. This would ensure Australia is supplied the latest vehicle technology, while reducing the risk of vehicle operability issues for consumers. It would also enable implementation of Euro 6d standards. Introducing Euro 6d standards would provide an NPV of \$4.9 billion in avoided health costs from 2025 to 2050.

5. What policy options are under consideration?

Changes to fuel standards can affect a large mix of stakeholders. The Department undertook extensive consultation to formulate fuel quality options. These considered the potential impacts on:

- domestic fuel producers (two refineries)
- fuel importers
- fuel wholesalers
- fuel retailers
- vehicle importers
- fuel consumers (road passenger and road freight)
- potential health benefits to the Australian community.

5.1 Business as usual

The business as usual (BaU) option is the baseline in the assessment. The benefits and impacts of the options presented can be quantified and compared against these existing conditions. The aromatics limit of the BaU option remains at a 35% maximum pooled average across all grades of petrol with a 45% maximum for each grade. This reflects the aromatics limits from January 2022. In addition, the 2024 reduction in the sulfur limit is part of the BaU case. The diesel standard remains unchanged.

This option has several issues. Most countries that implement Euro 6d or similar standards for light vehicles limit aromatics to less than 35%.[†] Implementing Euro 6d in Australia may create vehicle operability and warranty issues or car importers may not provide their most advanced engine technology. It also does not reduce the noxious emissions from vehicles.

5.2 Option 1 (91 RON: 35% maximum aromatics, 95 RON: 35% grade average)

This option closely aligns to the existing fuel quality standards, except for:

1. an improvement for 91 RON petrol, proposed to have a maximum of 35% aromatics
2. an improvement for 95 RON petrol, proposed to have a 35% maximum grade average and 45% maximum aromatics.

This option has been assessed for completion by the end of 2024. The Australian Institute of Petroleum proposed this option during the consultation process. This option would provide the least regulatory burden and the least cost for refineries and fuel importers. Changes to 91 RON would only support importing Euro 6d vehicles that can run on 91 RON. Most vehicles in Australia currently run on 91 RON, however an increasing number of vehicles require the use of petrol with minimum 95 RON. The FCAI was not able to confirm whether models made for the Australian market would meet Euro 6d standards using 91 RON.

5.3 Option 2 (95 RON: 35% maximum aromatics)

This option incorporates a 35% aromatics limit for 95 RON, and a maximum pooled average of 35% aromatics across all grades. Both 91 RON and 98 RON would be limited to a maximum of 45% aromatics. This option was assessed for implementation by the end of 2024.

[†] Canada has Euro 6d equivalent standards, but does not regulate aromatics. However, actual average aromatics levels in Canadian petrol are 23.9%.

Option 2 would enable the introduction of Euro 6d standards, and allow all new vehicles that can run on 91 RON or 95 RON to meet noxious emissions standards. This would account for around 99% of new vehicles in the Australian fleet. The Department chose to cost this option as a lower cost alternative to reducing aromatics across all grades.

5.4 Option 3 (35% maximum aromatics limit across all grades)

This option requires a maximum limit of 35% aromatics for all three grades of unleaded petrol from 2027. To achieve this, infrastructure modifications will be required at the refineries and throughout the distribution and retail supply chain to enable the use of ethanol in all 98 RON petrol to reduce aromatics. The time required to undertake infrastructure updates means it is not feasible to implement this option before 2027.

A hard limit of 35% aromatics is only possible in 98 RON for refiners and importers with the use of an octane enhancer and infrastructure upgrades. The Department costed Option 3 using the addition of up to 10% ethanol as the implementation pathway. This option aligns Australian petrol with best practice across all grades.

The Department considered a similar option, with a reduction in the maximum aromatics content across all grades to below 45% but above 35%. Initial analysis and consultation suggested that the cost would be similar to Option 3, but would not provide the necessary aromatics reduction for the automotive industry to introduce Euro 6d vehicles. On this basis, the Department decided not to continue to a cost benefit analysis on that option.

5.5 Technical pathways to reduce aromatics in 98 RON considered but not costed

5.5.1 Methyl tertiary butyl ether (MTBE)

The Department ruled out the use of MTBE during analysis of the preliminary options. MTBE is a volatile organic chemical used as an octane enhancer in some countries, including the EU and in Asia. The benefits of MTBE are that it is cheap to produce and by increasing octane, it improves fuel combustion and reduces noxious emissions.

Some ethers, such as MTBE, are limited in Australian petrol. Even in small concentrations, MTBE is a groundwater contamination risk due to its taste, odour, persistence and mobility in water. Since January 2004, the volume of MTBE has been limited in all grades of petrol supplied in Australia to less than 1%. Although Australian refineries do not use MTBE, fuel from international refineries may contain trace levels of MTBE.

Western Australia implements a 0.1% MTBE limit and other states limited its use prior to 2004.²⁵ If the Government were to decide to increase the limit, it is likely other states would follow Western Australia and re-introduce MTBE limits in state legislation. The Department does not consider MTBE to be a viable option for Australian petrol.

5.5.2 N-methylaniline (NMA)

NMA is a derivative of aniline and includes a benzene ring and an amino group. It is an efficient octane enhancer, particularly for petrol with low octane. 96 RON can be achieved from 90 RON base petrol with addition of 3% NMA.²⁶ The Department consulted on whether NMA could be a feasible octane enhancer. The Department decided NMA should not be considered further based on feedback from a range of stakeholders on the vehicle operability impact and consumer aversion.

5.6 Option 4: Diesel

This option would align one or all parameters considered with EU standards for diesel fuel. It includes changes to:

- the PAH level (reduction from 11% to 8%)
- DCN (implementing a 51 DCN for all diesel)
- density at 15 °C (reduction in the range from 820–850 kg/m³ to 820–845 kg/m³).

The Department developed this option to assess the cost of aligning Australia's diesel standard with the EU standard. The Department also analysed whether these changes are required to enable the efficient operation of Euro 6d light diesel vehicles, or Euro VI heavy vehicles.

6. What are the likely net benefits of each option?

The Department engaged independent advisors GHD and ACIL Allen to undertake an economic analysis. GHD and ACIL Allen worked with key industry stakeholders to determine the net benefits and regulatory burden of the policy options. The analysis:

- assesses the incremental benefits and costs of the options relative to the BaU case
- considers implementation dates ranging from 2024 (Options 1, 2 and 4) to 2027 (Option 3)
- costed three options for changes to petrol quality (option 1 to 3), and one option for diesel (option 4).

The cost benefit analysis did not consider the benefits associated with the implementation of Euro 6d standards. Previous analysis undertaken by the Bureau of Infrastructure and Transport Research Economics (BITRE) found implementing Euro 6d standards from 2025 would provide an NPV of \$4.9 billion to 2050.

A further description of the results and methodology is at [Appendix A](#).

6.1 Petrol

Table 5 Net present value of costs and benefits of petrol options to 2040

Fuel quality parameter		Option 1 91 RON, 35% max aromatics 95 RON, 35% avg. aromatics	Option 2 95 RON, 35% max aromatics	Option 3 91 RON, 35% max aromatics	Option 3 95 RON, 35% max aromatics	Option 3 98 RON, 35% max aromatics
Year regulation commences		2024	2024	2027	2027	2027
		\$m	\$m	\$m	\$m	\$m
Costs (to 2040)	Refinery capital costs	0.0	67.7	0.0	55.3	55.3
	Refinery operating costs	16.5	47.0	10.4	30.1	192.0
	Imported fuel price increase	21.0	92.3	15.3	84.3	157.6
	Fuel demand impacts (loss of consumer surplus)	1.1	4.5	0.8	3.9	8.5
	Increased GHG emissions at refinery	2.6	4.9	1.7	3.1	20.1
	Ethanol supply chain capital costs for terminal operators and distributors	-	-	-	-	56.9
	Ethanol supply chain operational costs for terminal operators and distributors	-	-	-	-	7.2
	Ethanol supply chain capital costs for retailers	-	-	-	-	437.7
	Ethanol supply chain operational costs for retailers	-	-	-	-	273.1
	Total costs	41.3	216.4	28.2	176.7	1,208.4
Benefits	Avoided health costs	0.0	20.0	0.0	29.9	66.9
NPV at 7%	Benefits minus costs	-41.3	-196.4	-28.2	-146.7	-1,141.5
BCR		0.000	0.093	0.000	0.169	0.055

Option 1

Option 1 (91 RON: 35% aromatics limit, 95 RON: 35% grade average limit) has a negative NPV of –\$41.3 million and is unlikely to deliver a net benefit to the community compared with BaU. Most 91 RON supplied in Australia already meets the proposed 35% aromatics limit. Implementing this standard would result in additional annual costs for existing refineries of around \$2.5 million. These costs ensure refineries meet the 35% aromatics limit post desulfurisation in 2024. Desulfurisation is expected to slightly reduce octane in petrol, meaning small amounts of alkylate may be required to boost octane without adding more aromatics.

Option 1 includes a maximum grade average of 35% aromatics for 95 RON. The Department expects the grade average aromatics for 95 RON for each Australian refinery will still be less than 35% post the commencement date of ultra-low sulfur petrol being produced. This means there are no costs or benefits associated with reducing the grade average of 95 RON to a maximum of 35%, as it is the same as BAU.

This option would not enable the implementation of Euro 6d standards. It is unlikely that a large range of Euro 6d vehicles would be able to run on a 91 RON grade of petrol, even with a maximum aromatics limit of 35%. Euro 6d vehicles that only take 95 RON would be at higher risk of operability issues. Implementing Option 1 would result in no measurable health benefits, as any changes to real world aromatics content would be insignificant.

Option 2

Option 2 (95 RON: 35% maximum aromatics limit) has a negative NPV of –\$196.4 million. If a 35% aromatics limit is implemented for 95 RON in 2024, it is unlikely to deliver a positive net benefit without the implementation of Euro 6d standards. The CBA estimated each refinery would require \$35 million in total capital expenses required to meet this standard. Under this option, each refinery could be eligible for grants of \$26 million under Phase 2 of the RUP. The net effect is a present value of capital costs for both refineries of \$17.4 million.

The net present benefit of total avoided health costs for Option 2 is \$20.0 million. This assumes that under a 35% aromatics limit for 95 RON, there would be a 1.6% reduction in particulate emissions.

This option would enable implementation of Euro 6d standards for more than 99% of the vehicle fleet through the availability of ‘low aromatics’ 95 RON. The NPV associated with implementation of Euro 6d standards from 2025 to 2050 is around \$4.9 billion, but the NPV is not included in this CBA.

Option 3

Option 3 could be implemented for all petrol grades in 2027 at the earliest and would enable implementation of Euro 6d standards from 2027, but has a total negative NPV of –\$1,316.4 million. This option would limit aromatics in all grades of petrol to 35%. This option is unlikely to deliver a net benefit to the community without the implementation of Euro 6d standards. BITRE’s cost benefit analysis estimated the NPV associated with implementing Euro 6d standards from 2027 to 2050 to be \$4.4 billion.²⁷

Changes to 91 RON under this scenario have a negative NPV of –\$28.2 million and 95 RON has a negative NPV of –\$146.7 million.

