Australian Government
Department of Climate Change, Energy, the Environment and Water

Non-Road Diesel Engines: Noxious Emission Standards

Impact Analysis – May 2023

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Acknowledgement of Country

Our department recognises the First Peoples of this nation and their ongoing connection to culture and country. We acknowledge First Nations Peoples as the Traditional Owners, Custodians and Lore Keepers of the world's oldest living culture and pay respects to their Elders past, present and emerging.

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Executive Summary

An evaluation of potential national approaches to manage noxious emissions from non-road diesel engines was undertaken by the Commonwealth and New South Wales Governments. This document provides a summary of the evaluation, including the market analysis and the cost-benefit analysis outcomes. This information was provided to the Minister for the Environment and Water, the Hon Tanya Plibersek MP in 2022. Minister Plibersek endorsed undertaking an Impact Analysis process before any decision would be made to regulate.

This work is the culmination of more than 10 years effort by both governments. The cost-benefit analysis looks at non-road diesel engines used in 27 different equipment types, covering 10 power bands, 6 emission standards over 40 years, equating to around 57,000 different cases. Out of scope were intermodal transport equipment (road, rail, ship, aircraft) as well as defence equipment and stationary engines.

Policy assessment criteria for the impact analysis includes:

1) Achieve appreciable health and environmental outcomes
2) Ensure the most effective operation of non-road diesel engines
3) Facilitate adoption of better non-road diesel engine and emission control technologies
4) Reduction in greenhouse gas emissions
5) Achieve harmonisation with international standards
6) Maximise net national benefits

This impact analysis is seeking a preferred option based on consideration of the policy assessment criteria and the feedback received through the consultation processes. Stakeholder consultation has been a foundation of the evaluation and this document is again seeking a response to the seven questions required by the Australian Government Guide to Policy Impact Analysis (Commonwealth of Australia, 2023). This feedback will be presented to decision makers at the completion of the impact analysis process.

The seven Impact Analysis questions are:

1) What is the policy problem you are trying to solve and what data is available?
2) What are the objectives, why is government intervention needed to achieve them, and how will success be measured?
3) What policy options are you considering?
4) What is the likely net benefit of each option?
5) Who will you consult and how will you consult them?
6) What is the best option from those you have considered and how will it be implemented?
7) How will you evaluate your chosen option against the success metrics?

Stakeholder views will be sought on the costs and benefits included in the analysis, how and when the policy options could be implemented and whether the options are likely to achieve the desired health, environmental and technological outcomes.

Information from the cost-benefit analysis report is set out in the document. In 2018, non-road diesel engines in Australia emitted 104 kilotonnes (kt) of CO, 19.5 kt of THC, 312 kt of NO_X, 13.4 kt of PM_{10}, 13.0 kt of $PM_{2.5}$, 178 t of SO_2 and 29.5 megatonnes (Mt) of CO_2. Non-road diesel engines are likely to be responsible for around 10-15 per cent of national anthropogenic NO_X emissions, up to 5 per cent of $PM_{2.5}$ emissions, around 1-2 per cent of PM_{10} emissions and approximately 5 per cent of national GHG emissions.

These emissions resulted in a combined annual years of life lost (YLL) for the whole of Australia of 5,387, equating to a cost to society of $1.6 billion (real 2021 prices). This equated to around 9% of all YLL due to anthropogenic (all source) $PM_{2.5}$ and NO_2 concentrations in Australia. Health impacts and costs would continue to be incurred in future years.

The main results of the cost-benefit analysis, defined as the net effects of the management scenarios relative to the business as usual (BAU) scenario, are outlined in this report. The costs of the management scenarios over the full timeframe of the analysis ranged from $640 million to $3.0 billion. All three management scenarios resulted in a large total benefit over the full timeframe (between around $1.1 billion and $5.3 billion). The net present values (NPV) ranged from $2.2 billion, down to $470 million. The main differences between the different options (and the NPV) were the amount of stock affected, and how quickly the impact on the stock occurred.

The risks to success are also discussed, including possible exemptions to the standards and how these might be applied.

1 Introduction

Unlike most developed nations Australia does not have national noxious emissions standards for non-road diesel engines. Comparable nations implemented standards more than twenty years ago. Australia has implemented and progressively upgraded standards for other sources of noxious emissions, such as registered vehicles, but emissions from non-road diesel engines are not regulated.

Non-road diesel engines are now the largest unregulated source of air pollution in Australia. These emissions are harmful to human health and the environment. They are carcinogenic, and contribute to premature deaths, cardiovascular and respiratory diseases.

The National Clean Air Agreement (NCAA) was established by Australia's environment ministers in 2015 to address the impacts of air pollution on human health and the environment. One priority in the 2018-2020 NCAA work plan was to evaluate a national approach to managing emissions from non-road diesel engines (the evaluation).

The evaluation was undertaken in two main stages:

- A market analysis (2020)

  The first stage of the evaluation was a market analysis of the non-road diesel engine market in Australia. This included an engine stock model and emission calculations. The analysis found that non-road diesel engines produce a significant quantity of noxious emissions. It also found that there has generally been a low uptake of equipment compliant with the most recent international emission standards.

- A cost-benefit analysis (2022)

  The second stage was a national cost-benefit analysis (CBA). The CBA examined various 'management scenarios' for reducing non-road diesel engine emissions. It drew on the market analysis data, as well as significant data input from industry stakeholders, to establish a 'business as usual' (BAU) case from which to analyse the impact of three potential management scenarios. It did this through examining emissions from the stock model, a chemical transport model to show exposure to populations, a health impact model and an economic model to cost the health impacts.

In 2022 the evaluation's findings were presented to the Minister for the Environment and Water, the Hon Tanya Plibersek MP. The Minister endorsed proceeding to an impact analysis process (formerly a Regulation Impact Statement) to determine possible impacts of the introduction of emission standards on the community. The impact analysis formally commenced after approval from the Office of Impact Analysis.

