REDUCING EMISSIONS FROM NON-ROAD SPARK IGNITION ENGINES AND EQUIPMENT

DECISION REGULATION IMPACT STATEMENT

September 2015

FOREWORD

This Regulation Impact Statement (RIS) has been prepared in accordance with the Council of Australian Government (COAG) requirements to assess the impact on Australian governments, industry and the community of reducing emissions from Non-road Spark Ignition Engines and Equipment (NRSIEE).

In particular, this document takes into account the COAG principles for preparing a RIS that state that 'the purpose of preparing a RIS is to draw conclusions on whether regulation is necessary, and if so, on what the most efficient regulatory approach might be'. This RIS has also drawn upon the guidance outlined in the Australian Government Guide to Regulation.

This RIS is structured as follows:

- Section 1 introduces the issues and outlines the context
- Section 2 outlines the problem that needs to be addressed
- Section 3 states the objectives for government action and sets out the case for government intervention
- Section 4 outlines the options
- Section 5 outlines the approach to the impact and effectiveness analysis
- Section 6 outlines the assessment of options and makes a recommendation
- Section 7 outlines the consultation undertaken
- Section 8 outlines the approach to implementation and review.

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GLOSSARY

- $m (in) million dollars
- AAQ NEPM National Environment Protection (Ambient Air Quality) Measure
- ABS Australian Bureau of Statistics
- ACCC Australian Competition and Consumer Commission
- AMEC Australian Marine Engine Council
- AUD Australian dollar
- BAU Business as usual
- CAA Clean Air Act (United States)
- CBA Cost Benefit Analysis (also referred to as a benefit cost analysis)
- CFR Code of Federal Regulations (United States)
- CI Compression ignition
- CO Carbon monoxide
- COAG Council of Australian Governments
- CRIS Consultation regulation impact statement
- Cth Commonwealth (of Australia)
- DRIS Decision regulation impact statement
- EPA Environment Protection Authority
- EPHC Environment Protection and Heritage Council
- EU European Union
- gm gram
- HC Hydrocarbon
- hp horsepower
- hr hour
- kg kilogram
- kW kilowatt
- mg milligram
- MMA McLennan Magasinik and Associates

- N/A not applicable
- NEPC National Environment Protection Council
- NEPC Act National Environment Protection Council Act 1994
- NEPM National Environment Protection Measure
- NOx Nitrogen oxides (or oxides of nitrogen)
- NPV Net Present Value
- NRSIEE Non-road spark ignition engines and equipment
- OBPR Office of Best Practice Regulation
- OEDA Outboard Engine Distributors Association
- OPEA Outdoor Power Equipment Association
- PAH Polycyclic aromatic hydrocarbons
- PM Particulate matter (also referred to as particles in the National Environment Protection (Ambient Air Quality) Measure)
- PM2.5 Particulate matter with an aerodynamic diameter of less than 2.5 micrometres
- PM10 Particulate matter with an aerodynamic diameter of less than 10 micrometres
- PV Present Value
- RBM Regulatory Burden Measure
- RIS Regulation Impact Statement
- SI Spark ignition
- TTMRA Trans Tasman Mutual Recognition Agreement
- US United States
- US EPA United States Environmental Protection Agency
- VELS Voluntary emissions labelling scheme
- VOC Volatile organic compounds
- WHO World Health Organization

EXECUTIVE SUMMARY

Introduction

In November 2008, the then Environment Protection and Heritage Council (EPHC) commissioned a Consultation Regulation Impact Statement (RIS) canvassing options for reducing emissions from new Non-Road Spark Ignition Engines and Equipment (NRSIEE) and establishing whether there was a case for government action. This was in recognition that:

- NRSIEE are a significant source of various air pollutants which increase the risk of adverse health effects
- NRSIEE emissions are unregulated and not well covered by national or state/territory policies and/or programs.

NRSIEE includes a wide range of petrol powered equipment with the main categories covering:

- Marine engines, including outboard, inboard or stern-drive engines
- Outdoor powered equipment, including trimmers, brush cutters, leaf blowers, chain saws, chippers, cement mixers, pumps, generators, and air compressors.

The Consultation RIS, released in September 2010, concluded that establishing NRSIEE emission standards for new products in line with accepted international standards would provide the greatest benefit.

This RIS updates that analysis and takes into account submissions received following release of the Consultation RIS as well as consultations undertaken since 2012, in the following ways:

- the policy options for the introduction of emission standards are expanded to consider voluntary action by industry, co-regulation or regulation to better meet the objectives of the Australian Government's regulation reform agenda; and
- the cost benefit analysis was amended to
  - include the impact of the options on consumer and producer surplus;
  - reflect feedback during consultations;
  - include the regulatory costs to business and the costs to government of each option; and
  - be based on a period of analysis 2016-2035.

The Problem

Ambient air pollution is a problem in Australia...

NRSIEE emit various air pollutants including particulate matter (PM), hydrocarbons (HC) and oxides of Nitrogen (NOx). Increased population exposure to air pollutants increases the risk of adverse health effects. Significant health costs are associated with inhalational exposure to fine PM by the general population, including costs of hospital admission and lost work productivity [1]. There is also no known threshold for PM exposure below which health effects do not occur, meaning any exposure can be harmful.

The World Health Organization (WHO) states that air pollution is now the world's largest single environmental health risk. Elevated levels of some common air pollutants can result in an increase in respiratory and cardiovascular effects in humans and contribute to premature deaths. In October 2013, the International Agency for Research on Cancer (IARC) concluded that there is sufficient scientific evidence that exposure to outdoor air pollution causes cancer in humans.