98 RON has the highest negative NPV at –\$1,141.5 million. This is because lowering aromatics limit in 98 RON requires the use of an octane enhancer. The octane enhancer chosen for this study was ethanol as it has the lowest engine, health and environmental impacts. The use of ethanol requires

modifications to many Australian fuel terminals, distribution equipment and retailer infrastructure to accommodate the ethanol-blended 98 RON. It would also require construction of additional ethanol production capacity in Australia (out of scope for the analysis). For further information on the supply chain costs in Option 3, see [Appendix A](#).

The net present benefit of total avoided health costs under Option 3 for 95 RON and 98 RON between 2027 and 2040 is \$96.8 million. This assumes a 7.4% reduction in particulate emissions from a 35% aromatics limit for 98 RON, and the same reduction in particulate emissions for 95 RON as in Option 2.

6.2 Diesel (Option 4)

Table 6 Net present value of costs and benefits of diesel options to 2040 (Option 4)

Fuel quality parameter		All	PAH	DCN, CI	Density
Year regulation commences		2024	2024	2024	2024
		\$m	\$m	\$m	\$m
Costs (to 2040)	Refinery capital costs (net of government assistance)	5.8	0.0	5.8	0.0
	Refinery operating costs	436.0	6.8	82.1	347.1
	Imported fuel price increase	134.5	0.0	134.5	0.0
	Fuel demand impacts (loss of consumer surplus)	6.1	0.0	6.1	0.0
	Total costs	582.4	6.8	228.5	347.1
Benefits	Total benefits or avoided costs	25.1	0	0	25.1
NPV at 7%		-557.4	-6.8	-228.5	-322.0
BCR		0.043	0.000	0.000	0.072

Option 4 relates to the diesel fuel quality parameters, and involves aligning the PAH limit, minimum DCN and maximum density with EU standards. It has a negative NPV for all three parameter changes, ranging from -\$6.8 million for PAH, to -\$322.0 million for density, totalling -\$557.4 million.

The analysis did not find any evidence to suggest that diesel quality was a barrier for enabling more stringent noxious emissions standards. It identified that there are already many Euro 6d/VI vehicles sold on the Australian market and no known reports of operability issues. In addition, DCN, density, and PAH standards vary considerably globally.

Meeting the lower PAH limit is not an issue for imported diesel and would not likely involve a price increase. However, the CBA identified that a small number of Australian refined batches currently exceed a PAH limit of 8%. Producing diesel with maximum 8% PAH at refineries would cost around \$1 million. This would incur, on average, operational expenses of 0.019 cents per litre (cpl). Nearly all Australian diesel already has PAH content below 8%. There are therefore no benefits associated with lowering the limit, as the impact on real world diesel quality would be negligible.

Achieving a 51 DCN minimum would require the use of cetane enhancer. Adding cetane enhancer to achieve DCN of at least 51 would require capital expenditure of \$3 million for each refinery. It would also incur a 0.227 cpl increase in cost to produce diesel domestically, and a 0.087 cpl increase to the price of imported diesel.

To comply with the density maximum of 845kg/m³, the 'crude diet'^u at Australian refineries would need to change, i.e. the choice of crude oil Australian refineries could use would be limited. This would incur 0.962 cpl for domestic refined diesel. Meeting the density standard is not an issue for imported diesel and would not involve a price increase.

The net present benefit of total avoided health costs under Option 4 for diesel is \$25.1 million. This assumes a 0.5% reduction in particulate emissions resulting from a maximum density of 845 kg/m³. Changes to the other diesel specifications under Option 4 do not result in health benefits.

6.3 Consumer price impact of the options

Changes to the fuel quality standards will likely have a small impact on the fuel price. The Department carefully examined price impacts when considering options for improving fuel quality in Australia^v.

Wholesale fuel prices in Australia are set on the basis of the import parity price (IPP). The IPP closely reflects the actual cost of importing fuel into Australia, as it is based on the international price of refined fuel plus freight and other import costs. The IPP and taxes (fuel excise and the wholesale GST) are the major elements of wholesale prices in Australia. They account for over 95% of wholesale prices, with the other elements being wholesale costs and margins.

Table 7 outlines the estimated IPP increases for fuel under the reform options.

Table 7 Import price parity increase for each option^w

	Option 1	Option 2	Option 3	Option 3	Option 3	Option 4
	91 RON	95 RON	91 RON	95 RON	98 RON	Diesel
Import price parity increase (cpl)	0.03	0.5	0.03	0.5	1.3	0.087

In Options 1 and 2 for petrol, and Option 4 for diesel, the price impact to consumers is the same as the IPP increase in Table 7. The Department's modelling assumes that the \$775 million of additional supply chain costs of adding ethanol to 98 RON in Option 3, will be passed through to the consumers. The fuel excise rate for ethanol (Option 3) is lower than for petrol so motorists would pay a lower fuel excise due to the inclusion of 10% ethanol in the grade. This would partly offset the increased cost to motorists. The model also assumes that the price increase as a result of ethanol use is only passed through 98 RON. As 98 RON consumption reduces in our forecasts, the price increase from a BaU scenario also increases. This is because there is less product to spread the cost through.

Option 1 and 2 would only see a price increase in a single grade of petrol (91 RON and 95 RON respectively), and the other grades would remain unchanged. In contrast, Option 3 would increase petrol prices for all grades.

All price forecasts come with a large degree of uncertainty, as they are dependent on the future global market conditions. The increase for Options 1, 2 and 4 will be unnoticeable to motorists due to the large fluctuations in the price of petrol and diesel. They are also insignificant when comparing to BaU price fluctuations in the market.

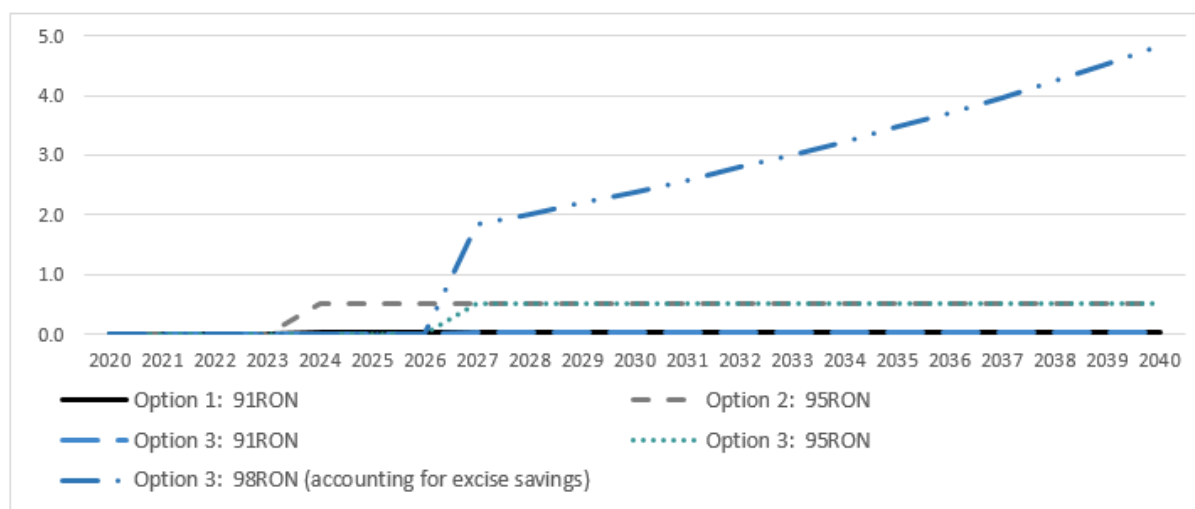
^u Crude diet is the mix of different crude grades that the refinery is running.

^v Further analysis of the price impacts will be included in the final RIS, taking into account late-2022 market considerations.

^w These estimations are indicative only as they are dependent on future global market conditions.

The Department is updating the price premium assumptions for options 2 and 3 based on current market conditions. The results of the updated analysis will be included in the final RIS.

Figure 4 Real petrol price increase for motorists under various petrol options



6.4 Regulatory burden measurement

The Department has prepared an estimate of the regulatory burden of the proposed reform options on the private sector (businesses, community organisations and individuals) and government-owned corporations in line with the Government's *Regulatory burden measurement framework: guidance note*.²⁸

Table 8 provides a summary of the regulatory burden for the reform options.

The analysis did not include a number of administrative costs due to uncertainties regarding implementation. For example, the analysis did not have sufficient information on potential administrative costs for retailers under Options 1 and 2. The Department is seeking to understand additional costs through this consultation process.

Administrative compliance costs may include, but are not limited to:

- retailers requiring changes to signage
- retailers changing procedures and undertaking additional processes related to the change in fuel quality, such as tank flushing. The Department will aim to introduce any changes to aromatics in alignment with the changes to sulfur. This will ensure no additional regulatory burden from tank flushing for changes to aromatics.

The Department assumes there would be no change in the testing regime and no additional reporting costs.

Substantive compliance costs for domestic refiners and the supply chain include:

- additional compliance costs for refineries due to the need for infrastructure to meet the new standards
- introduction of ethanol into petrol for Option 3 would increase costs for refineries and the supply chain, due to the need for additional equipment for storage and ethanol blending
- increased running costs and staff for all options
- increased carbon emissions.

Substantive compliance costs for individuals include:

- all options would lead to an increase in the price of fuels and hence, increased costs to motorists. The increase in price ranges from 0.03 cpl for 91 RON under Option 1, to up to 4.84 cpl for 98 RON under Option 3. Under Option 4, the model found the price of diesel could increase by 0.087 cpl.

Table 8 Regulatory burden estimate summary (\$m/year)

Average annual regulatory costs to 2040 (\$m/year)	Option 1	Option 2	Option 3			Option 4
	91 RON	95 RON	91 RON	95 RON	98 RON	Diesel
Refining Sector	1.3	5.1	1.0	9.6	26.1	49.2
Supply chain	0	0	0	0	136.2	0
Consumers	3.3	13.4	3.1	15.4	71.7	19.1

Consultation question

**Are there additional costs the Department should consider in calculating regulatory burden?
Please provide evidence of costs where possible.**

6.5 Unquantified benefits

Not all potential benefits of implementing the options are directly or fully reflected in market prices. It is difficult to quantify those benefits in dollar values or estimate their worth in a way that provides a true reflection of their economic value. In other cases, the full impacts of implementing a policy alternative can be difficult to quantify. For the CBA, the Department did not consider benefits where there was a lack of data to assign a monetary value to the benefits.

Due to data uncertainties and a lack of available evidence, the CBA could not quantify benefits from increased fuel efficiency and the subsequent GHG reductions, or certain health benefits. The Department was also unable to quantify the GHG reduction of including ethanol in the 98 RON grade for option 3, due to uncertainties over life cycle emissions. However, Bioenergy Australia estimates that ethanol use at up to 10% in all grades of petrol in Australia can reduce total greenhouse gas emissions by up to 2.6 million tonnes CO₂ equivalent per year.²⁹ For a full description of these unquantified benefits, see [Appendix A](#).