As the issues covered in this impact analysis are also examined in the CBA report, it is recommended that any appraisal of this work be read in companion with the CBA report as well.

1.1 Scope

The Australian Government, under the Auditing and Assurance Standards Board, has a policy of harmonising Australian standards with overseas standards wherever possible. The CBA referenced the United States Environmental Protection Agency's (US EPA) regulations, as well as the standards in place in Europe, as being appropriate to apply in Australia. For consistency, the cost-benefit analysis used the definitions and stock data from the market analysis, which generally reflected the emission regulations in the US and EU.

For the cost-benefit analysis, the feedback from stakeholder consultation was also considered to refine the stock model. Emissions were calculated for 27 different equipment types. For each type, the stock was broken down into 10 power bands and 6 emission standard categories over a 40-year age distribution. Allowing for non-existent combinations in the real world, this equated to a total of 57,000 different cases.

Non-road diesel engines that were out of scope in the analysis were generally those used in intermodal transport equipment (rail, ship, aircraft, truck), as per the practice with US EPA standards. Defence equipment was also excluded due to the sensitivity of associated information.

Stationary engines are also not covered under the US EPA non-road regulations. Stationary engines can be associated with significant diesel consumption, such as at offshore petroleum facilities or diesel power generation plant. Some of the datasets used for the cost-benefit analysis included stationary engines, but these engines could not always be identified, or their identification and removal would have involved considerable effort. Therefore, for overall consistency of the data and statistics, stationary engines were retained in the analysis. However, an investigation of facility-based data identified around 40 facilities that were either offshore or used diesel in power stations, and these contributed just 0.5 per cent of total national non-road diesel use.

1.2 Policy Assessment Criteria

To meet the best practice regulation guidelines, the department considered six assessment criteria in the development of the policy options. These are:

1) Achieve appreciable health and environmental outcomes
2) Ensure the most effective operation of non-road diesel engines
3) Facilitate adoption of better non-road diesel engine and emission control technologies
4) Reduction in greenhouse gas emissions
5) Achieve harmonisation with international standards
6) Maximise net national benefits

Through this impact analysis the department seeks to identify which option best meets the policy assessment criteria. It includes a detailed analysis of the costs and benefits for individuals, non-government organisations and businesses covering a wide range of sectors. An analysis of potential impacts on the environment and regional Australia should also be considered. In this context, the above assessment criteria are all important and will be considered in the deliberations, but those that are most reflected in the cost-benefit analysis include health and environmental outcomes and maximising net national benefits.

1.3 Consultation

We are seeking stakeholder input on this draft Impact Analysis.

The final Impact Analysis will be used to advise the Australian Government on the likely impacts of the management options under consideration. The department will propose a preferred option based on consideration of the policy assessment criteria and impact analysis findings. Feedback received on this draft will be incorporated into the final report presented to decision makers.

The department has prepared draft answers to the seven questions required by the Australian Government Guide to Policy Impact Analysis (Commonwealth of Australia, 2023). We request feedback from stakeholders on the draft assessment under those seven sections (2.1 to 2.7).

Stakeholder views are sought on the costs and benefits included in the analysis, how and when the policy options could be implemented and whether the options are likely to achieve the desired health, environmental and technological outcomes. As implementation of the policy reforms would require capital and operating cost investment by Australia's major industrial sectors (mining, agriculture, construction, forestry etc.) we are particularly seeking their input to this process.

Significant consultation has been conducted throughout earlier stages of the evaluation, outlined in section 2.5.1. We greatly appreciate the stakeholder input provided to the department over the last two years and thank you for your continuing support in finalising this work.

Consultation questions are posed to stakeholders throughout this document. See section 2.5.2 on how to make a submission.

2 The Impact Analysis process

In accordance with the Australian Government Guide to Policy Impact Analysis (Commonwealth of Australia, 2023), this impact analysis addresses the following questions:

1) What is the policy problem you are trying to solve and what data is available?
2) What are the objectives, why is government intervention needed to achieve them, and how will success be measured?
3) What policy options are you considering?
4) What is the likely net benefit of each option?
5) Who will you consult and how will you consult them?
6) What is the best option from those you have considered and how will it be implemented?
7) How will you evaluate your chosen option against the success metrics?

Through consultation on this draft Impact Analysis, stakeholder views are being sought on the following aspects:

- the costs and benefits included in this impact analysis
- how and when the policy options could be implemented
- whether the options are likely to achieve the proposed and desired health, environmental and technological outcomes.

Stakeholder input will contribute to the final set of regulatory options proposed to Government. This impact analysis will inform the Australian Government's decision on whether to regulate.

2.1 What is the policy problem you are trying to solve and what data is available?

Research presented in the 2021 State of the Environment Report states there may be no 'safe' level of exposure to some pollutants, particularly fine particulate matter ($PM_{2.5}$). $PM_{2.5}$ concentration is a key well-being indicator for the United Nations Sustainable Development Goal 11, which aims to make cities and human settlements inclusive, safe, resilient and sustainable. Peak reported levels of $PM_{2.5}$ were above the national standards in all Australian cities, and levels are increasing in many locations. Exposure to $PM_{2.5}$ is estimated to be responsible for around 2 per cent of all deaths in Australia (Emmerson & Keywood, 2021). Using technology already available in the market that meets non-road diesel engine emission standards can reduce the death rate.

Non-road diesel engine emissions are the largest source of unregulated air pollution in Australia. Unlike most developed nations, Australia has no standard to manage noxious emissions from non-road diesel engines. Emission standards have been in place in other countries for more than twenty years. While Australia implemented noxious emission standards for registered diesel vehicles in 1995, there are no corresponding Australian standards for non-road diesel engines. The CBA shows there is a net benefit to adopting national emissions standards. Non-road diesel engine emissions will continue to be a problem in the absence of intervention.

Diesel engines are installed in a wide range of non-road vehicles and equipment. Specific examples of equipment include tractors, cranes, loaders, excavators, bulldozers, forklifts, pumps, compressors and generators. Non-road diesel engines are also used in a wide range of sectors and applications, including industrial, construction, power generation, mining, agriculture, marine and forestry.