In Australia, air pollution is an important public health issue. The Australian Institute of Health and Welfare estimated that urban air pollution was responsible for more than 3000 premature deaths in 2003. This was twice the number of deaths caused by traffic accidents in the same year.

... and NRSIEE are an important – and growing – source of pollutants

The two main sources of NRSIEE emissions are from marine engines and outdoor powered equipment. Approximately 40,000 marine engines and one million units of outdoor powered equipment are imported annually. Australian manufacturing is limited to incorporating engines manufactured overseas into products made in Australia.

Emissions from NRSIEE contribute to air pollution in Australia, especially on summer weekends in urban centres when their use is high. NRSIEE are high polluters relative to their size and usage. For example, one hour of operation of a brushcutter produces around the same emissions of air pollutants as ten cars operated over the same period.

NRSIEE emissions are currently unregulated in Australia...

There are currently no Australian standards or regulations that seek to specifically limit pollutant emission rates from new NRSIEE, unlike other countries – including the US, Europe, China, Japan and Canada – that have adopted NRSIEE emission standards in order to minimise the general population's exposure of these emissions. NRSIEE emission sources are also not well covered by any other national and state/territory policies and/or programs.

[1] Bureau of Transport and Regional Economics. (2005). *Health impacts of transport emissions in Australia: Economic costs*(working paper 63). Canberra, Australia: Author

... and the problem will get worse without intervention.

The problem will get worse if the status quo is maintained. Population growth is likely to drive further demand for, and consequently an increase in emissions from, NRSIEE. Increasingly strict international standards are also likely to increase the cost differential between internationally-compliant NRSIEE and cheaper non-internationally-compliant NRSIEE. This is expected to impede the future uptake of lower emission NRSIEE in Australia.

Without some form of intervention, NRSIEE emissions of these pollutants are expected to increase by 40 to 80 per cent over the period 2015 to 2035, with the majority of the growth attributed to the outdoor powered equipment category.

Reducing emissions from NRSIEE will not address the whole problem of air pollution in Australia. However, given there is no threshold below which adverse health effects do not occur for some pollutants emitted from NRSIEE, even a small reduction in emissions will result in substantial health and economic benefits (through reducing the incidence of health impacts and reducing health costs).

Objectives

The objectives in managing NRSIEE emissions are to:

1. Reduce the adverse impacts of NRSIEE emissions on human health and the environment

2. Ensure any emission-reduction measure/s provide for a consistent national approach and are commensurate with international trade requirements and accepted international standards

3. Ensure that any approach provides a net benefit to the community and meets the objectives of the Australian Government's regulation reform agenda by minimising the impact and costs on business to the extent possible while still meeting objectives 1 and 2.

Options

Option 1 – No Policy Change	Government and industry maintain current policy and practices into the future and do not take specific action to manage NRSIEE emissions
Option 2 – Voluntary	Voluntary scheme operated by industry where NRSIEE are voluntarily labelled if compliant with the emission standards, with the emission standards set by government
Option 3 – Co-Regulation	Legislation establishes emission standards with industry administering the arrangement
Option 4 – Regulation	Legislation establishes emission standards with government administering the arrangement

The proposed approach to establishing Australian NRSIEE emission standards is to adopt relevant US emission standards and recognise the equivalent standards of other countries. US standards continue to be the most stringent internationally, and are the default for most manufacturers due to the US market share for NRSIEE products.

This approach directly follows the Australian Government and the Council of Australian Governments (COAG) principle to adopt or align with accepted international standards to reduce regulatory burden for business and remove barriers to trade [2].

Assessment of Options (Impact Analysis)

Each alternative option was compared against the business as usual No Policy Change option, which describes the situation if no emission standards for NRSIEE were introduced in Australia.

The analysis found that there was a significant net benefit under each of the alternative options compared to the No Policy Change option. The greatest net benefit is achieved from the Regulation option in the order of $636 million. The Voluntary and Co-Regulation options had net benefits of $324 million and $503 million respectively.

[2] Australian Government Department of Prime Minister. (2014). *Office of Deregulation – Guidance Note: International Standards and Risk Assessments*. Council of Australian Governments. (2014). COAG *Communique 10 October 2014*.

Cost Benefit Outcome – Net Present Value (NPV)

Option		Cost Benefit Outcome - NPV 2016 to 2035 ($ million)							
		Avoided health costs	Change in consumer surplus	Change in producer surplus	Fuel	Service	Business compliance	Govt. Admin.	Total (NPV)
Voluntary	Marine	102	-75	-5	27	-19	-0.7	-0.1	30
	Outdoor equipment	747	-487	-100	470	-308	-22.5	-4.8	294
	Total NPV								324
Co-Regulation	Marine	164	-120	-8	43	-30	-0.7	-0.1	49
	Outdoor equipment	1,205	-780	-161	627	-411	-22.5	-4.8	454
	Total NPV								503
Regulation	Marine	205	-150	-10	54	-37	-0.1	-0.3	61
	Outdoor equipment	1,511	-975	-201	732	-480	-4.4	-9.2	574
	Total NPV								636

All alternative options will reduce the total annual emissions from NRSIEE and therefore exposure to pollutants compared with the No Policy Change option, resulting in significant avoided health costs. The difference in emission reduction rates (and associated avoided health costs) is due to the assumed levels of compliance with the standards under each policy option. Under the Voluntary and Co-Regulation options it is assumed that there will be a greater number of non-compliant, higher emitting NRSIEE remaining in the market.

The analysis indicates that the main cost involved is the reduction in consumer surplus. Because compliant NRSIEE are likely to be more expensive that non-compliant NRSIEE, consumers will face a choice between either paying more for new equipment, or not buying new equipment at all.