7. Consultation

This chapter provides an overview of the consultation process and stakeholder views that have shaped the policy options in this draft RIS.

7.1 Stakeholders

At the outset of the analysis, the Department identified nine key stakeholder groups to consult:

- domestic refiners
- fuel importers
- fuel supply chain sector
- automotive industry
- fuel additive suppliers
- renewable fuel industry
- consumer representatives
- health and environment interest groups
- state and Commonwealth Government agencies.

The Department identified these stakeholder groups due to their specialised knowledge of the issues and potential impacts on their business or area of interest. The stakeholders represented a range of views including full coverage of the liquid fuel sector (see [Appendix B](#) for a full list of stakeholders consulted).

7.2 Regular consultation

The Department met with 22 stakeholders over a period of two months. Following the meetings, the Department provided questions tailored to each specific stakeholder to allow for a considered response. The Department also reached out to non-government organisations specialising in health and environment issues, however these groups were unable to meet.

Following this round of stakeholder engagement, the Department finalised the options for analysis. The Department then undertook focussed consultation with specific stakeholders to further explore issues raised through the first round of consultation. The Department's consultants engaged with importers and domestic refiners to develop the cost impacts used in the CBA.

7.3 Issues raised

Table 9 summarises the issues raised by stakeholders through the consultation process.

Table 9 Outcomes from consultation

Issue	Stakeholder feedback summary
Interaction with planned reduction in sulfur	<ul style="list-style-type: none"> Reducing sulfur in petrol will reduce the octane rating, making it more costly to achieve 35% aromatics in petrol
Reduced aromatics to 35%	<ul style="list-style-type: none"> Reducing aromatics will decrease octane in petrol, requiring addition of an octane enhancer or alkylate to provide petrol with the appropriate RON Importers noted they could source 95 RON petrol with reduced aromatics at an increased cost of supply Vehicle industry requires a maximum limit of 35% aromatics in fuel before introducing vehicles that meet Euro 6d standards
Ethanol blending	<ul style="list-style-type: none"> Ethanol is the one viable octane enhancer to make 98 RON petrol with 35% aromatics Use of ethanol would have additional infrastructure costs for the supply chain, refiners and importers Some concern from fuel suppliers and retailers regarding consumer acceptance of ethanol in fuel Biofuels industry supported ethanol as an octane enhancer
Additives and octane enhancers	<ul style="list-style-type: none"> Some importers noted ethers (especially MTBE) are used internationally to increase octane in low aromatic fuels, but are limited to trace elements in the petrol standard, and also some states in Australia No stakeholder supported the use of NMA as an octane enhancer
Issues related to increasing the DCN to 51	<ul style="list-style-type: none"> Supplying diesel with DCN greater than 51 would be feasible, with increased cost of supply
Maximum PAH level of 8%	<ul style="list-style-type: none"> Supplying diesel with PAH of less than 8% would be feasible with increased cost of supply
Maximum density of 845 kg/m ³	<ul style="list-style-type: none"> Refiners would incur high costs to supply diesel with a maximum density of 845 kg/m³ Fuel importers would be able to source diesel with a maximum density of 845 kg/m³ with increased cost of supply

8. The Department's proposed approach

8.1 What is the best option from those considered?

Table 10 provides the outcomes of the Department's policy assessment.

Table 10 Summary of the policy assessment criteria outcomes

Policy assessment criteria	1 91 RON: 35% max aromatics 95 RON: 35% grade avg, 45% limit	2 95 RON: 35% max limit on aromatics No changes to 91 RON and 98 RON	3 35% max aromatics across all grades	4 Diesel: Changes to DCN, PAH, density
Facilitate adoption of fuel standards that enable the implementation of Euro 6d standards	No Does not align any grade with EU or other international standards	Yes Aligns 95 RON with EU and other international standards for 99% of new vehicles sold in Australia	Yes	No evidence provided to suggest a change is required, with standards varying significantly across the globe. Australia's real world diesel quality is very close to meeting the EU limit without the need for more stringent standards. Euro VI trucks, and some Euro 6d light vehicles already sold in Australia
Ensure the most effective operation of engines	No	Yes Aligns with EU standards for more than 99% of new vehicles sold in Australia	Yes Aligns with EU standards all new vehicles sold in Australia	No issues reported with Euro VI trucks, and some Euro 6d light diesel vehicles already sold in Australia
Minimise regulatory burden	Yes Regulatory burden is the lowest of the options considered, but does not enable Euro 6d standards	Partial Lowest regulatory burden while enabling the introduction of Euro 6d standards	No This option represents the highest regulatory burden of the three petrol options	No, significant regulatory burden
Maximise net national benefits	No	Yes	No	No
Overall	Net cost Lowest cost improvements, but changes not enough to enable new vehicle technology	Net cost (exc Euro 6d standards) Enables Government to implement Euro 6d from 2025 (providing an NPV of \$4.9 billion to 2050)	Net cost (exc Euro 6d standards) Enables Government to implement Euro 6d from 2027 (providing an NPV of \$4.4 billion to 2050)	Net cost

8.2 Petrol

The cost benefit analysis shows changes to petrol quality should only be made if Euro 6d standards are also implemented in Australia. The costs involved to guarantee that refineries and importers can always meet the proposed standards are significantly greater than the health benefits.

None of the petrol quality standard options analysed had a positive NPV based on health or environmental benefits alone. The health benefits from changing fuel standards are minor, as most Australian petrol is of a higher quality than the standard mandates. Therefore, the key consideration is which option enables the implementation of Euro 6d standards at the lowest cost to consumers and the regulated community.

- Option 2 is the Department's preferred option. It enables the implementation of Euro 6d standards at the lowest cost. Option 2 produces the greatest net benefit to the community. Reducing the maximum aromatics content of 95 RON to 35% would enable more than 99% of all new vehicles sold in Australia to meet Euro 6d standards. This option has an NPV of –\$196.4 million to 2040. However, this would also give consumers' access to the latest vehicle technology by allowing implementation of Euro 6d standards. Implementing Euro 6d standards would provide an NPV of up to \$4.9 billion to 2050.³⁰
- Option 1 has the lowest implementation costs of any of the options. However, it is not expected that lowering the aromatics limit in 91 RON alone would enable Euro 6d standards without transferring any operability risks to consumers. Euro 6d vehicles currently available on the market require 95 RON as a minimum. The Department received no evidence to suggest Euro 6d vehicles could run on 91 RON.
- Option 3 would enable all light petrol vehicles that meet Euro 6d standards to use 95 RON or 98 RON as the base fuel. The estimated cost to reduce aromatics content to a maximum of 35% in 98 RON is \$1.2 billion and would only provide benefits to the 1% of vehicles that must use 98 RON. This is disproportionate to the \$216 million cost to reduce aromatics content to a maximum of 35% in 95 RON under Option 2.

8.3 Diesel

The Department is not proposing any changes to the diesel standard. Stakeholders provided no evidence that Australia's current diesel quality impacts Euro 6d or Euro VI vehicle operability. The road transport sector is also particularly sensitive to price increases in diesel, due to the large amount required to transport goods around Australia. While price increases for the changes are minor, any price increases would disproportionately impact road freight sector users. For instance, each articulated truck on average travelled 78.3 thousand kilometres in 2020, compared to 11.1 thousand kilometres for private vehicles.³¹

The FCAI suggests changes to diesel standards are essential to ensure Euro 6d diesel engine technology works at its optimum. However, there is already a range of Euro 6d diesel light vehicles on the Australian market. The Department is not aware of any reports of operability issues with these vehicles.

The Department spoke to a range of stakeholders in the heavy vehicle sector. They stated that no changes to diesel standards are required for trucks, as many Euro VI trucks are already in use in Australia. This is consistent with DITRDC's 2020 *Heavy vehicle emission standards for cleaner air: draft regulation impact statement*. The Government has announced the phase in of Euro VI standards over 12 months starting from 1 November 2024.³²

The issues with diesel are different to petrol because the vast majority of petrol vehicles are sold into countries with low-aromatics petrol. Diesel standards vary internationally, and vehicles operate effectively with diesel of differing quality. Therefore, the risk of vehicle operability issues associated with using Australia's diesel on Euro 6d vehicles is very low. Changes to the diesel standard to mitigate vehicle operability risks are not required at this time.

8.4 Regulatory burden of the best option

The estimation of regulatory burden provides the average yearly costs to stakeholders that results from changes to regulation. The analysis estimated the regulatory burden of the Department's preferred option, Option 2, to be \$18.5 million per annum. The final RIS will include a revised figure based on information provided submissions to this draft RIS. The preferred option for diesel is to make no change to the standard. This will impose no additional regulatory burden on businesses or individuals.

8.5 What the Department's preferred option would achieve

Successful implementation of the measures set out in the preferred option would:

- enable the implementation of Euro 6d standards
- improve Australia's petrol quality by reducing the aromatics limit in petrol to align with world's best practice
- set achievable, balanced improvements in the quality of Australia's fuel to ensure the ongoing viability of refineries in Australia
- contribute to the supply of reliable quality, fit-for-purpose fuel to enable the operation of more efficient, lower emissions, high-technology vehicles.

9. Implementation of the preferred option

None of the changes to Australian fuel standards being considered will require motorists to change the fuel they use in their existing vehicle. Changes to standards will only impact the fuel required for new vehicles if Euro 6d standards commence.

The Department's preferred option of reducing the aromatics limit in 95 RON enables the implementation of Euro 6d at the lowest cost. This will require changes to the fuel and vehicle sectors for new vehicle purchasers. This section sets out implementation considerations of the preferred option. For some issues, the Department has included proposed solutions. The Department is seeking feedback on the implementation of the preferred option. Feedback on the implementation of the other options is also welcomed.

9.1 Changes for motorists

Motorists generally associate higher RON with better quality petrol. Creating a low aromatics 95 RON petrol will challenge this perception. 95 RON could become the recommended grade of petrol for most new Euro 6d vehicles.

During consultation, the Australian Automobile Association raised the issue of misfuelling due to confusion that 95 RON becomes the preferred grade of petrol for new Euro 6d vehicles. The Department investigated this issue and expects the change would impact motorists gradually, as it would only affect those purchasing new vehicles. Approximately 5% of the fleet turns over every year^x, and so it would take many years before the majority of the fleet requires 95 RON petrol. Many motorists that purchase new European vehicles are already advised by the importer or automotive dealership to use 95 RON in their vehicles.

The Department also found no evidence to suggest that the occasional or accidental use of 98 RON would impact on a Euro 6d compliant vehicle operating (i.e. starting and running). Further, as there are already a small number of Euro 6d vehicles that are sold in Australia, the risk of operability issues with these vehicles is already being tested. The risk to operability of vehicles that run on 98 RON appears to be low. Analysis by the Department suggests that sustained use of high aromatics 98 RON may lead to a need for more frequent servicing and reduced PPF life. There is no evidence of this occurring in Australia to date.