As found in the evaluation, in Australia all non-road diesel engines are imported, either as loose engines or already incorporated into equipment. In 2018 around 70,000 engines were imported, with a combined market value of $1.9 billion. Most imported engines are new, although some are reconditioned (both loose and incorporated engines). Engines are imported into Australia from approximately 25 countries. In 2018 the major sources were China (30 per cent), European countries (26 per cent) and the US (22 per cent).

Non-road diesel engine stock has generally been increasing over time. Estimates for the non-road diesel engine population in 2008 was 620,000, according to the NSW EPA's "Reducing Emissions from Non-Road Diesel Engines" information report (p.73). Whereas the CBA notes that in 2018 the total number of non-road diesel engines in Australia was around 640,000 units. It is projected to increase to around 750,000 units by 2028 and to around 945,000 units by 2043.

Non-road diesel engines are a significant – but poorly characterised – contributor to air pollution in Australia. Diesel engines emit a large number of air pollutants, many of which can cause harm to human health and the environment. Diesel exhaust poses a significant risk to human health. It is associated with both acute and chronic health effects and has been classified as a Group 1 carcinogen. Diesel engine emissions contribute to the formation of secondary particles including ozone and these have a range of health impacts in their own right.

Pollutants emitted by diesel engines are also associated with a range of non-health impacts, including damage to plants, animals and materials, reduced atmospheric visibility and climate change. Of the approximately 700,000 non-road diesel engines in Australia at the present time, particulate matter pollution from these engines is almost double that emitted by 20.1 million registered on-road vehicles of all fuel types.

Non-road diesel engine emission standards were first implemented by the US in 1996, followed by the European Union (EU) in 1999. Various other countries have also adopted the US or EU standards. There are currently no regulations to limit emissions from most non-road diesel engines in Australia. In Australia, there has been a low passive uptake of engines meeting international emission standards. This low uptake represents a market failure to voluntarily reduce noxious emissions.

In Australia non-road diesel engines currently consume a volume of diesel comparable to that of road vehicles. This is despite there being far fewer engines in the non-road sector - 640,000 non-road diesel engines (2018) compared with around five million on-road diesel engines. In 2018, non-road diesel engines in Australia emitted 104 kt of CO, 19.5 kt of THC, 312 kt of NO_X, 13.4 kt of PM_{10}, 13.0 kt of $PM_{2.5}$, 178 t of SO_2 and 29.5 Mt of CO_2. Depending on how other emission sources are defined, and what is considered to be 'anthropogenic', non-road diesel is likely to be responsible for around:

- 10-15 per cent of national anthropogenic NO_X emissions,

- up to 5 per cent of $PM_{2.5}$ emissions, and
- around 1-2 per cent of PM_{10} emissions.

Non-road diesel engines accounted for approximately 5 per cent of national greenhouse gas emissions in 2018.

One way for a cost-benefit analysis to assess health costs is in terms of Years of Life Lost (YLL). This is an indicator of premature mortality and is calculated by multiplying the number of deaths by the standard life expectancy (in years).

Health modelling found that in 2018 the atmospheric concentrations of NO_2 and $PM_{2.5}$ due to non-road diesel engines resulted in a combined annual YLL for the whole of Australia of 5,387. This equated to a cost to the Australian community of $1.6 billion in real 2021 prices. Even though non-road diesel engine emissions occur mostly in rural and remote areas, the YLL of 5,387 in 2018 equated to around 9 per cent of all YLL due to anthropogenic (all source) $PM_{2.5}$ and NO_2 concentrations. The health impacts and costs would continue to be incurred in future years. For example, the aggregated YLL for non-road diesel engines in the BAU scenario over the period 2018-2063, was 259,163.

Consultation questions

1) Do you agree that the information above and provided in the CBA Report supports the introduction of non-road diesel engine emission standards in Australia?
2) Are there other avenues that are available to address the harm caused by non-road diesel engine emissions?
3) If you do consider there is an alternative pathway, what data and analysis can you provide that supports this?

2.2 What are the objectives, why is government intervention needed to achieve them, and how will success be measured?

Noxious emissions from non-road diesel engine have notable health effects on the community. The health impacts attributable to non-road diesel engine emissions represent a significant cost to Australia. The cost-benefit analysis report found that without government action, non-road diesel engine emissions are likely to remain a concern in the future. Despite a projected transition towards higher-tiered technology in some types of equipment, significant noxious emission reductions are unlikely to be realised without government intervention. Government action would prompt and accelerate the uptake of lower-emitting engines in line with international approaches. This action would be in the community interest to minimise health impacts, environmental impacts and cost of exhaust emissions. All three management scenarios studied in the cost-benefit analysis provided a positive net benefit for the community.

Government intervention may also provide an impetus for industry to adopt horizon technology (electric or hydrogen fuel cell engines) that will eliminate diesel emissions altogether. Some large mining companies have already announced initiatives using this technology. Such initiatives would provide both improved community health outcomes and reduce greenhouse gas emissions.

The above initiatives highlight the importance of the mining industry in managing noxious non-road diesel engine emissions. There are approximately 77,000 non-road diesel engines operating in the mining sector. Of the total mining engines around 8,700 are big engines above 560kW (1.4 per cent). While only representing 12 per cent of all non-road diesel engines, mining engines account for around 60 per cent of total fuel use by non-road diesel engines in 2018.

The effects of new technology outcomes in the mining sector were not measured in the cost-benefit analysis. Replacement of these large engines with horizon technology could represent a significant improvement in noxious emission reductions. However, significant non-road diesel engine use and associated noxious emissions will continue throughout urban, rural and remote Australia where new technology does not replace diesel engines.

Failure of the market to progressively introduce higher emission standard engines provides impetus for government intervention. Economic theory suggests that government intervention is justified where it is necessary to address market failures that prevent markets from delivering the optimal outcomes for society. Reducing non-road diesel engine emissions helps to address the market failure known as negative externality.