There will be compliance costs for industry associated with any of the alternative options. These costs are lowest under the Regulation option; this is mainly due to the adoption of a simpler form of regulation, i.e. the Commonwealth administering the arrangement, including compliance measures.

The results are sensitive to the assumed reduction in health costs per tonne of pollutant emitted – the unit health cost. When lower unit health cost values are used, the net present value of the options becomes negative – that is, the costs outweigh the likely benefits. This is important as a number of studies have produced different estimates of the unit health costs of the pollutants considered in this analysis.

Consultation

Australian industry is highly supportive of the development of Australian emission standards for NRSIEE that harmonise with established overseas standards, particularly those of the US. Some sectors are promoting the adoption of these standards as soon as possible whereas others are seeking a phased implementation approach. Community groups are similarly supportive of the introduction of emission standards to reduce pollution.

Conclusions / Recommendation

The analysis indicates that on a per-engine basis the benefits (largely in terms of lower emissions and better fuel economy) of replacing old engines with less-polluting new engines outweigh the costs (reduced consumer and producer surplus). This is true for both types of NRSIEE, but particularly so for outdoor powered equipment due largely to the significant HC emissions from older engines in this sector. As a result, the more non-compliant engines that can be removed from the market, the higher the net-benefit.

The lower compliance levels likely under the Voluntary (50 per cent) and Co-Regulation (80 per cent) options mean that fewer non-compliant engines are removed from the market than under the Regulation option. As such, it is likely that the net benefit of these options is lower than the Regulation option, and it follows that the preferred alternative option is to develop emissions standards for NRSIEE.

Are national standards better than no policy change? This largely depends on the assumptions around the unit health costs of the various pollutants. If the health impact of ambient air pollution is significantly lower than that assumed in the central case in this analysis, then the benefits from reduced emissions may not exceed the costs. In such circumstances, no policy change would be preferred.

However, the unit health costs modelled in this analysis are consistent with the range of costs used in other studies. In addition, other likely benefits from the reduction in emissions from NRSIEE – namely environmental and climate change benefits – are not quantified. On balance, while highlighting the uncertainty around the health impacts of reduced ambient air pollution, the analysis provides guarded support for the introduction of national standards.

The introduction of national NRSIEE standards would result in a net benefit of over $600 million in NPV terms over the period 2016-2035, under the central case assumptions. Much of the cost of the change would be borne by NRSIEE consumers, who would pay more for compliant equipment, while much of the benefit would accrue to the broader community in the form of reduced adverse health impacts from ambient air pollution.

Option 4 – regulation through the legislated introduction of national emission standards – is recommended.

1 INTRODUCTION

In September 2005, the EPHC established a working group to examine the need to reduce emissions from NRSIEE in Australia and established two expert panels, made up of industry members. This was in recognition that:

- NRSIEE are a significant source of various air pollutants which increase the risk of adverse health effects; and
- NRSIEE emissions are unregulated and not well covered by national or state/territory policies and/or programs.

In November 2008 the EPHC released a cost benefit analysis of options to reduce emissions from NRSIEE and approved the development of a Consultation RIS on those options. Over May to July 2010 the Consultation RIS was open for consultation and submissions.

The Consultation RIS, released in September 2010, concluded that establishing NRSIEE emission standards for new products in line with accepted international standards would provide the greatest benefit. It identified a number of options that could establish such emission standards:

- Voluntary industry agreement (restricted to the outboard industry)
- Commonwealth regulation
- National Environment Protection Measure (NEPM).

In 2012, additional consultation was undertaken with key stakeholders that included state and national bodies representing recreational fishing and boating groups, and discussions continued with other organisations. This round of consultation sought clarification on issues that were raised during the 2010 consultation period. A consultation summary report, which provides an overview of the main matters raised in submissions, was released in November 2012.

In March 2013, the then Standing Committee on Environment and Water (SCEW) Senior Officials Committee agreed to the preparation of a Decision RIS for options to reduce emissions from NRSIEE.

In October 2013, the Minister received representations from the Boating Industry Alliance Australia (BIAA), Australian Marine Engine Council (AMEC), Outdoor Power Equipment Association (OPEA), and Briggs and Stratton on NRSIEE. The Department of the Environment held talks with AMEC, OPEA and the Outboard Engine Distributors Association (OEDA) in November 2013. Additional market data was provided by two industry peak bodies in December 2013 and January 2014 to support the project's current cost benefit and sensitivity analyses.

In April 2014, Australia's environment ministers initiated work to identify strategic priorities and approaches as a basis for developing a National Clean Air Agreement by

2016. Reflecting the significance of fine particle emissions from 'non-road spark ignition engines', they also called for the finalisation of a regulation impact statement on potential emission control options for these sectors.

In August 2014 and in the period following, the Department of the Environment met with OEDA, AMEC and OPEA representatives, as well as Surf Life Saving Australia, BIAA and major retailers to discuss the options considered in the RIS, introducing a modified voluntary option and a co-regulatory option not considered in the Consultation RIS.

This RIS updates the Consultation RIS and takes into account submissions and consultations undertaken to date, in the following ways:

- The policy options that introduce emission standards are expanded to consider voluntary action by industry, co-regulation or regulation to better meet the objectives of the Australian Government’s regulation reform agenda; and

- An additional cost benefit analysis was undertaken to accommodate the expanded options.

2 THE PROBLEM

This Section:

- outlines the current understanding of the impact on human health of ambient air pollution;
- provides a summary of the NRSIEE sector in Australia, and the problem caused by emissions from this sector;
- highlights that NRSIEE emissions are currently unregulated in Australia; and
- that the problem will get worse without some form of intervention.