Premium sports cars from brands such as Ferrari, Lamborghini, Porsche and other luxury marques often recommend or require the use of 98 RON in Australia. These vehicles tend to be high-performance cars with highly tuned engines specifically designed to run on high octane fuels. Data from previous years suggests that around 0.6% of annual vehicle sales were models that are required to use 98 RON.^y

The Department acknowledges that in the event Euro 6d standards are implemented, future new vehicles sold that require 98 RON may need more regular service intervals due to the potential for higher levels of aromatics in 98 RON. However, existing vehicles will be able to continue to use 98 RON without any impacts. The Department's testing showed 98 RON had an average aromatics content of 37.0% for 2021–22.³³ While slightly higher than the European limit, this is considerably lower than Australia's legislated maximum. With the trend to electrification occurring at a faster rate in the premium vehicle markets, the proportion of vehicles requiring 98 RON may gradually decline in the future from the already very small number of vehicles in Australia that require this fuel. It is

^x Based on ABS and vehicle sales (VFACTS) data.

^y Based on Departmental calculations using data from the Green Vehicle Guide and VFACTS.

therefore the Department's view that the additional \$1.2 billion in costs to introduce 35% maximum aromatics limit to 98 RON does not provide a net benefit to the community.

Consultation questions:

What are the key concerns for consumers in the event a low aromatics 95 RON standard is introduced and becomes the primary recommended petrol for new light vehicles?

Are there further risks to operating Euro 6d vehicles recommended to run on 98 RON petrol with Australian 98 RON?

The Government will work with industry to educate consumers on any changes

The Government will provide consumers with information about the new fuel standards prior to their implementation. The Department has budgeted around \$350,000 in the 2024–25 financial year to provide information on the introduction of the new fuel quality standards. The Government will consult with industry prior to the campaign to ensure a coordinated approach.

The Government could require consistent labelling requirements to assist consumers

Under the Act, the Minister has the power to create fuel quality information standards. The Department will consider the appropriateness of creating a new information standard for petrol that is compatible with Euro 6d vehicles. An information standard requiring labelling of 95 RON with maximum 35% aromatics as 'Euro 6d compliant' could reduce consumer confusion and the risk of misfuelling. To complement this measure, other grades of petrol could require labels stating they are 'unsuitable for use in Euro 6d vehicles'. The Department would co-develop details of the standard with industry and consumer groups. Introducing a new information standard would incur additional regulatory burden for petroleum retailers, comprising the costs in additional labelling of fuel bowsers at service stations. Feedback on this draft RIS will also assist the Department to assess the appropriateness of this approach.

Information about fuel is available on the Green Vehicle Guide website

The Government's Green Vehicle Guide (the GVG) provides information to consumers on the environmental performance of light vehicles sold in Australia, such as whether a vehicle is Euro 6 compliant. This includes information to consumers regarding the appropriate grades of petrol for specific vehicles. As part of the information materials, the Department will draw consumer's attention to this feature. This will also be a useful tool for motorists who are uncertain of the refuelling requirements for their vehicles.

Consultation questions:

What is the best way for the Government to partner with industry to provide the most effective education materials? Do you have any suggested approaches?

Do you have comments on labelling requirements that should be implemented for low aromatics petrol or 98 RON?

9.2 Changes for vehicle importers

The Department seeks further information from vehicle importers regarding the implementation of the preferred option.

If the Government introduces improved fuel quality and Euro 6d standards, 95 RON could become the recommended grade of petrol for Euro 6d vehicles. Vehicle importers may be concerned about the risk of higher aromatics content petrol impacting the life of PPFs. This may result in importers advising customers against operating Euro 6d vehicles regularly on 98 RON. This would require changing the recommended fuel filling information supplied on new vehicles.

Vehicles in Japan, South Korea and the US can run on 91 RON (or an equivalent anti-knock index). These markets have noxious emissions standards equivalent, although not identical, to Europe. Aromatics content of 91 RON is almost always below 35%, even without a regulated limit. It is therefore possible vehicle importers from these markets may allow the use of 91 RON petrol in their Euro 6d vehicles.

Consultation question:

Do car importers agree that 95 RON is expected to become the primary recommended petrol for Euro 6d vehicles? Is any information available on the use of 91 RON petrol in Euro 6d compliant vehicles?

Can new Euro 6d high performance vehicles operate effectively on ultra-low sulfur and low aromatics (35%) 95 RON? If not, please provide a list of specific models and the reasons for the operability issues with those models.

9.3 Changes for service stations

The Department seeks further information regarding implementation issues for service stations.

Around 55% of Australian fuel retailers provided 95 RON in 2021. We expect that with the specification changes to 95 RON and potential implementation of Euro 6d standards, gradual growth in demand for 95 RON petrol would likely result in a greater number of fuel retailers stocking the product. The Department does not expect that availability of 95 RON will need Government intervention.

With changes to fuel quality, service stations may need to undergo a tank flushing procedure. The Department aims to time any changes to the aromatics limit to align with changes to the sulfur limit. This should eliminate the need for additional tank flushing required as a result of the Department's preferred option. If the Government creates new information standards, service stations will be required to implement additional labels on pumps. The Department is seeking stakeholder input on this issue through the draft RIS process to assess the regulatory burden.

Consultation question:

Can the service station industry provide additional information on the costs and implementation requirements of the preferred option for service stations?

9.4 Changes for refineries

Domestic refineries will need to upgrade their infrastructure to produce 95 RON petrol with 35% maximum aromatics. It is important that these upgrades can be completed without compromising Australia's fuel security by affecting the viability of Australia's remaining refineries.

The Government is providing assistance to Australia's refineries to improve fuel quality

Funding for refinery infrastructure upgrades may be available through a proposed Phase 2 of the RUP. This existing program could provide up to \$26 million for each of the Australian refiners to produce low aromatics petrol. If the Government chooses to proceed with the preferred option, the Department will work towards establishing Phase 2 of the RUP.

9.5 Changes for fuel importers

Imported 95 RON regularly meets a 35% aromatics limit. To ensure that all product meets the standard, importers may have to secure new supply agreements with overseas refineries.

Most markets in the Asia Pacific already have a 35% aromatics limit on their petrol. The product often includes oxygenates such as methyl tertiary butyl ether (MTBE) and ethyl tertiary butyl ether (ETBE). Australian legislation limits these oxygenates to trace amounts in petrol supplied in Australia. As a result, there will be fewer sources of supply for MTBE/ETBE-free, low aromatics 95 RON. The CBA commissioned by the Government assumed that because of the reduction in supply options for importers, there would likely be a 0.5 cpl price premium for the product. However, there may also be more competition and greater volumes of 95 RON sold, putting downward pressure on local prices. The Department is undertaking further work to update these assumptions based on current market conditions.

Consultation question:

Is further information available on the costs and implementation requirements of the preferred option for refineries and fuel importers?

9.6 Assessing compliance with improved fuel quality standards

If the Government chooses to improve fuel quality and implement Euro 6d standards, the Department will need to monitor compliance with the improved fuel quality standards. Information about Australia's real world fuel quality will also be important for vehicle importers in ensuring they have the confidence to bring in Euro 6d vehicles.

The Government will provide more data on fuel quality

The Department's fuel quality compliance program is expanding in the lead up to the 2024-25 implementation of fuel quality standard improvements. This will provide the Government with more data on the real world quality of Australia's fuel, and will assess the level of industry compliance when the improved standards come into force.

Through the Act's annual report, the Department will publish detailed data on the results of the expanded compliance program. This will provide industry with up-to-date information on Australia's actual fuel quality standards. Australia's fuel quality usually far exceeds the regulated minimum standards. This could provide industry with the certainty to import a greater number of Euro 6d diesel vehicles without additional regulatory burden on the petroleum industry.

Consultation question:

Will increased data showing that Australia's diesel exceeds regulated minimum standards provide the certainty vehicle importers require to bring Euro 6d diesel vehicles to Australia?

9.7 Shifts in petrol demand by grade

The Department is seeking to better understand the impacts of any shift in consumer demand for petrol grades and the resulting impacts on the fuel industry. If the Government reduces aromatics content in 95 RON and implements Euro 6d standards, this is likely to impact the demand of petrol by grade. The Department expects that demand will transition away from 91 RON and towards 95 RON. As only around 5% of the Australian fleet turns over annually, the transition will be gradual. The analysis has not quantified the costs or benefits of this transition because:

- vehicle importers have been unable to provide information on whether they could provide 91 RON vehicles that meet Euro 6d standards to the Australian market. Hence, the proportion of new vehicles that run on 91 RON versus 95 RON is difficult to estimate.
- most of the existing Australian fleet can use 91 RON. However, many motorists choose to fuel their vehicles with 95 RON and 98 RON. This will still be possible for any existing vehicles within the fleet. There may also be more competition and greater volumes of 95 RON sold,

putting downward pressure on price. With these counteracting factors it is difficult to quantify the impact on demand for petrol by grade.

Consultation Questions:

**How would an increase in demand for 95 RON impact the operations of the petroleum industry?
Are there any issues associated with implementing the preferred option that the draft RIS does not consider?**

9.8 Evaluation

Following the introduction of improved fuel standards, the Department will periodically evaluate its ongoing operation. This will include consideration of whether the new standards are meeting the objectives of the Act and are enabling all Euro 6d vehicles to be supplied in Australia.

The Department is proposing a review in 2027 to assess implementation of new fuel standards. The focus of the review will be on:

- are diesel parameters a barrier to future diesel vehicle operability?
- have the costs and benefits to supply a 'low aromatics' 98 RON petrol changed?

Consultation Questions:

Do you have any comments on the Department's proposed approach to evaluation?

10. Privacy and submissions

The Department of Climate Change, Energy, the Environment and Water is bound by the Australian Privacy Principles in the *Privacy Act 1988*. We respect your rights to privacy under the Privacy Act and we will comply with the requirements under the Act in respect of the collection and management of your personal information. The Department's Privacy Policy contains information about how to access or correct your personal information or make a complaint about a breach of the Australian Privacy Principles. The Policy is available at <https://www.dcceew.gov.au/about/commitment/privacy>

We respect your rights to privacy under the Privacy Act and we will comply with the requirements under the Act in respect of the collection and management of your personal information. By clicking 'submit' or otherwise sending us your submission to this consultation, you are consenting to the use and disclosure of any personal information contained in your submission as detailed in the following section of this draft RIS.

Personal information being collected

As part of this consultation process, the Department will collect the following personal information from you: your full name, mailing or street address, email address and contact telephone number.

Purposes for which we have collected your personal information

We request that you provide your personal information so that we can contact you in the event that your submission is unclear or incomplete. We may also use this personal information to keep you informed about the outcomes of this consultation process, as well as inform you of other relevant consultation processes. If you do not provide your personal information we may be unable to contact you regarding your submission or other consultations.