Negative externalities arise where the actions of one party negatively impact another, without directly compensating the other party for that negative impact. In the context of non-road diesel engine emissions this can arise when diesel emissions cause health effects in nearby and downwind populations. In some cases, the impact may be partially compensated through policy or regulation. For example, state and territory governments often require major project proponents to acquire property that is likely to be significantly impacted by the project’s air or noise emissions. However, a large proportion of the negative impact, such as in nearby towns and cities, is not directly compensated.

Another potential market failure is information failure. This occurs when a lack of perfect information results in an economic agent making decisions that are not necessarily in their best interests. For example, in the context of non-road diesel engines, this could occur where a user purchases equipment with lower capital costs because they do not account for the benefits of what would otherwise be an overall more cost-effective engine model. Such benefits could include fuel savings, which the user is unaware or sceptical of, without having had the direct prior experience.

Consultation questions

4) Do you agree that the information above and provided in the CBA Report supports the need for government intervention?

5) In the near to medium term, will be uptake of horizon technology be sufficient to remove the need for new non-road diesel engines and equipment? In all sectors?

6) If so, can you provide data/evidence of such movement in the market that is sufficient to remove the need for government action?

2.3 What policy options are you considering?

The Australian Government considered three management scenarios for addressing non-road diesel engine emissions in the cost-benefit analysis: a BAU scenario and three management scenarios (MS1, MS2 and MS3) for non-road diesel engine emissions. These scenarios were developed in collaboration by the Australian and NSW governments. They address the requirements set by the Office of Impact Analysis to successfully assess impacts of proposed regulation.

The effects of the management scenarios were examined relative to the BAU scenario. The management scenarios focussed on the reduction of emissions through the introduction of emission standards for new engines. The guidelines published by the Office of Impact Analysis require that an impact analysis examine options that cover both non-regulatory and regulatory mechanisms. In this instance, the first two scenarios below cover non-regulatory options, while the last two examine Commonwealth regulation that would apply across all states and territories.

The four scenarios are summarised as follows:

- BAU: business as usual. This scenario represented the expected evolution of the non-road diesel engine stock and emissions in the absence of any emission standards or other management approaches.
- MS1: industry agreement (non-regulatory). In this scenario, industry would, in cooperation with government, agree to meet targets for sales of new non-road diesel engines which align with international best practice emission standards (Tier 4f).
- MS2: phased standards (Commonwealth regulation). In this scenario, interim emission standards (Tier 3) would be introduced as soon as practicable, with a subsequent transition to standards that align with international best practice emission standards (Tier 4f).
- MS3: best practice standards (Commonwealth regulation). In this scenario, emission standards that align with international best practice (Tier 4f) would be introduced as soon as practicable.

The BAU scenario described the composition of the engine stock in 2018, and the expected evolution of the stock and emissions between 2018 and 2043. This being in the absence of any Australian emission standards or any other government or industry approaches for reducing emissions. The national stock was defined in terms of equipment type, power band, emission standard (tier) and year of manufacture. The effects of the management scenarios were only considered in terms of changes to the distribution of tiers in the stock. Other factors, such as annual equipment usage and equipment lifetime, were retained from the BAU scenario, and there was no transfer of units between equipment types and power bands.

The management scenarios followed the Australian Government principle to adopt or align with accepted international standards to reduce the regulatory burden for business and to remove barriers to trade. It was also assumed that there would be no technical barriers (such as fuel quality) to the adoption of the corresponding technology, and that the standards would apply to all within-scope equipment introduced into Australia for the first time (including imported second-hand equipment).

The cost-benefit analysis focussed entirely on diesel engines and fossil fuel. The BAU projections and management scenarios did not include any uptake of alternatives to fossil fuel such as biodiesel, hybrids, plug-in hybrids, battery electric technology and hydrogen fuel cell technology. As noted above, the stock model used in the analysis mirrors the US EPA standards and excludes diesel locomotives, international and interstate commercial marine engines (>130 kW), aircraft engines, underground mining equipment and engines used in the defence sector.

Consultation questions

7) Are there other viable management scenarios that should be included in the evaluation?

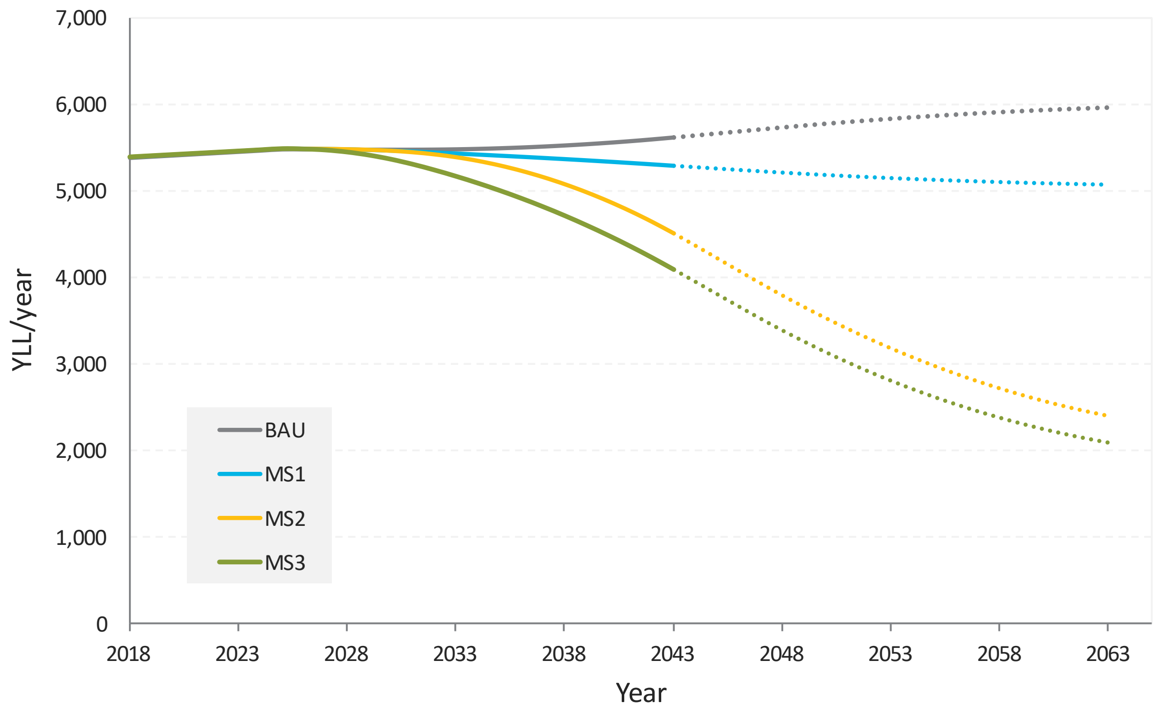
2.4 What is the likely net benefit of each option?