2.1 The impact of air pollution on human health

The World Health Organisation (WHO) states that air pollution is now the world's largest single environmental health risk [3]. Significantly, the WHO recently announced that outdoor air pollution has been classified as carcinogenic to humans [4].

The health effects of urban air pollution are largely chronic conditions resulting from long-term exposure to this risk. There may also be an additional burden from short-term exposure to abnormally high levels of urban air pollution, although this risk is more controversial [5]. In 2012, 3.7 million deaths worldwide were attributable to ambient air pollution. Worldwide, the breakdown of ambient air pollution related deaths are:

- 40% – ischaemic heart disease
- 40% – stroke
- 11% – chronic obstructive pulmonary disease
- 6% – lung cancer
- 3% – acute lower respiratory infections in children

The United Nations Environment Programme estimated that the monetary impact of death and illness due to outdoor air pollution in 2010 in Organisation for Economic Co-operation and Development (OECD) countries alone was US$1.7 trillion [6].

An overview of health impacts from some common specific air pollutants can be seen in Table 2.1. The nature and severity of the effect are a function of the type and

[3] WHO Media Centre, press release, 2014, air pollution
[4] International Agency for Research on Cancer. (2013). *Press release 221: Outdoor air pollution a leading environmental cause of cancer deaths.* Retrieved March 10, 2015
[5] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, (2007). *The burden of disease and injury in Australia 2003*.(Cat. No. PHE 82). Canberra: AIHW.
[6] United Nations Environment Programme. (2014). *Air pollution: World's worst environmental health risk.* Retrieved November 24, 2014

concentration of pollutant, the duration of exposure and the sensitivity of the individual [7].

Table 2 1 Health endpoints associated with selected air pollutants (from NSW Dept Environment and Conservation, 2005) [8]

Pollutant type	Particulates (PM)	Nitrogen dioxide	Carbon monoxide	Air toxics	Air toxics (PAHs)
Potential impact on human health	Increase in cardiac and respiratory mortality, Admissions to respiratory and cardiovascular casualty room and hospital, Increased incidence of acute bronchitis in adults and children, Increased prevalence and exacerbation of COPD in adults and children, Asthma attacks in adults and children, Cough, Restricted activity days, Reduced lung function	Increased mortality, Impaired lung function, Impaired respiratory immune response leading to increased susceptibility to infections, Increased respiratory disease in childhood	Cardiovascular related mortality, Aggravation of cardiovascular disease and chest pain, Nausea, Headache, Fatigue	**Eg Benzene**[9]**:** Leukaemia, Long-term harm to immune system, Skin and eye irritation, Drowsiness, Dizziness, Headaches	Cancer Kidney and liver damage Respiratory irritation Exacerbation of asthma Chronic bronchitis Coughing and throat irritation

[7] Department of Sustainability, Environment, Water, Population and Communities (2011) *Australian State of the Environment 2011 report*. Department of Sustainability, Environment, Water, Population and Communities. Canberra, Australia (page 123).
[8] Department of Environment and Conservation (NSW). (2005) *Air Pollution Economics: Health Costs of Air Pollution in the Greater Sydney Metropolitan Region*. (page20).
[9] Health impacts from other air toxics include **Toluene**: CNS dysfunction (often reversible), Narcosis, Light-headedness; **Xylene**: Irritation of respiratory tract, Eye irritation, Headaches, Dizziness, Fatigue, Tremors, Coordination difficulties, Impaired pulmonary function; **1,3-butadiene**: Cancer, Eye, nose and throat irritation.

2.1.1 Air pollution in Australia is low by world standards, but still a problem...

While by world standards Australia has very clean air, there are ongoing challenges. Australia's ambient (outdoor) air quality does not always meet national health-based ambient air quality standards.

Sources of ambient (outdoor) air pollution in Australia include 'point' sources (for example, an industrial power plant) and 'diffuse' sources, such as motor vehicles, bush fires, various types of planned burning, fugitive dust from industrial, transport and agricultural activities, domestic and commercial solvents, service stations, and domestic lawnmowers.

The most widespread pollutants include carbon monoxide (CO), volatile organic compounds (VOC), ozone (O), oxides of nitrogen (NOx), sulfur dioxide (SO2) and particles (particulate matter – PM [10]).

2.2 ... and ambient air pollution causes health problems in Australia

Air pollution is an important public health issue in Australia. As described earlier, the health problems associated with ambient air pollution are often chronic conditions, and can be difficult to ascribe directly to pollution. As such, unlike deaths due to (say) traffic accidents the impacts of air pollution on health cannot be directly counted and must be evaluated from estimates of health risk based on scientific research [11].

The Australian Institute of Health and Welfare estimated that urban air pollution was responsible for more than 3000 premature deaths in 2003 [12]. This was almost twice the number of deaths caused by traffic accidents in the same year [13].