Disclosure of your personal information and submission

We may disclose your submission (including confidential submissions) and personal information to other Australian Government agencies, and state and territory governments, only for the purposes of providing advice to Government, for related purposes, and otherwise as required or permitted by law. Submissions marked as confidential will be treated as such by other agencies and will not be circulated further without the express permission of the Department and the author. We may also disclose submissions (including confidential submissions) and personal information where the Department is required or authorised to do so under law.

Other person's personal information and their consent

If you are making a submission which contains the personal information of another person, and you have not obtained the person's consent to their information being included in your submission, please de-identify or otherwise remove the personal information before providing your submission to the Department.

Publication of submissions

Unless you indicate that your submission is to be treated as confidential, the Department may publish your submission on the Department's website along with your name or organisation. This includes any personal information within your submission. If you choose for your submission to be treated as confidential, please indicate whether you agree for your submission to be published as an anonymous response. We recommend that submitters remove any personal information that they do not want published prior to making a submission. The Department reserves its rights to edit, and/or not consider or publish submissions that contain potentially offensive, or irrelevant material.

11. Appendix A - Further information on the cost benefit analysis

11.1 Costs associated with using ethanol as an octane enhancer for 98 RON in Option 3

11.1.1 Costs for refineries and terminals

To create 98 RON with a 35% aromatics limit, the refineries can likely produce a reformulated blendstock for oxygenate blending (petrol blendstock). This would have an approximate RON of 95.5 and a reduced Reid vapour pressure (RVP), such that the ethanol-blended petrol has a RON of 98 and an RVP which meets the current specification. E10 has a lower energy content than ULP, so using E10 98 RON will reduce fuel economy by a small percentage.

Ethanol cannot be added to petrol at the refineries and is instead added at fuel terminals. This is because ethanol absorbs water which promotes corrosion in the finished petrol systems. It is best mixed into the petrol as close to the delivery point as possible. This option requires more infrastructure costs outside the refineries. This includes investment in ethanol storage and blending infrastructure at fuel terminals around Australia, and upgrades to 98 RON tanks and dispensing systems at retailers.

Australian fuel terminals would need more tank and upgraded fire suppression equipment. The industry consultations show a wide range of costs, with an average of around \$2 million per terminal. This equates to a total terminal capital expenditure of \$72 million across all sites. The analysis projected annual operational expenditure to be 1.5% of capital expenditure, which equates to around \$1.1 million per year.

11.1.2 Ethanol supply chain costs

Introducing ethanol into a new petrol grade for 98 RON will impose costs on retailers due to the following changes:

- new underground storage tanks or re-lining of existing tanks, as some tanks are incompatible with ethanol—noting this does not impact all sites
- introducing ethanol-blended petrol into a tank that previously did not hold it involves a complex change-over and quality-verification process
- higher costs for maintenance and inspections required on bowsers and tanks that have ethanol-blended fuels
- rebranding with new decals, signage and software to notify consumers that 98 RON has changed to E10 98 RON.

For petrol retailers, ethanol-petrol blends can cause corrosion in old underground steel storage tanks. Storage of E10 in older fiberglass tanks can cause failure of the resin if it concentrates in the bottom of the tank when there is free water present.

It will be challenging for the fuel supply chain to accommodate use of ethanol in 98 RON by 2027. Introducing ethanol blends to all retail sites will take several years (approximately 7,000 sites) and there are limited resources to complete necessary facility upgrades.

The use of ethanol as an octane enhancer to produce 98 RON with a maximum of 35% aromatics would allow importers to import and certify Euro 6d vehicles that use either grade of PULP.

However, if 98 RON containing ethanol is suitable for Euro 6d vehicles, and there is also a 95 RON without ethanol that is suitable for Euro 6d vehicles, some consumers may move away from 98 RON to avoid the use of petrol containing ethanol.

In Australia, fuel grade ethanol is made as a biofuel from feedstocks that are byproducts of human food production, such as molasses, wheat starch and sorghum. According to a 2021 Bioenergy Australia report, the current installed production capacity is 436 ML/year from three facilities. One ethanol plant is currently shut down (in 2021), reducing the domestic ethanol capacity to approximately 360 ML/year.³⁴ The preexisting ethanol capacity would be needed to meet the NSW and QLD ethanol mandates.

The amount of ethanol required to make all 98 RON sold in Australia in 2021 contain 10% ethanol is around 310 ML/year. The development of Australia's ethanol industry, while important, is out of scope for this draft RIS.

11.2 Benefits from reduced health costs

Under BaU, annual health costs in Australian cities associated with motor vehicle emissions were approximately \$3.9 billion in 2024. This equates to around 1.6% of total health spending in Australia. These costs include:

- premature deaths from respiratory and cardiovascular illnesses and lung cancer which are associated with long-term exposure to air pollution
- premature deaths from respiratory and cardiovascular illnesses, associated with acute exposure to air pollution
- hospital admissions
- emergency Department admissions (especially due to asthma attacks)
- reduced quality of life associated with illnesses.

Under the BaU option, health costs remain constant over the period of analysis despite significant reductions in emissions of the main pollutants over that time. This is because:

- the number of people exposed to the pollution increases over time as population densities in our cities increase
- some of the health impacts of pollution associated with long-term exposure and changes in air quality can take time to take effect.

The CBA calculated health impacts using the damage cost approach. This approach estimates the avoided health costs through improving fuel quality standards. These damage costs assume an average impact on an average population affected by changes in air quality. Results are presented as a cost per tonne of emissions per geographic location. These costs are influenced by:

- deaths and illnesses caused by pollutant exposure
- the number of people exposed
- the value placed on human life and health
- the range of added costs and damages.

The BAU assumed the 2024 introduction of the 10 ppm sulfur limit. The focus of the CBA is limited to the reduction of aromatic content in Australian petrol and changes to diesel.

Implementing Option 1 would result in no net benefits. This is because the vast majority of regular unleaded petrol (RULP) currently sold has an aromatics level below the proposed 35% maximum aromatics, so any changes would be negligible.

The net present benefit of total avoided health costs for Option 2 between 2024 and 2040 is \$20.0 million. The estimation assumes that under a 35% aromatics limit for 95 RON, there would be a 1.6% reduction in particulate emissions. This result does not consider the benefits of Option 2 enabling Euro 6d standards.

The net present benefit of total avoided health costs under Option 3 for 95 RON and 98 RON between 2027 and 2040 is \$96.8 million. This assumes a 7.4% reduction in particulate emissions from a 35% aromatics limit for 98 RON, and the same reduction in particulate emissions for 95 RON as in Option 2.

There is evidence that suggests that blending 91 RON petrol with up to 10% ethanol may result in a 19–33% reduction of particulate emissions.³⁵ This may also translate to 98 RON, however the positive contribution to air quality and human health from blending ethanol with 98 RON was not quantified due to the lack of available evidence. The health benefits of \$96.8 million for Option 3 is likely underestimated as the air quality benefits from including ethanol in 98 RON were not completely quantified.

The net present benefits of avoided health costs under Option 4 for diesel is \$25.1 million. This assumes a 0.5% reduction in particulate emissions resulting from a maximum density of 845 kg/m³. No health benefits were linked with changes to the other diesel specifications under Option 4.

11.3 Unquantified benefits

Not all potential benefits of implementing the policy options are directly or fully reflected in market prices. It is difficult to quantify those benefits in dollar values or estimate their worth in a way that provides a true reflection of their economic value. For the CBA, the Department did not consider certain benefits where there was a lack of data to assign a monetary value to the benefits.

11.3.1 Fuel efficiency benefits

There will be some fuel efficiency benefits directly associated with improving fuel quality, even if Euro 6d standards are not implemented. The Department expects some vehicle importers will voluntarily import Euro 6d vehicles even if it is not mandated, where it makes commercial sense. Euro 6d vehicles tend to be more fuel efficient than the Euro 5-equivalent vehicles as many countries have both stringent noxious emissions standards and fleet fuel efficiency standards. Engines are now often designed to meet both standards. Through vehicle importers voluntarily bringing more Euro 6d vehicles to the Australian market, Australia's average fuel efficiency would improve. The Department was unable to find any data sources that could quantify this benefit and stakeholder feedback was unclear on this issue. As a result, this benefit was excluded from the CBA.

11.3.2 Greenhouse gas emissions reductions

Improved fuel quality will reduce GHG emissions but the reduction has not been quantified in this study. There are two sources of GHG emissions:

1. increases in fleet fuel efficiency as described above
2. for option 3, including ethanol in 98 RON would reduce GHG emissions.

Bioenergy Australia estimates that ethanol use at up to 10% in all grades of petrol in Australia can reduce total greenhouse gas emissions by up to 2.6 million tonnes CO₂ equivalent per year. Due to complexities around the lifecycle emissions of ethanol, the CBA was unable to quantify this reduction.

11.3.3 Unquantified health benefits

Adding ethanol to any petrol grade generally results in a reduction of noxious emissions and an increase in emissions of acetaldehyde and formaldehyde. The extent of emissions reductions attributed to ethanol varies greatly between studies. The Department did not find literature or evidence specifically relating to E10 98 RON. As a result, the analysis does not include a reduction of particulate emissions from including 10% ethanol in 98 RON.

Other potential non-market health benefits of options relative to the BaU case that have not been assessed in this analysis due to a lack of specific data include:

- some of the long-term health benefits associated with reducing tailpipe noxious emissions, particularly in relation to some cancers associated with ultrafine particulate emissions
- productivity benefits of reduced illness and hospitalisation
- health benefits associated with reducing evaporative emissions from vehicles (such as when refilling at petrol stations).

11.4 CBA sensitivity analysis

The CBA is based on a series of assumptions, meaning there is a degree of uncertainty around the results. Sensitivity testing can clarify which assumptions can materially change the results, including on discount rates and the number of refineries.

11.4.1 Discount rates

The OBPR requires the calculation of NPVs at an annual real discount rate of 7%. The sensitivity analysis also calculated the NPV with real discount rates of 3% and 10%. The analysis indicates the discount rate does not change whether the NPV of the options is positive or negative. This is mainly due to the proportional changes in costs and benefits over time moving together in all options assessed in this study.