The results of the cost-benefit analysis at the national level are summarised in Table 6.1 of the analysis report (Table 1, copied below).

By 2043, MS1 was predicted to reduce annual NO_X and $PM_{2.5}$ emissions by around 20 per cent relative to the BAU scenario. MS2 would reduce emissions by around 40-50 per cent, and MS3 by around 45-60 per cent. When aggregated over the period 2018-2043, the reductions in emissions would be 7-8 per cent for MS1, 14-18 per cent for MS2 and 20-22 per cent for MS3. All three management scenarios studied in the cost-benefit analysis provided a positive net benefit for the community should government introduce emission standards.

The annual benefits of the management scenarios were greatest in the years after 2043 due to health outcomes being realised years after reductions in noxious emissions. For example, in 2043 the management scenarios reduced annual YLL by between 6 per cent and 27 per cent, whereas in 2063 the corresponding reductions were between 15 per cent and 65 per cent. Over the full timeframe of the analysis from 2018 to 2063, the management scenarios reduced annual YLL attributable to non-road diesel engines by 6 per cent for MS1, by 22 per cent for MS2, and by 27 per cent for MS3. The annual time series of YLL for the various scenarios over the timeframe of the cost-benefit analysis are shown in Figure 1.

Figure 1 Estimated years of life lost (YLL) in each year of the cost-benefit analysis (combined NO2 and PM2.5)



Source: Figure 5.7, DCCEEW 2022.

Table 1 Summary of cost-benefit analysis results (national level, non-road diesel only)

Aspect		Units	Year(s)	Scenario				Net effect of management scenario (relative to BAU)		
				BAU	MS1	MS2	MS3	MS1	MS2	MS3
Emissions	NO_X	kt	2018 only	311.7	*As BAU*	*As BAU*	*As BAU*	-	-	-
			2043 only	452.4	372.8	273.8	252.7	-18%	-39%	-44%
			2018-2043[(a)(b)]	9,757.9	8,959.1	8,344.7	7,757.7	-8%	-14%	-20%
	$PM_{2.5}$	kt	2018 only	13.0	*As BAU*	*As BAU*	*As BAU*	-	-	-
			2043 only	10.6	8.6	5.0	4.5	-19%	-53%	-58%
			2018-2043[(a)(b)]	280.8	260.7	231.4	219.7	-7%	-18%	-22%
Health outcomes	Premature mortality	YLL	2018 only	5,387	*As BAU*	*As BAU*	*As BAU*	-	-	-
			2043 only	5,614	5,289	4,501	4,092	-6%	-20%	-27%
			2063 only	5,957	5,067	2,404	2,089	-15%	-60%	-65%
			2018-2063[(a)(b)]	259,163	243,719	201,386	189,745	-6%	-22%	-27%
Economics	Total costs	$M, PV	2018-2063[(b)(c)]	-	-	-	-	640	2,374	3,030
	Total benefits	$M, PV	2018-2063[(b)(c)]	-	-	-	-	1,114	3,976	5,260
	Net present value	$M	2018-2063[(b)(c)]	-	-	-	-	473	1,602	2,230
	Benefit-to-cost ratio	-	2018-2063[(b)(c)]	-	-	-	-	1.7	1.7	1.7

(a) Aggregate over timeframe of analysis to 2043 (emissions were not calculated for 2043-2063). (b) Noting that the management scenarios had no effect between 2018 and 2026. (c) Incremental values for management scenarios.
Source: Table 6.1, DCCEEW 2022.

The costs of the management scenarios over the full timeframe of the analysis ranged from $640 million in MS1 to $3.0 billion in MS3. All three management scenarios resulted in a large total benefit over the full timeframe of the cost-benefit analysis (between ~$1.1 billion and ~$5.3 billion), and a large net present value. **MS3 was estimated to deliver the greatest net benefit to the community**, with a Net Present Value (NPV) of $2.2 billion. This compared with $1.6 billion and $470 million for MS2 and MS1, respectively. The main differences between the scenarios (and the NPV) were the amount of stock affected, and how quickly the impact on the stock occurred. Unsurprisingly, the three scenarios resulted in a similar ratio of benefits to costs (approximately 1.7:1). Overall, the results show that the most material contributors to costs and benefits were capital costs and mortality benefits, respectively.

Table 2 Regulatory burden estimate (RBE) table

Average annual regulatory costs (from business as usual)					
	Change in costs ($ million)	Business	Community organisations[1]	Individuals	Total change in costs
Management scenario 1	Total, by sector	63.7	0.0	0.2	63.9
Management scenario 2	Total, by sector	215.9	0.0	0.7	216.6
Management scenario 3	Total, by sector	194.7	0.0	0.6	195.3

Average annual cost over a ten-year period, 2026-2035 inclusive. The estimates in this table are in real 2021 prices and undiscounted.

[1] Examples of community organisations that use non-road diesel engines include rural fire and other volunteer emergency services. Their proportion of non-road diesel engine use is expected to be comparably small. There are insufficient data to quantify their relative cost impact, which is expected to be very low.