The mortality and morbidity burden attributable to ambient air pollution translates into large economic costs – in 2005 the Department of Environment and Conservation NSW published estimates of the health cost of air pollution in the Greater Metropolitan Region of NSW in the range of $1 billion to $8.4 billion [14]. To illustrate these costs, a recent study on the health impacts of air pollution in Australia (for Sydney, Melbourne, Brisbane – including south-east Queensland – and Perth) estimated the following rates of mortality and morbidity attributable to PM [15], [16]:

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[10] Most widespread pollutants.
[11] Morgan, G. Broome, R. and Jalaludin, B., *Summary for Policy Makers of the Health Risk Assessment on Air Pollution in Australia*
[12] Begg S, Vos T, Barker B, Stevenson C, Stanley L, Lopez AD, (2007). *The burden of disease and injury in Australia 2003*.(Cat. No. PHE 82). Canberra: AIHW.
[13] Traffic accident reference, State of the Air Report, 1999 – 2008, p9
[14] After Department of Environment and Conservation NSW, 2005, Table S.1, page iii. Costs primarily reflect long-term mortality, for which a value of statistical life of $1.0m to $2.5m is used. Resident population of GMR for study period estimated at 5.27 million.
[15] 2006-2010, HRA Report 2013, captures most of Australia's urban population. Also looked at other pollutants relevant to NRSIEE emissions, eg ozone, nitrogen dioxide, sulphur dioxide

- Annual mortality attributable to long-term PM2.5 exposures above background is equivalent to approximately 1590 deaths at typical ages (2.2%).

- Approximately 2070 cardiovascular hospital admissions across all ages (1.4%) were attributable to short-term PM2.5 exposures above background.

- Approximately 120 hospital emergency department attendances for childhood asthma (0.6%) were attributable to short-term PM2.5 exposure above background.

- Approximately 1130 respiratory hospital admissions in 0–14 year olds (2.2%) were attributable to short-term PM10 exposures above background.

- Approximately 530 pneumonia and acute bronchitis hospital admissions at ages 65+ (2.5%) were attributable to short-term PM10 exposures above background.

Pollutants such as PM can travel a long distance from their source and therefore affect various populations over a wide geographical area. At an individual level, the health burden of exposure to ambient levels may be relatively small. However, these individual effects translate to a large public health burden when multiplied by the large number of people exposed in urban centres.

2.3 NRSIEE and the NRSIEE Industry

Non-road emission sources comprise compression ignition (diesel) engines, spark ignition (petrol and gas) engines and aircraft engines (jet or turbofan) and have a broad range of applications. NRSIEE as referred to in this RIS covers a wide range of spark ignition petrol powered equipment. The marine engines and outdoor powered equipment categories account for the majority of NRSIEE. These categories cover:

- Marine engines – including outboard, inboard or stern-drive marine engines and personal watercraft (with in-built marine engines); and

- Outdoor powered equipment [17] – including trimmers, brush cutters, leaf blowers, chain saws, chippers, cement mixers, lawn mowers, pumps, generators, air compressors.

Approximately 40,000 marine engines and one million units of outdoor powered equipment are imported annually. Very few are manufactured domestically.

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[16] Accepted international methodology for assessing health impacts of air pollution is to estimate attributable health effects for an index (or surrogate) pollutant, which covers the majority of effects of all other correlated pollutants and avoids the issue of double counting (Jalaludin, B., Glen Salkeld, Geoff Morgan, Tom Beer, Yasir Bin Nisar **A Methodology for Cost-Benefit Analysis of Ambient Air Pollution Health Impacts: Final Report.** Commonwealth Department of Environment, Water, Heritage and the Arts, Canberra (16 January, 2009). PM is often used as the index pollutant (HRA Report 2013 and also, the WHO suggests that PM or sulphur dioxide is selected as the index air pollutant for health effects of transport sources of ambient air pollution (World Health Organisation **Air Quality Guidelines. Global update 2005. Particulate matter, ozone, nitrogen dioxide and sulphur dioxide**. WHO Regional Office for Europe, Copenhagen (2006)).

[17] The engines are less than 19 kW or 25 horsepower in power.

2.3.1 The NRSIEE industry

Over 500 manufacturers, importers, distributors, dealers and retailers are involved in the sale of NRSIEE in Australia. A number of these are represented by three peak industry organisations: the Outdoor Powered Equipment Association (OPEA), the Outboard Engine Distributors Association (OEDA) and the Australian Marine Engines Council (AMEC).

NRSIEE Industry

- Over 500 manufacturers, importers, distributors, dealers and retailers are involved in the sale of NRSIEE in Australia.
- Australian manufacturing is largely limited to incorporating engines manufactured overseas into products made in Australia.
- Around 1 million outdoor powered equipment units are imported annually with an estimated value of $248 million in 2009-10 [18].
- Around 40,000 marine engines are imported annually worth an estimated $144 million in 2009 10 [19].

2.3.1.1 Marine NRSIEE

There are six major outboard marine manufacturers that import into Australia (Mercury, Yamaha, Tohatsu, Evinrude, Honda, Suzuki) that hold approximately 80 per cent of the market, with at least a further nine brands imported from Asia [20]. Marine engines are distributed by dealerships and agents for the major brands, as well as by independent outlets and one major retailer. The manufacturers are represented by two peak industry organisations – OEDA and AMEC. OEDA and AMEC members respectively represent approximately 75 per cent and between 5 and 25 per cent of the marine engines market [21].

2.3.1.2 Outdoor powered equipment

The outdoor powered equipment category covers a more diverse group of businesses that cover specialists in the lawn and/or garden area, or general hardware and supply businesses. Product quality and price also varies between home consumer and garden professional markets.

OPEA represents over 100 manufacturers, importers, distributors and dealers in Australia, including Stihl, Briggs and Stratton, Husqvarna, Makita, and Yamaha.

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[18] Australian Bureau of Statistics. (2010). *Australian customs value*.Canberra, Australia. ABS

[19] Australian Bureau of Statistics (2011) Australian importation data on non-road engines 1998 to 2011 (supplied October 2011). Equipment included blowers/vacuums, garden trimmers, AC GenSets, ride-on mowers and tractors, and push-mowers

[20] Survey conducted by the Department of the Environment, June 2014.

[21] OEDA market share data, retrieved October 23, 2014

Members from OPEA represent approximately 50 per cent of the outdoor powered equipment market (i.e. garden equipment) with the remaining market share representing the more generic imported equipment [22].