Table 11 Discount rate sensitivity analysis

Option	Grade	Timing	NPV, 3% discount rate, \$m	BCR, 3% discount rate	NPV, 7% discount rate, \$m	BCR, 10% discount rate	NPV, 10% discount rate, \$m	BCR, 10% discount rate
Option 1	91 RON	2024–2040	–55.7	0.00	–41.3	0.00	–33.8	0.00
Option 2	95 RON	2024–2040	–244.9	0.10	–196.4	0.09	–171.3	0.09
Option 3	91 RON	2027–2040	–41.0	0.00	–28.2	0.00	–21.7	0.00
	95 RON	2027–2040	–195.8	0.10	–146.7	0.17	–119.2	0.09
	98 RON	2027–2040	–1,578.9	0.07	–1,141.5	0.06	–989.1	0.06
Diesel Options	Diesel all	2024–2040	–750.5	0.04	–557.4	0.04	–457.6	0.04
	PAH	2024–2040	–9.1	0.00	–6.8	0.00	–5.7	0.00
	DCN, CI	2024–2040	–313.7	0.00	–228.5	0.00	–185.3	0.00
	Density	2024–2040	–427.7	0.07	–322.0	0.07	–266.6	0.07

11.4.2 Ongoing operation of Australian refineries

Under the FSSP and the Refinery Upgrades Program, Australian refineries have committed to continue operation until 2027, with the option of extending to 2030. After this time, there is

significant uncertainty around the operation of Australian refineries to 2040. The sensitivity analysis considers the implication of the refinery operations under two alternative BaU cases. The BaU case used in the CBA assumes two refineries would continue to operate to 2030 and one would operate to 2040. The alternative BaU cases are:

- BaU2: The existing two refineries continue to operate to 2040.
- BaU3: The existing two refineries continue to operate to 2030 and both would end their operations in 2031.

The impact of refineries on the estimated net benefits of fuel quality standards is small. This is mostly due to their small share of supply in the domestic market. Table 12 summarises the results of different BaU cases.

The estimated net costs are lower when the existing two refineries cease to operate under BaU3. This is because they avoid paying the amortised capital expenditure required to upgrade their facilities and there will be no need for imported alkylate to improve the fuel quality specifications.

Table 12 Impact of different BaU cases with a 7% discount rate

Option	Grade	Timing	BAU 1	BAU 1	BAU 2	BAU 2	BAU 3	BAU 3
			NPV, \$m	BCR	NPV, \$m	BCR	NPV, \$m	BCR
Option 1	91 RON	2024–2040	–41.3	0.00	–44.4	0.00	–38.1	0.00
Option 2	95 RON	2024–2040	–196.4	0.09	–204.6	0.09	–188.2	0.10
Option 3	91 RON	2027–2040	–28.2	0.00	–31.3	0.00	–25.0	0.00
	95 RON	2027–2040	–146.7	0.17	–155.0	0.16	–138.5	0.18
	98 RON	2027–2040	–1,141.5	0.06	–1,231.5	0.05	–1,094.9	0.06
Diesel Options	Diesel all	2024–2040	–557.4	0.04	–678.9	0.04	–435.8	0.05
	PAH	2024–2040	–6.8	0.00	–8.8	0.00	–4.9	0.00
	DCN, CI	2024–2040	–228.5	0.00	–247.3	0.00	–209.8	0.00
	Density	2024–2040	–322.0	0.07	–422.8	0.06	–221.2	0.10

11.5 Distributional impact analysis

Besides the overall BCR, decision makers also consider the distributional impacts of a regulatory change on affected parties. As analysed in the CBA, the proposed standards have different impacts on the affected parties. The main affected groups are:

- refineries
- motorists
- environment
- community
- government
- petroleum supply chain.

Similar to Marsden Jacob's study in 2018,³⁶ Figures 5-8 list the potential impacts of the options, both positive and negative, on these stakeholder groups. A key point to note about the distributional analysis is that it not only includes costs and benefits but also transfers. Transfers are financial

transactions between two or more stakeholder groups that are not of themselves an economic cost or benefit. Key transfers in this analysis include Government support to the refineries. The analysis includes consideration of a transfer between the Government and motorists through the reduction in fuel excise in option 3.

Figure 5 Option 1 – 91 RON distributional analysis total cost and benefits (NPV) to 2040

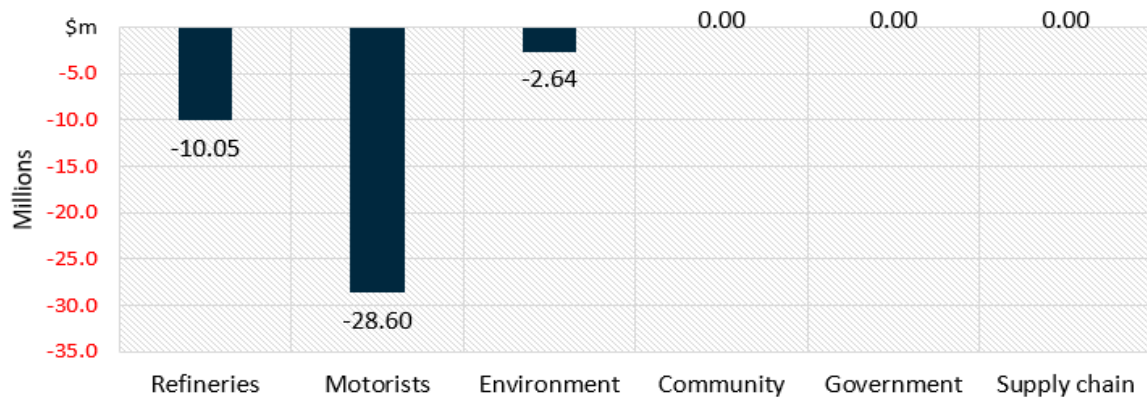


Figure 6 Option 2 – 95 RON distributional analysis total cost and benefits (NPV) to 2040

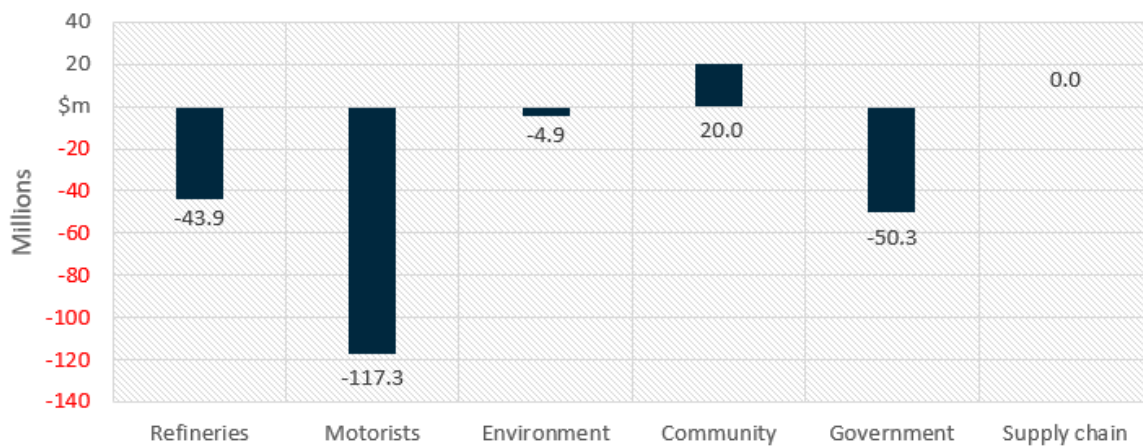


Figure 7 Option 3 – 91/95/98 RON distributional analysis total cost and benefits (NPV) to 2040

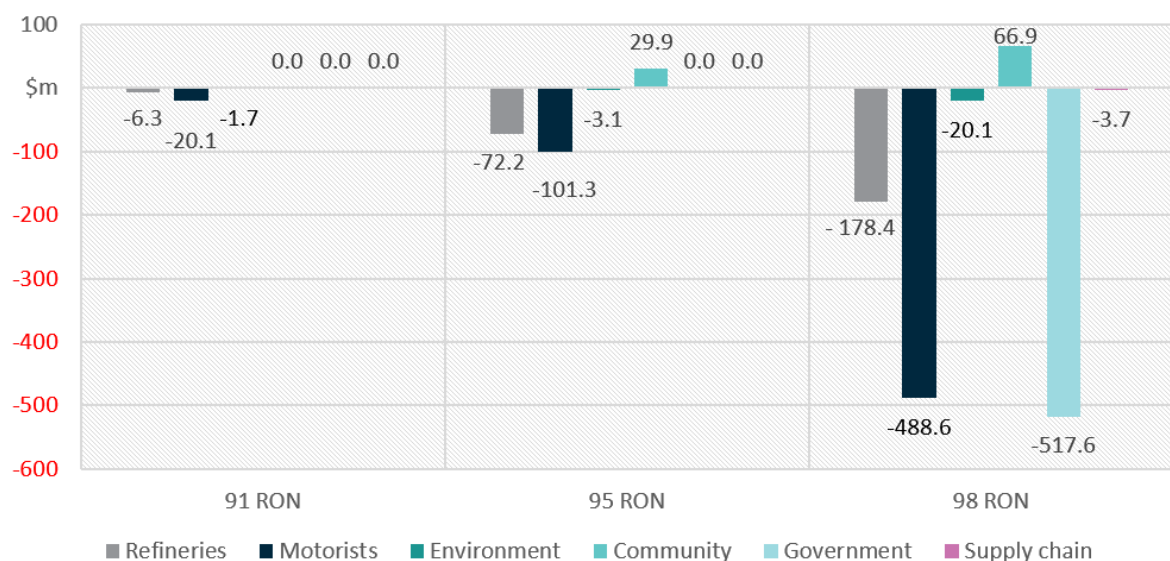
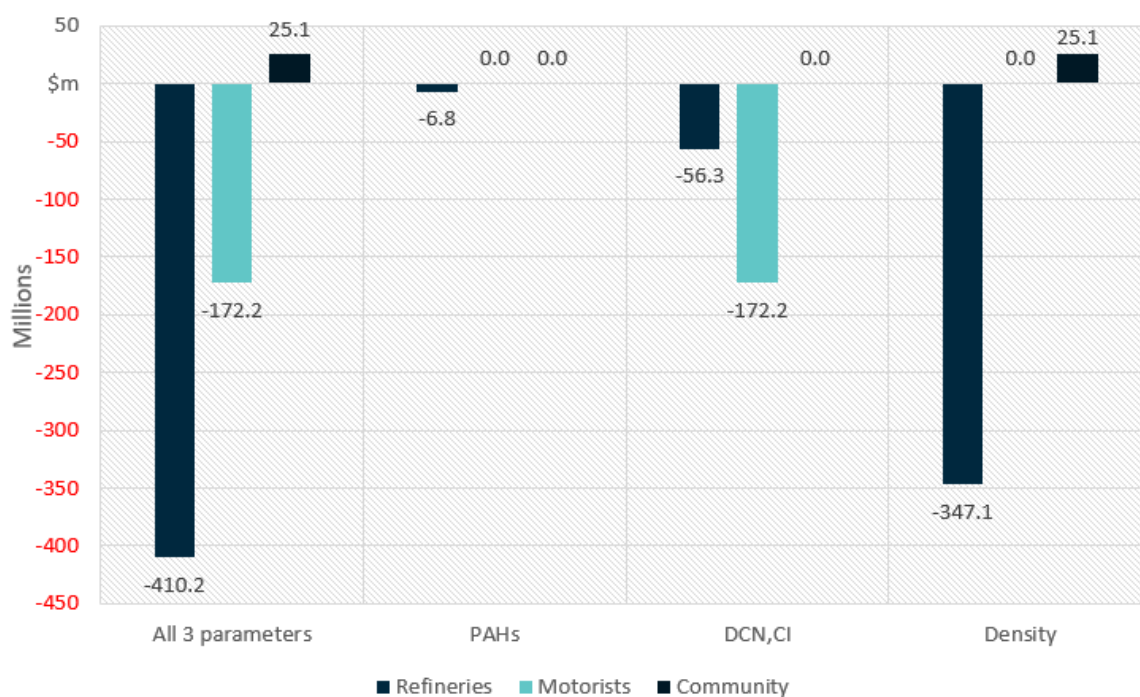


Figure 8 Option 4 – Diesel quality distributional analysis total cost and benefits (NPV) to 2040

11.6 Sources

The analysis has drawn on a number of information sources.