Table 2 outlines the estimated average annual change in regulatory costs imposed on businesses, community organisations, and individuals.

The regulatory burden estimates were prepared in accordance with the Regulatory Burden Measurement Framework (OBPR, 2020). They are expressed as an average net annual cost over a ten-year period, in real prices, and undiscounted. This means the estimates are not directly comparable with figures reported in the cost-benefit analysis, which calculated costs and benefits as discounted present values over a longer timeframe (40 years).

The estimates include administrative costs, substantive compliance costs, and delay costs. The estimates are expressed as the net impact to businesses and individuals, and therefore include offsetting benefits. The net impacts are comprised of the following incremental costs and offsetting benefits:

- Compliance costs
- Capital costs
- Operating and maintenance costs
- Fuel benefits (offsetting benefit)

The values were derived using data from the cost-benefit analysis, mainly based on the distribution of cost by economic sector (see section 5.6.3 of the CBA). The distribution of regulatory burden assumes that the costs incurred by all economic sectors represent 'Business' costs, except for recreational boats which represent costs to 'Individuals'.

Capital costs comprise around 95 per cent of the net cost estimate. Under management scenario 3, regulated entities would incur the higher costs of complying with Tier 4f standards sooner than management scenario 2. Discounting future values, the cost-benefit analysis found that MS3 would incur the greatest costs. However, in real prices, MS2 would have the greatest annual average regulatory cost over the first ten years.

Consultation questions

8) Do you feel that the CBA provides sufficient evidence of health benefits to the community for government to introduce emissions standards?

9) Are there any elements in the results of the CBA that you feel do not reflect the true position of the market as a whole?

2.5 Who will you consult and how will you consult them?

2.5.1 Previous consultation

An important element of the cost-benefit analysis was an extensive and targeted process of consultation with stakeholders. The consultation had a number of other objectives, including:

- refining the engine stock data, activity data and assumptions from the market analysis;
- strengthen the definition of each scenario;
- providing stakeholders with up-to-date information about the evaluation, understanding their perspectives; and
- generally increasing transparency around actions and timing.

The consultation process for the preliminary cost-benefit analysis was managed by the department with support from external consultants. Consultation took the form of an online webinar that provided the background to the work as well as to request data from the industry stakeholders. Also included were regular broadcast emails providing updates on progress and regular/ad hoc discussions with major participants. The stakeholders involved in the consultation process included the NSW Department of Planning and Environment, major original equipment manufacturers, suppliers/distributors, end users, industry associations and community groups.

More than 750 stakeholders and organisations have been consulted since the cost-benefit analysis project commenced 2019, with input received from major industry participants across all relevant sectors. Many engine importers favour the introduction of emissions standards. They believe it would provide certainty through alignment with overseas markets and thus reduce their costs through standardising the types of engines they import. Industry training and maintenance processes would be more aligned to the automotive sector. Community groups were also in favour of emission standards due mainly to the reduction in noxious emissions that will lead to reduced health effects.

Non-road diesel engines are a significant business investment and have a long post-market life. Because of this some end-users, including parts of the mining and agricultural sectors, expressed reticence to emissions standards due to the possibility of higher capital and ongoing costs for compliant engines.

Following some delays due to COVID-19 pandemic restrictions and industry disruption, the department sought further information from industry. The original engine stock and activity data from the market analysis were updated to incorporate additional information and feedback from the stakeholder consultation. Importantly, the feedback from stakeholders identified material inconsistencies in the original data for the BAU scenario, mainly in relation to the engine stock in the mining sector. The model was modified to address this feedback. The feedback was also used to refine the settings of the management scenarios.

The management scenarios and their implementation schedule also considered the inputs received from industry stakeholders during consultation. The implementation dates were selected to be achievable, but also to maximise the period over which costs and benefits could be assessed.

Attendance at preliminary discussions on the impact analysis was through three identical webinars held during February 2023. Invitations were offered to all people and organisations listed on the project stakeholder register. The webinar outputs (a copy of the presentation and its transcript, and a consolidated list of questions and answers from the webinars) were uploaded to the department's website in mid-March 2023.

A cross-section of major associations that the department have engaged with includes:

- Mining
  - Construction and Mining Equipment Industry Group
  - Minerals Council of Australia
  - Association of Mining and Exploration Companies
  - NSW Minerals Council
  - Queensland Resources Council
- Agriculture
  - National Farmers Federation
  - Tractor and Machinery Association of Australia
  - Meat and Livestock Australia
- Forestry
  - Australian Forest Products Association
  - Australian Forest Contractors Association
- Supply
  - Australian Diesel Engine Distributors Association
  - Truck & Engine Manufacturers Association
- Trucking
  - Australian Trucking Association
  - Truck Industry Council
- Marine
  - International Council of Marine Industry Associations
  - Boating Industry Association
- Community
  - Doctors for the Environment Australia
  - Asthma Australia
  - Environmental Justice Australia

2.5.2 Upcoming consultation

Consultation for the impact analysis is being managed by the department. Email (for registered stakeholders), social media and the department's webpage will be used to notify interested stakeholders of consultation dates and other information relevant to the impact analysis. Formal submissions should be made through the department's Have Your Say system, linked from the Evaluation of Non-Road Diesel Engine Emissions web page - www.dcceew.gov.au/environment/protection/air-quality/national-clean-air-agreement/evaluation-non-road-diesel-engine-emissions.

All enquiries and other feedback should be made through the project mailbox - airquality@dcceew.gov.au.

Consultation questions

10) Do you believe there has been sufficient consultation with all stakeholders during the development of the cost-benefit analysis?
11) If no, what other types of consultation would you have liked to have been included and why?

2.6 What is the best option from those you have considered and how will it be implemented?

2.6.1 Assessing the best option

No decision has been taken by government regarding the management of emissions from non-road diesel engines. Submissions to this impact analysis will be collated and presented to the government.

The cost-benefit analysis found that all three management scenarios would deliver positive net benefits. The CBA identified that Management Scenario 3 (MS3) would deliver the most beneficial outcome for the community, followed by Management Scenario 2 (MS2).