Trade data shows that more than 26.1 million NRSIEE were imported in the period 1988 to 2001. Outdoor powered equipment contributes significantly to the total of NRSIEE imports. For example, in 2010 42,701 outboards compared to 378,622 brushcutters and 125,626 hand-held blowers/vacuums were imported into Australia.

The majority of consumers undertake boating and gardening activities as recreation and/or maintenance. However, some consumers operate businesses that use these products, for example lawn and garden care operators, plant nurseries, small fishing concerns, aquaculture, and some tourism operators.

2.4 NRSIEE emissions are a significant contributor to air pollution

The wide distribution and frequent use of NSIREE within or close to Australian urban environments make them a source of pollution into these environments. The important pollutants associated with combustion engines are:

- ozone (a secondary pollutant that is formed post-engine exhaust);
- particulate matter (mostly PM2.5);
- carbon monoxide (CO);
- nitrogen oxides (NOx); and volatile organic compounds (VOCs) that consist of the non-methane hydrocarbons.

Many NRSIEE are powered by conventional two stroke engines due to their power characteristics, relative lightness (especially for handheld equipment), and mechanical simplicity. Carburetted 2-stroke spark ignition engines are very high pollution emitters. These engines have significant “scavenging losses” where a large proportion (up to 30%) of the incoming fuel is lost with outgoing exhaust gas during the engine cycle. In addition, blending oil with fuel increases the PM2.5 emissions from these engines compared to 4-stroke engines [23], with higher blend ratios resulting in higher PM2.5 emissions.

Carburetted 2-stroke engines emission rates are therefore significantly elevated when compared against direct injection 2- or 4-stroke engines, or carburetted 4-stroke engines. A NRSIEE engine that meets current European Union or US emission standards for the criteria pollutants will emit only 1/10 to 1/25 the amount of these pollutants emitted from an equivalent carburetted 2-stroke engine of the same power and used for the same purpose

[22] OPEA market share data, Retrieved October 23, 2014
[23] Volckens, John, James Braddock, Richard F. Snow, William Crews (2007) *Emissions profile from new and in-use handheld, 2-stroke engines*. Atmospheric Environment 41: 640-649

Currently a significant proportion of NRSIEE imported and sold in Australia is 2-stroke technology – and more specifically, higher emitting 2-stroke carburetted technology. As a result, the NRSIEE sector is a significant contributor to the overall pollution load in Australian airsheds. A 2007 review of four Australian airshed inventories [24] indicated that lawn-mowing and recreational boating together contributed between:

- 2.4 to 5% of total man-made carbon monoxide (CO) emissions;
- 0.1 to 1.7% of total man-made oxides of nitrogen (NOx) emissions;
- 0.2 to 0.6% of total man-made particulate matter (PM, mostly as PM2.5) emissions; and
- 3 to 6% of total man-made volatile aromatic hydrocarbon (VOC) emissions.

NRSIEE are high polluters relative to their engine size and usage

At peak times, NRSIEE are estimated to contribute up to 10 per cent of overall air pollutants in Australian urban environments.

Many NRSIEE are powered by conventional two stroke engines which produce more pollution compared to four-stroke engines and some advanced technology two-stroke engines [25].

One hour of operation of a 2-stroke leafblower can produce around the same emissions of NOx as a car operated over the same period [26], and as much HC as 150 cars operated over the same period.

These values represent the long-term averages. The review demonstrates that, on a summer weekend day, lawn-mowing and recreational boating activities together contribute on those days about 20% of total man-made CO, 5 to 9% of total man-made PM, and 20% of total man-made VOC emissions in these urban environments.

Coastal emissions from NRSIEE are captured in figures for NRSIEE emission levels in urban centres. This is because most recreational boating activities occur within the close proximity to where the boats are registered [27], and most boats are registered

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[24] Department of the Environment and Water Resources. *Non-Road Engine Emissions Inventory Source Contribution Review.* Prepared by Pacific Air and Environment - PAE Job 2165a (11 April 2007). Author, Canberra, Australia. Four airsheds are included in this review: NSW Greater Metropolitan Region (Newcastle-Sydney-Wollongong), South East Queensland (Noosa-Brisbane-Gold Coast, to Toowoomba in west), Port Phillip (Bacchus Marsh-Wallan-Healesville-Somerville-Melbourne-Geelong), and Perth (Perth-Tow Rocks-Rolling Green-North Rockingham).

[25] The 2011 test was undertaken in the American Automobile Club emissions laboratory, the Automotive Research Center at Diamond Bar, California and reported on Edmunds car dealership website (accessed 28/08/2015).

[26] CRIS – fn certified to US standards – ie even the better-performing NRSIEE emit disproportionately higher levels of air pollutants when compared against typical modern car engines

[27] Queensland study

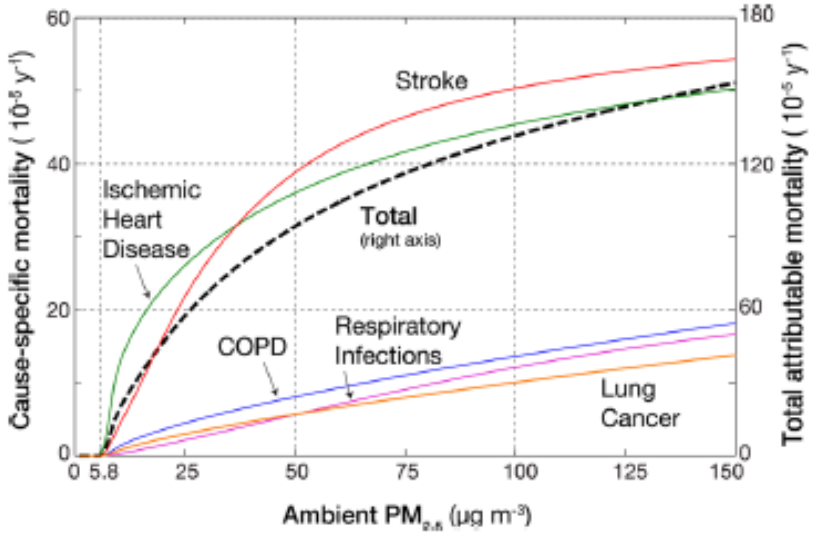
within major urban centres with adjacent navigable coastal waterways such as in Brisbane, Sydney and Melbourne [28].