11.6.1 Specialist consultant inputs

The Department commissioned three studies in 2021 as part of the review of fuel quality standards.

1. Hale & Twomey, *Fuel quality standard investigations*.³⁷

A desktop research report on options for reform to Australia's fuel quality standards. This work was utilised by GHD and ACIL Allen in their preparation of a CBA report.

2. Stratas Advisors, *Impacts of aromatics in gasoline on Euro 6 vehicle operability*.³⁸

A desktop study on the impacts of higher aromatics levels on Euro 6d engines. This work canvassed international experience and academic literature. The report was utilised by GHD and ACIL Allen in their preparation of a CBA report.

3. GHD and ACIL Allen, *Fuel quality standards implementation: cost benefit analysis*.³⁹

GHD and ACIL Allen undertook the CBA which underlies the information presented in this draft RIS.

11.6.2 Discussions with key stakeholder groups

The Department worked with industry in formulating the assumptions for the study. Please see section 7 for further information on the consultations.

11.6.3 Fuel demand forecasts

The fuel demand forecasts are consistent with the forecasts used for BITRE's 2021 CBA modelling on Euro 6d (this modelling has not been published). Future demand for petroleum fuels is expected to be influenced by population growth, fuel efficiency and electric vehicle uptake.

11.6.4 Fuel price forecasts

Two sources of long-run crude oil price projections are available from the US Energy Information Administration and the OECD/International Energy Agency (IEA). The analysis has opted to use OECD/IEA's World Energy Outlook 2021 Stated Policies Scenario oil prices.⁴⁰ They project the price of oil will be US\$82/bbl in '2020 prices' by 2040. The analysis uses an exchange rate of A\$0.73/US\$ to convert into Australian dollars.

The analysis assumes that the historical price differentials between different grades of petrol and the price differentials between the terminal gate prices and retail prices would remain and continue reflecting their quality differences, transport, and other costs and margins.

The analysis calculates retail fuel price components of 91 RON, 95 RON, 98 RON and diesel prices based on the projected nominal prices. All grades of petrol and diesel pay the same excise duty rates. Petrol and diesel prices moved in line with each other historically (generally following movements in the price of crude oil).

As fuel prices in Australia are largely driven by international fuel prices, fuel price increases experienced by motorists under the different options will largely reflect the estimated changes to prices of imported fuel.

11.7 Assumptions

Where necessary, the CBA made assumptions based on the best available evidence collected from a wide range of published sources, expert advice and stakeholder feedback. Table 13 outlines the key factors that determine the benefits of each option, and the values used for them. These key factors include:

- supply of raw materials:
 - additional refinery blendstock – required to improve the octane number whilst reducing the level of aromatics. This would impact on refinery operational expenditure.
 - blendstock price premium - as blendstock is a product from an overseas refinery that is imported and costs more than the same volume of crude oil.
 - change in refinery crude slate required to adjust the diesel specification.
- production of finished fuels:
 - additional refinery capital costs – capital expenditure associated with modifications to existing refinery equipment and installation of new infrastructure.
 - Government support with capital costs – through RUP phase 2, each refinery is eligible for up to \$26 million in grants towards infrastructure improvements to enable the implementation of Euro 6d standards in Australia. This is only available in the event the improved fuel standards are implemented in 2024.
 - additional refinery operating costs – operational expenditure associated with changed refinery operations, for example, purchase of additional feedstock and increased fuel consumption.
- addition of ethanol (where applicable), which has the following impacts:
 - capital expenditure on additional fuel terminals– changes such as increased storage and mixing facilities for options that require ethanol to be added to the petrol.
 - retail distribution capital expenditure – retailers will incur extra costs to supply grades of fuel containing ethanol. This requires some retailers to upgrade or modify their

- underground storage tanks and pipework. There will be other associated costs with site features such as tank changeover, certification and signage.
- additional ethanol production operating costs – the price premium of ethanol over 98 RON is not known and is not included in the CBA.
 - current proportion of fuel that does not already meet the changed specification for each option.
 - per cent impact of each option on noxious emissions, and the associated urban and rural emissions unit health costs.
 - human life extension benefits (avoided health and human costs) due to lower noxious emissions.
 - change in GHG emissions in refining and road transport, and the associated real GHG emissions price, taken to be \$17/tonne CO₂ equivalent, based on the Australian Government Emissions Reduction Fund average price in October 2021.^{41,z}

Table 13 Key assumptions

Item	Variables	Relevant options	Units	Value \$
Costs				
Capital costs	Infrastructure to meet 35% max aromatics	Option 1: 91 RON and Option 3: 91 RON	\$m	0
	Infrastructure to meet 35% max aromatics	Option 2: 95 RON and Option 3: 95 RON	\$m	70
	Infrastructure to meet 35% max aromatics	Option 3: 98 RON for refineries	\$m	70
	Infrastructure to meet 35% max aromatics	Option 3: 98 RON supply chain terminals	\$m	72
	Infrastructure to meet 35% max aromatics	Option 3: 98 RON supply chain retailers	\$m	554
	Infrastructure to meet 35% max aromatics	Option 3: 98 RON total capital expenditure	\$m	696
	No infrastructure required to meet <8% PAH in diesel	Option 4: Diesel PAH	\$m	0
	Infrastructure required to meet >51 DCN in diesel	Option 4: Diesel DCN	\$m	6
	Infrastructure required to meet ≤845 kg/m ³ density in diesel	Option 4: Diesel density	\$m	0
	Three diesel parameters	Option 4: Total capital expenditure	\$m	6
Refinery operating cost impact on fuel prices	Operational expenses required to meet 35% max aromatics	Option 1: 91 RON and Option 3: 91 RON	cpl	0.08
	Operational expenses required to meet 35% max aromatics	Option 2: 95 RON and Option 3: 95 RON	cpl	1.10
	Operational expenses required to meet 35% max aromatics	Option 3: 98 RON	cpl	3.60
	Operational expenses required to meet <8% PAH in diesel	Option 4: Diesel PAH	cpl	0.019
	Operational expenses required to meet >51 DCN in diesel	Option 4: Diesel DCN	cpl	0.227

^z Note the Australian Government published a new average price of carbon credits in April 2022, which averaged at \$17/tonne.

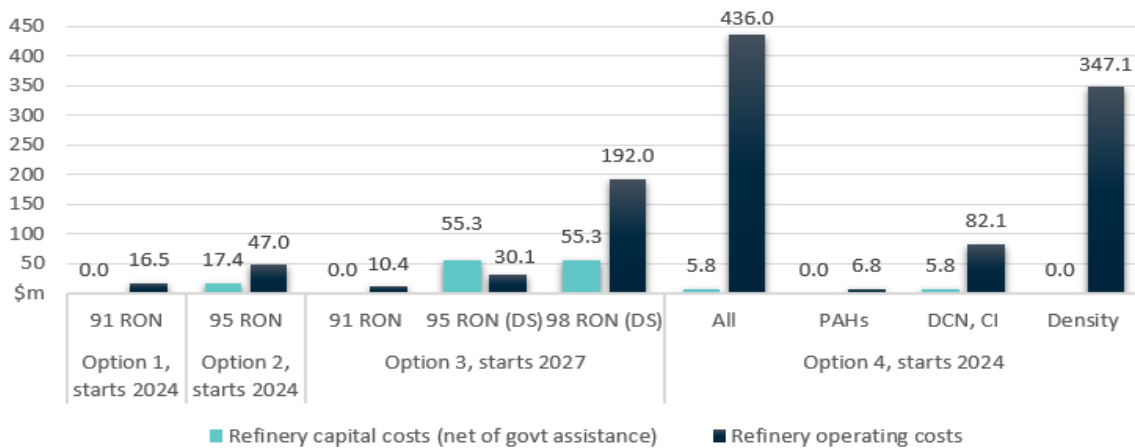
Item	Variables	Relevant options	Units	Value \$
	Operational expenses required to meet ≤ 845 kg/m ³ density in diesel	Option 4: Diesel density	cpl	0.962
Imported fuel price impacts	Expenses required to meet 35% max aromatics	Option 1: 91 RON and Option 3: 91 RON	cpl	0.03
	Expenses required to meet 35% max aromatics	Option 2: 95 RON and Option 3: 95 RON	cpl	0.50
	Expenses required to meet 35% max aromatics	Option 3: 98 RON	cpl	1.30
	Expenses required to meet <8% PAH in diesel	Option 4: Diesel PAH	cpl	0.00
	Expenses required to meet >51 DCN in diesel	Option 4: Diesel DCN	cpl	0.087
	Expenses required to meet ≤ 845 kg/m ³ density in diesel	Option 4: Diesel density	cpl	0.00
Benefits				
Noxious emissions	PM _{2.5} and PM ₁₀ reductions	Option 1: 91 RON and Option 3: 91 RON	%	0.00%
	PM _{2.5} and PM ₁₀ reductions	Option 2: 95 RON and Option 3: 95 RON	%	-1.60%
	PM _{2.5} and PM ₁₀ reductions	Option 3: 98 RON	%	-7.40%
	PM _{2.5} and PM ₁₀ reductions	Option 4: Diesel PAH	%	0.00%
	PM _{2.5} and PM ₁₀ reductions	Option 4: Diesel DCN	%	0.00%
	PM _{2.5} and PM ₁₀ reductions	Option 4: Diesel density	%	-0.50%
Avoided health costs	PM _{2.5}		\$/t, \$2021 prices	584,971
Avoided health costs	PM ₁₀		\$/t, \$2021 prices	109,695

11.7.1 Refinery production costs

The actual reduction in aromatics required under Options 1 and 2 to meet a 35% limit (down from 45%) is likely to be minor. Data indicates the current levels of aromatics in petrol are already substantially below current limits and mostly meet the revised limit.

For Option 2 the reduction in aromatics in 95 RON would require an estimated capital investment of around \$70 million across the two Australian refineries, mainly related to alkylate storage facilities. Under Option 3 for 98 RON, refineries will need capital investment and incur operating costs to meet the proposed new standard. There will be significant supply chain capital and operating costs.

Lowering aromatics in petrol is also anticipated to add to the operating cost of producing 95 RON and 98 RON petrol. Only slight cost increases are expected for the production of 91 RON petrol as it already normally meets the proposed 35% aromatics limit. The estimated refinery capital and operational expenditure related to various options are outlined in Figure 9.