The CBA report shows that the best net present value outcome is returned for MS3, at $2,230 million over the defined period. By comparison, the lowest benefit is returned for the non-regulatory option (MS1) at $473 million. A more comprehensive description of the management scenarios is provided in the CBA report under Section 3. The advantages and disadvantages of each management scenario are available at sub-section 3.4 of the report.

In choosing the best management scenario to recommend to the government, MS2 and MS3 both meet the requirements of the policy assessment criteria (section 1.3). MS3 is the better of the two because of the higher net present value outcomes. While MS1 goes part way to meeting the policy assessment criteria, this option may fail to meet criteria 3, 5 and 6.

Under MS3 and MS2, emissions from non-road diesel engines would be regulated by the Commonwealth via mandatory standards for all new engines. Under MS 1, emissions would be managed via industry agreement with government to use sales targets for lower-emitting engines.

MS3 would implement emissions standards consistent with international best practice. All new engines imported, manufactured, and supplied in Australia would be required to meet emissions standards consistent with the strongest international emissions standards (US EPA Tier 4f).

Under MS3, implementation of the standards would be expected to commence two years after the government's decision. The standards would initially apply to import and manufacture, and then, one year later, to supply. Industry would be able to continue to import new engines that do not meet the standards in the two-year period between government decision and commencement of import requirements. Industry would also be able to sell existing stock up until the commencement of the supply requirements. The exact timing of these arrangements would be determined following consultation with the industry sectors concerned.

In contrast, MS2 would take a slower phased approach to the implementation of international best practice. Phase 1 would introduce a minimum standard (USA EPA Tier 3) and later in Phase 2 the standards would be amended to be consistent with the strongest international emissions standards (US EPA Tier 4f).

Similar to MS3, the implementation of standards under MS2 would be expected to commence two years after a decision from government. In Phase 1, the minimum standard (US EPA Tier 3) would initially apply to import and manufacture, and then, one year later, to supply. Phase 2 would commence six years after government decision to introduce the regulation, with the standards first strengthened for import and manufacture, and then another year later, for supply. The transition period between Phase 1 and Phase 2 would allow consumers to purchase engines that could be maintained or repaired without the specialist personnel or software that may be required for Tier 4f.

The greater net present value outcomes delivered by MS3 are due to the introduction of international best practice standards in a shorter timeframe, as opposed to the phased approach of MS2.

MS1 would involve an agreement between government and industry to reduce emissions using sales targets for engines. Under this non-regulatory scenario, the peak industry bodies representing Australian suppliers and consumers of non-road diesel engines would form an agreement with government. The agreement would aim to reduce emissions using sales targets for engines which align with international best practice emission standards (US EPA Tier 4f).

Under MS1, implementation would be expected to commence in 2026, three years after the government's decision. From 2026 onwards, 50 per cent of new engines introduced into Australia for the first time, in each power band, would comply with Tier 4f emission standards.

In practice, 'equivalent alternative technology' could be used to comply with the requirement of the agreement. However, as noted earlier, such alternatives were not considered in the cost-benefit analysis itself. Where these horizon technologies are used, emissions reductions would be greater than those associated with a transition to Tier 4f diesel engines.

MS1 would not have binding emissions standards. Implementation of the agreement would be driven by the industry. Industry would agree to transform its fleet to meet the requirements, and to report on compliance. Implementation could include industry codes of practice developed with government involvement, guidance notes, accreditation and labelling schemes.

2.6.2 Implementation

The *Product Emissions Standards Act 2017* (PES Act) is the main framework being considered to regulate noxious emissions from non-road diesel engines. The PES Act establishes a national framework that allows Australia to address the adverse impacts of air pollution from certain products on human and environmental health. It allows the Minister to prescribe emissions-controlled products and make Rules relating to those products. Under the Act, offences relate to the import and supply of emissions-controlled products in Australia if they do not meet the Australian standard or a recognised international noxious emission standard.

The PES Act was introduced in 2017 and has been regulating the import and supply of new non-road spark ignition engines with a maximum power of 19kW and new spark-ignition engines used in marine vessels. Products captured under the Rules include lawn mowers, ride-on mowers, mulchers, leaf-blowers, chain saws, small generators, and pumps as well as outboard engines, personal watercraft, and stern drive engines. More information on the operation of the PES Act can be found here - Product emissions standards – DCCEEW.

The department considers that the PES Act could be used to regulate non-road diesel engines. Under the PES Act, all non-road diesel engines newly introduced to the Australian market would be regulated at the point of importation and supply, including sale, gift, lease and loan. As no engines are completely made in Australia, they can be more easily regulated at the point of importation. In some instances, new lower-tier stock is imported by Australian manufacturers for domestic upgrade to international best-practice emissions-control technology.

As indicated above, there would be a sufficient phase-in period to allow retailers to dispose of existing, uncertified stock and for users to replace old engines with new or refurbished engines of similar (older) standards before the new rules apply. While Tier 4 engines will be suitable for most applications, due to their construction, a minority of equipment and vehicles cannot be retrofitted with these engines. Should this be a significant concern for industry the Australian Government could consider exemption options, as is already available under current PES Rules.

The department does not expect that changes would be required to the PES Act itself. However, additions would be required to the associated PES Rules. The changes are expected to take a minimum of a year to implement after government decision to introduce standards for non-road diesel engines.

Under the Commonwealth regulatory options Management Scenarios 2 and 3, the administrative and operational costs to government may be recovered from industry. This would be consistent with the Australian Government policy that, where appropriate, non-government recipients of specific government activities should be charged the costs of those activities. Regulatory charging would be appropriate because the operation of non-road diesel engines in Australia requires government action to minimise their adverse impacts on people's health.

Current administration of the PES Act involves cost recovery arrangements. Levies are paid by importers and local manufacturers who bring new emissions-controlled products to the Australian market. Fees are charged for applications for the certification of engines to Australia's standards, and applications for exemption from these standards.