2.4.1 Health impacts and costs from NRSIEE air pollution in Australia

Even though NRSIEE emissions represent only a portion of total air pollution in Australia, and Australian air pollution levels are relatively low by international standards, NRSIEE emissions are likely to have a significant impact on health outcomes. This is because the current science indicates that there is no threshold below which adverse health effects from PM and other pollutants in the atmosphere are not observed, and that adverse effects can be experienced after both short- and long-term exposures. Adverse health effects have been demonstrated at ambient air pollution concentrations and levels below current standards. This is illustrated in Box 1.

Given NRSIEE emissions represent a small but significant proportion of total ambient air pollution, it is arguable that dozens of the approximately 3000 deaths per year deaths attributed to ambient urban air pollution could be due to NRSIEE emissions. Even a small reduction in the concentration of air pollutants such as PM will have a public health benefit when averaged across large populations.

Box 1: Health impacts of PM2.5 at different ambient pollution levels.



The above figure represents global concentration-mortality relationships for ambient PM2.5 for five individual endpoints (solid lines, left axis), and for the total of five causes (dashed line, right axis). The vertical axes indicate per-capita mortality rates attributable to PM2.5 for a hypothetical global population uniformly exposed to a given level of PM2.5.

What is important to note is the shape of the concentration-mortality relationship. It shows that there are health impacts right down to very low levels of pollution, and that even at very high levels marginal increase in pollution is likely to increase mortality.

[28] State boat registration data

For comparison, peak daily PM2.5 levels in Australian capital cities are commonly in the range of 20-50ug/m3 [29].

This illustrates the current scientific view that additional ambient air pollution is likely to be harmful, regardless of the current population level.

Source: Apte, J., Marshall, J., Cohen, A. and Brauer, M. 2015, 'Addressing Global Mortality from Ambient PM2.5', Environmental Science and Technology, 49, pp. 8057−8066.

2.4.2 Environmental impacts from air pollution in Australia

In addition to health impacts, air pollution may have significant impacts on the environment, either directly or indirectly. Impacts may include damage to crops and other vegetation through impaired growth; acidification of soils and freshwater, which depletes essential nutrients that support flora and fauna; eutrophication which depletes oxygen levels and can lead to a change in species diversity; and chronic health problems in wildlife from heavy metals and organic pollutants6,7. Additionally, NRSIEE emit CO2 and NOx, both greenhouse gases which contribute to climate change.

The focus of this RIS is on reducing emissions from NRISEE to reduce associated health impacts. However, it is important to note that there are broader impacts associated with air pollution. As NRSIEE emissions contribute to air pollution, they also contribute to these broader impacts.

2.5 The problem will get worse if the status quo is maintained

More than one million NRSIEE were imported into Australia in 2012 [30]. Historical import and retail data show a growth trend in annual NRSIEE sales that keeps pace with or slightly exceeds Australia's population growth rate. The number of operational NRSIEE is therefore growing in Australia and this will lead to an increase in pollution from these engines under current business as usual arrangements.

Australia has benefited somewhat from the import of cleaner engines compliant with NRSIEE emission standards issued by the US, EU and other jurisdictions. However these engines are more expensive and so that there is a continuing domestic market for cheaper but more polluting engines. A review of the emission performance of new NRSIEE being sold into the Australian non-road market indicates that a significant portion of units are high emitters relative to units being sold into the US and EU [31].

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[29] State of the Environment 2011 Committee 2011, *Australia State of the Environment 2011*, Independent report to the Australian Government Minister for Sustainability, Environment, Water, Population and Communities, Canberra DSEWPaC Australian Government 2011.

[30] ABS Trade data.

[31] Environment Link and Vehicle Design Research (2007). *Comparative assessment of the environmental performance of small engines. Marine outboards and personal watercraft*. Commissioned by the Department of Environment and Water Resources. Retrieved December 8, 2014

Retail surveys of the Australian outboard market in 2005/06 estimate that 63% of outboards [32] and 64% of powered garden equipment [33] could not meet the US EPA phase 2 emission standards for NRSIEE introduced into the USA at that time. Data from the Australian outboard industry suggests that the proportion of high emitters has reduced to 51% in 2012 [34].

Available retail data supplied by the Australian peak body for powered outdoor equipment (Outdoor Powered Equipment Association – OPEA) does not disaggregate into compliant and non-compliant categories. Therefore there is no current evidence of a similar trend in this sector.

Without some form of intervention, NRSIEE emissions of these pollutants are expected to increase significantly over the period 2015-2035 – by around 40 per cent for PM and HC emissions, and by almost 80 per cent for NOx emissions – with the majority of the growth due to outdoor powered equipment. This increase is driven by the likely continued growth in imports of NRSIEE, and continuing demand for the lowest priced equipment, particularly in the outdoor powered equipment category. Industry advises that the imported less expensive NRSIEE tend not to meet international standards.