Figure 9 Estimated refinery expenditure for each option

11.7.2 Impact of desulfurisation on aromatics

From 15 December 2024, all petrol supplied in Australia must meet a maximum limit of 10ppm sulfur. The desulfurisation process in petrol reduces octane. To bring petrol back up to the required octane levels, more aromatics content is needed. The CBA assumes a 2% increase in aromatics content post-desulfurisation. This assumption was then used to create estimations of post-desulfurisation aromatics content in the BaU scenario.

11.7.3 Alignment with other studies

DITRDC released the *Light vehicle emission standards for cleaner air: draft regulation impact statement* in October 2020. As far as possible, analysis for this review was undertaken to be consistent with the other reviews, including using the same base-case assumptions where relevant. These assumptions include:

- the current and projected fuel consumption by light and heavy vehicles, and the split of fuel types, are similar
- the current emissions standards for light vehicles (ADR 79/04) are expected to be in place for both studies

This study assesses the costs and benefits of changes to fuel quality standards in isolation from changes to noxious emissions standards.

Appendix B - Stakeholder groups consulted

Stakeholder group	Stakeholders
Key industry bodies	<ul style="list-style-type: none"> • Australian Institute of Petroleum • Federal Chamber of Automotive Industries • Australian Automobile Association • Truck Industry Council
Fuel refiners	<ul style="list-style-type: none"> • Viva Energy • Ampol
Fuel importers	<ul style="list-style-type: none"> • BP Australia • ExxonMobil • Chevron • United Petroleum • PetroChina • Park Fuels • Glencore
Fuel retailers	<ul style="list-style-type: none"> • Australian Convenience and Petroleum Marketers Association
Automotive industry	<ul style="list-style-type: none"> • Australian Trucking Association • Volkswagen • Toyota • Hyundai • Volvo trucks • Daimler trucks
Renewable fuels	<ul style="list-style-type: none"> • Bioenergy Australia
Fuel supply chain/fuel additive suppliers	<ul style="list-style-type: none"> • A.S. Harrison
Government	<ul style="list-style-type: none"> • Department of Agriculture, Water and Environment • Department of Infrastructure, Transport, Regional Development, Communications and the Arts • Department of Prime Minister & Cabinet • Fuel Standards Consultative Committee • State Government Departments

Appendix C - List of consultation questions

The Department is seeking feedback on the below questions. We also welcome any other feedback on all the policy options considered.

1. Is there further quantitative evidence available that demonstrates aromatics content above 35% impacts operability or necessitates more regular servicing or part replacement of Euro 6d emissions controls?
2. Are there additional costs the Department should consider in calculating regulatory burden? Please provide evidence of costs where possible.
3. What are the key concerns for consumers in the event a low aromatics 95 RON standard is introduced and becomes the primary recommended petrol for new light vehicles?
4. Are there further risks to operating Euro 6d vehicles recommended to run on 98 RON petrol with Australian 98 RON?
5. What is the best way for the Government to partner with industry to provide the most effective education materials? Do you have any suggested approaches?
6. Do you have comments on labelling requirements that should be implemented for low aromatics petrol or 98 RON?
7. Do car importers agree that 95 RON is expected to become the primary recommended petrol for Euro 6d vehicles? Is any information available on the use of 91 RON petrol in Euro 6d compliant vehicles?
8. Can new Euro 6d high performance vehicles operate effectively on ultra-low sulfur and low aromatics (35%) 95 RON? If not, please provide a list of specific models and the reasons for the operability issues with those models.
9. Can the service station industry provide additional information on the costs and implementation requirements of the preferred option for service stations?
10. Is further information available on the costs and implementation requirements of the preferred option for refineries and fuel importers?
11. Will increased data showing that Australia's diesel exceeds regulated minimum standards provide the certainty vehicle importers require to bring Euro 6d diesel vehicles to Australia?
12. How would an increase in demand for 95 RON impact the operations of the petroleum industry?
13. Are there any issues associated with implementing the preferred option that the draft RIS does not consider?
14. Do you have any comments on the Department's proposed approach to evaluation?

References

- 1 International Council on Clean Transportation – Anenberg, S, Miller, J, Henze, D, Minjares, R (2019). [*A Global Snapshot of the Air Pollution-Related Health Impacts of Transportation Sector Emissions in 2010 and 2015*](#), 2019, accessed 9 November 2022
- 2 Bureau of Infrastructure and Transport Research Economics estimates 2021, unpublished
- 3 Federal Chamber of Automotive Industries, *FCAI response to better fuel for cleaner air draft regulation impact statement*, FCAI, 2018
- 4 Carsguide.com.au, [*Volkswagen Golf, Audi A3 and other cars set to get cleaner thanks to Australia's new fuel plans*](#), accessed 6 October 2022
- 5 Stratas Advisors, *Impacts of aromatics in gasoline on Euro 6 vehicle operability*, report to the Australian Government Department of Industry, Science, Energy and Resources, Stratas Advisors, 2021
- 6 Stratas Advisors, *Impacts of aromatics in gasoline on Euro 6 vehicle operability*, report to the Australian Government Department of Industry, Science, Energy and Resources, Stratas Advisors, 2021
- 7 Stratas Advisors, *Impacts of aromatics in gasoline on Euro 6 vehicle operability*, report to the Australian Government Department of Industry, Science, Energy and Resources, Stratas Advisors, 2021
- 8 GoAuto [*Better fuel already on the way, opinions vary over ability of engines to meet Euro 6d*](#), 2021, accessed 27 September 2022
- 9 ABMARC, *Technical advice on fuel parameters and specifications*, report to the Australian Government Department of the Environment and Energy, ABMARC, 2017
- 10 The Hon Catherine King MP, [*Cleaner emissions standards for trucks and buses*](#), 2022, accessed 20 October 2022
- 11 Green Vehicle Guide data, 2021
- 12 International Agency for Research on Cancer (IARC), [*Air pollution and cancer: IARC scientific publication no. 161*](#) (K Straif, A Cohen and J Samet eds), World Health Organization, Geneva, 2013
- 13 International Agency for Research on Cancer (IARC), [*Air pollution and cancer: IARC scientific publication no. 161*](#) (K Straif, A Cohen and J Samet eds), World Health Organization, Geneva, 2013
- 14 J Gasana, D Dillikar, A Mendy, E Forno and ER Vieira, 'Motor vehicle air pollution and asthma in children: a meta-analysis', *Environmental Research*, 2012, 117:36–45, doi:10.1016/j.envres.2012.05.001;
- 15 J Gasana, D Dillikar, A Mendy, E Forno and ER Vieira, 'Motor vehicle air pollution and asthma in children: a meta-analysis', *Environmental Research*, 2012, 117:36–45, doi:10.1016/j.envres.2012.05.001;
- 16 E Samoli, RW Atkinson, A Analitis, GW Fuller, DC Green, I Mudway, HR Anderson and FJ Kelly, 'Associations of short-term exposure to traffic-related air pollution with cardiovascular and respiratory hospital admissions in London, UK', *Occupational and Environmental Medicine*, 2016, 73(5):300–307, doi:10.1136/oemed-2015-103136
- 17 DL Buckeridge, R Glazier, BJ Harvey, M Escobar, C Amrhein and J Frank, 'Effect of motor vehicle emissions on respiratory health in an urban area', *Environmental Health Perspectives*, 2002, 110(3):293–300, doi:10.1289/ehp.02110293

- 18 Environment Protection Authority Victoria, [Vehicle emissions and air quality](#), EPA Victoria website, 2019, accessed 27 May 2022; NSW Government, *Submission on the Better fuel for cleaner air discussion paper*, 2017
- 19 Emberson, L., 2020, [Effects of ozone on agriculture, forests and grasslands](#), *Philosophical Transactions of the Royal Society A* 378: 20190327
- 20 Department of Industry, Science, Energy and Resources, [National greenhouse gas inventory: quarterly updates](#), DISER, Australian Government, 2021, accessed 6 July 2022.
- 21 National Transport Commission, [Carbon Dioxide Emissions Intensity for New Australian Light Vehicles 2019](#), Australian Government 2020, accessed 28 September 2022
- 22 K Sharp and B Kallichurn, [Ethanol: Australia's octane enhancer](#), Bioenergy Australia, 2021, accessed 7 June 2022
- 23 Department of Industry, Science, Energy and Resources, [Australian Energy Statistics 2020 Table F](#) [data set], energy.gov.au, 2020, accessed 7 June 2022
- 24 Department of the Environment and Energy, [National clean air agreement](#), DOEE, Australian Government, 2015
- 25 *Environmental Protection (Petrol) Regulations 1999* (WA)
- 26 B Akaribo and B Afotey, 'Comparative analysis of selected octane enhancing fuel additives as substitute to methycyclopentadienyl manganese tricarbonyl (MMT)', *International Journal of Energy Engineering*, 2017, 7(3):65–73, doi:10.5923/j.ijee.20170703.01
- 27 Bureau of Infrastructure and Transport Research Economics estimates 2021, unpublished
- 28 OBPR, [Regulatory burden measurement framework](#), Department of the Prime Minister and Cabinet, Australian Government, 2020, accessed 7 June 2022
- 29 K Sharp and B Kallichurn, [Ethanol: Australia's octane enhancer](#), Bioenergy Australia, 2021, accessed 7 June 2022
- 30 Bureau of Infrastructure and Transport Research Economics estimates 2021, unpublished
- 31 Australian Bureau of Statistics, [Survey of Motor Vehicle Use, Australia](#), accessed 5 October 2022
- 32 The Hon Catherine King MP, [Cleaner emissions standards for trucks and buses](#), 2022, accessed 20 October 2022
- 33 Department of Industry, Science, and Resources, [Department of Industry, Science, Energy and Resources annual report 2021–22](#), page 150, accessed 6 November 2022
- 34 K Sharp and B Kallichurn, [Ethanol: Australia's octane enhancer](#), Bioenergy Australia, 2021, accessed 7 June 2022
- 35 T Beer et al., 'The Health Impacts of Ethanol Blend Petrol', *Energies*, 2011, 4(2):352–367, doi:10.3390/en4020352, accessed 7 June 2022
- 36 Marsden Jacob Associates, *Revised fuel quality standards: economic analysis*, report to the Australian Government Department of the Environment and Energy, MJA, 2018
- 37 Hale & Twomey, *Fuel quality standards 2021 investigations – final report*, report to the Australian Government Department of Industry, Science, Energy and Resources, ABMARC, 2021
- 38 Stratas Advisors, *Impacts of aromatics in gasoline on Euro 6 vehicle operability*
- 39 GHD Pty Ltd and ACIL Allen Consulting, *Fuel quality standards implementation: cost benefit analysis*, report to the Australian Government Department of Industry, Science, Energy and Resources, GHD and ACIL Allen, 2022
- 40 International Energy Agency, [World energy outlook 2021](#), IEA website, 2021, accessed 9 June

2022

- ⁴¹ Clean Energy Regulator, [Auction October 2021](#), Clean Energy Regulator website, 2021, accessed 5 July 2022