Consultation questions

12) Which management scenario would best meet your purposes (including BAU)?
13) What are the arguments to support this option, including priorities you think the government should give more weight to for any decision?
14) Why are these priorities more important in the context of providing the best outcome for the whole community?
15) Is your industry more or is it less supportive of the goals of introducing non-road diesel engine emission standards – i.e., reducing noxious emissions and thereby delivering consequent improvements in human health?
16) Some non-road diesel-powered equipment will be fitted with a replacement engine several times throughout its useful life. Under MS2 and MS3, standards would apply to all within-scope equipment introduced into Australia for the first time, including imported second-hand equipment. What approach would support users to source suitable replacement engines?
17) If government decides to regulate, do you believe that the proposed use of the Product Emissions Standards Act is an appropriate approach?
18) If not, what alternative approach do you propose?

2.7 How will you evaluate your chosen option against the success metrics?

2.7.1 What the chosen option would achieve

Successful implementation of the measures set out in management scenario 3 will:

- Improve Australia's air quality in population centres around the country by reducing noxious diesel emissions to similar levels experienced overseas
- Reduce overall morbidity and mortality outcomes across the community
- Facilitate adopting international best practice through the recognition and implementation of emission standards mirroring the US EPA/EU standards
- Provide certainty for industry in the adoption of recognised standards and avoid complicated administrative and training processes for different engine categories
- Avoid the complicated and administratively complex industry model (MS1) that lacks a certainty of outcomes due to its voluntary nature
- Encourage industry to adopt horizon technology that will contribute to the elimination of diesel emissions altogether and reduce significant amounts of greenhouse gas emissions
- Contribute to the supply of reliable quality, fit-for-purpose diesel engines to enable the operation of more efficient, lower emissions, high-technology equipment.

2.7.2 Risks to success

A risk to success is the complex and disparate nature of non-road diesel engine use. In Australia non-road diesel engines are used in all geographical locations, with many applications. For new standards to be effective, they must be applicable to all engines in scope.

However, users like the emergency services may have genuine reasons to continue sourcing new Tier 2 engines after standards are introduced. While exemptions are already allowed for under the PES Act in certain circumstances specified in the Rules, additional circumstances may be raised for consideration during the impact analysis consultation. To provide genuine benefit to the community from new emissions standards, exemptions must be necessary but kept to a minimum.

Unforeseen issues affecting engine or equipment operability and emissions present another risk. The department will identify, assess, and manage such issues if they arise through its monitoring, compliance, and enforcement framework. Management responses may include working with industry to address minor problems or revising relevant standards. These responses can be put into action whenever required and would be done in consultation with industry and in line with administrative processes established under the *Product Emissions Standards Act 2017*.

2.7.3 How the policy will be evaluated

The measure of success of the policy will be the successful adoption of emission standards for non-road diesel engines and the introduction of advanced emission control technologies in all industry sectors.

Key indicators that could be measured would include the reduction in noxious emissions and consequent reductions in health costs to the Australian community. Reductions in the importation and sale of non-compliant non-road diesel engines in Australia over the evaluation period following the introduction of any approved standards will be a key indicator. It would also include an increased level of knowledge, via appropriate education efforts, of the requirements of the new PES Act Rules within the customs broker, importers, and retailer communities. In addition, the burden of administration should be within reasonable outcomes to reflect preferred 'light touch' regulation.

The policy will be evaluated through the existing administrative processes and reporting required under the PES Act. This includes monitoring, compliance and enforcement processes which operate continually for standards in force. In addition to regulatory processes managed by the department, evaluation could be supplemented by possible voluntary reporting of new engine imports/sales during stakeholder consultations. The PES Act is due for review in 2024.

Consultation questions

19) If a mandatory standard was introduced what factors would impact its effectiveness against lower noxious emissions?

20) If Tier 4f based emission standards were introduced into Australia, do you think members of your industry sector would retain their older, lower standard engines longer than planned?

Glossary

Term	Definition
ABS	Australian Bureau of Statistics
BAU	business as usual
CBA	cost-benefit analysis
CO	carbon monoxide
CO2	carbon dioxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	(Australian Government) Department of Agriculture, Water and the Environment
DCCEEW	(Australian Government) Department of Climate Change, Energy, the Environment and Water
DPE	(NSW) Department of Planning and Environment
EU	European Union
gas engine	an internal combustion engine (typically heavy-duty, and operated continuously) that runs on a gaseous fuel, such as coal gas, producer gas, biogas, landfill gas or natural gas
G-drive	generator drive; these are loose engines that are intended for use in generator sets, and are designed to operate at a fixed speed, providing mechanical power to drive an electricity generator, either stand-by or prime
generator set	a set that includes both an engine and an alternator for generating electricity, rather than a loose engine
GMR	(NSW) Greater Metropolitan Region
kt	kilotonne (one thousand metric tonnes)
kW	Kilowatt
kWh	kilowatt-hour
Mt	megatonne (one million tonnes)
NFF	National Farmers' Federation
NH3	Ammonia
NO	nitrous oxide
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NPI	National Pollutant Inventory
NPV	net present value
NRDE	non-road diesel engine
NSW EPA	NSW Environment Protection Authority
O3	Ozone
OBPR	Office of Best Practice Regulation
OEM	original equipment manufacturer
PES Act	Product Emissions Standards Act 2017
PM	particulate matter
$PM_{2.5}$	particulate matter with an aerodynamic diameter of less than 2.5 µm

Term	Definition
PM_{10}	particulate matter with an aerodynamic diameter of less than 10 µm
prime power	main, continuous power supply
PV	present value
RIS	Regulation Impact Statement
SO2	sulfur dioxide
stand-by power	power required only when the mains supply is cut off or interrupted (typical applications include telecommunication centres, hospitals and airports)
THC	total hydrocarbons
US EPA	United States Environmental Protection Agency
VOC	volatile organic compound
VSL	value of a statistical life
VSLY	value of a statistical life year
WHO	World Health Organization
YLL	years of life lost

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