The increase in emissions from NRSIEE will contribute to greater levels of these pollutants in the ambient air in Australia, and will result in an increase in population exposure and associated health impacts.

2.6 Current air quality management in Australia does not address emissions from NRSIEE

The current approach to air quality management in Australia focuses on reducing exceedances of ambient air quality standards at specific locations. The standards are based on health considerations and are made under the National Environment Protection (Ambient Air Quality) Measure (AAQ NEPM). This recognises the importance of a nationally consistent approach to the management of air pollution standards, supported by local tailored responses, on environmental, economic efficiency and health cost/benefit grounds.

A review of the AAQ NEPM [35] in 2011 included a recommendation for the specification of air quality standards for PM2.5 and the introduction of an exposure reduction

[32] Department of the Environment and Water Resources. *Comparative Assessment of the Environmental Performance of Small Engines: Outdoor Garden Equipment*. Prepared by Environment Link and Vehicle Design and Research P/L (February 2007), Author, Canberra, Australia.
[33] Department of the Environment and Water Resources. *Comparative Assessment of the Environmental Performance of Small Engines: Marine Outboards and Personal Watercraft*. Prepared by Environment Link and Vehicle Design and Research P/L (February 2007), Author, Canberra, Australia.
[34] Outboard Engine Distributors Association (OEDA) presentation to the Department (2013).
[35] National Environment Protection Council. (2011). *National environment protection (ambient air quality) measure review, Review report*. Retrieved August 19, 2014 from

approach to maximise overall health benefits by reducing general population exposure to low air pollution concentrations. Given policy measure are already in place to address many other major sources of air pollution in Australia, efforts to further reduce air pollution will need to focus on either introducing more stringent or more broadly applicable measures for sectors that are already regulated, or on reducing emissions from currently unregulated sources/sector.

Currently, there are no national regulations in Australia that restrict emissions from non-road spark ignition equipment and engines. In contrast, national vehicle emission standards for on-road vehicles (motor vehicles) have been in force since 1972, and many point-source emissions, which are generally regulated at the state-level, have been similarly regulated for more than 20 years.

2.6.1 NRSIEE emissions are regulated in other countries

NRSIEE emission standards have been introduced in North America (USA and Canada), the European Union (EU), Japan and China.

The US Environmental Protection Agency (EPA) first introduced emission standards for some NRSIEE in 1995 and in 2008 released the Control of Emissions from Non-road Spark-Ignition Engines and Equipment; Final Rule, which set out the emission standards for all types of non-road engines, equipment, and vehicles [36], including for exhaust and evaporative emissions to reduce the environmental impact from marine spark-ignition engines and vessels [37] and small spark-ignition engines [38].

The emission standards require manufacturers to control exhaust emissions from the engines and evaporative emissions from fuel tanks and fuel lines. Evaporative emission standards address fuel permeation through fuel-system components in addition to fuel venting during engine operation.

The first European legislation to regulate emissions from non-road (off-road) mobile equipment was promulgated on 16 December 1997 [39]. The regulations for non-road diesels were introduced in two stages: Stage I was implemented in 1999 and Stage II was implemented over 2001 to 2004.

On 9 December 2002, the European Parliament adopted Directive 2002/88/EC [40], amending the non-road Directive 97/68/EC by adding emission standards for small, gasoline fuelled utility engines below 19 kW. The Directive notes that emissions from small spark ignition engines (gasoline engines) in different types of machinery contribute significantly to identified air quality problems, both current and future,

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http://www.scew.gov.au/resource/national-environment-protection-ambient-air-quality-measure-review-review-report – the recommendation was supported by a better understanding of the long-term health effects of $PM_{2.5}$.

[36] US NRSIEE Final Rule, retrieved August 19, 2014

[37] US NRSIEE Final Rule, Marine engines retrieved August 19, 2014

[38] US NRSIEE Final Rule, small engines retrieved August 19, 2014

[39] European Commission. (1997). *Directive 97/68/EC*. retrieved August 19, 2014

[40] European Commission. (2002). *Directive 2002/88/EC*. Retrieved August 23, 2014

especially ozone formation. The utility engine emission standards are to a large degree aligned with the US emission standards for small utility engines.

Emission standards for non-road engines and equipment are also in place in several other countries including Canada, Japan and China. The Canadian Off-Road Small Spark-Ignition Engine Emission Regulations [41] were promulgated on 19 November 2003. The Regulations apply to off-road engines of model year 2005 and later that use sparkplugs and develop no more than 19 kW (25 hp) of power such as those used in lawn and garden machines, in light-duty industrial machines, and in light-duty logging machines.

Chinese emission standards for non-road mobile machinery are generally based on the European emission standards, although they also include small diesel engines which are not included in the European standards [42].

These countries are phasing in stricter limits as awareness grows of the impact of the NRSIEE emissions, both within country and trans-nationally even at low levels [43], and advances in technology allow for a lower level of pollutants in emissions from these products.

2.7 Problem summary

- Air pollution has been shown to cause a range of health impacts – from respiratory and cardiovascular illnesses, to cancer and premature death. In Australia it is estimated that around 3000 deaths per year could be attributed to ambient air pollution.

- NRSIEE emissions contribute a small but significant proportion of air pollution in Australia – up to 10 per cent of urban pollution on peak days, although this is based on a 2007 study which adds some uncertainty in establishing the extent of the problem relative to other pollution sources.

- Recognising the significance of the contribution of non-road spark ignition sources to the problem of air pollution, other countries have implemented emissions standards to reduce emissions from these sources – some as long ago as 1995. Emissions by NSIREE are currently unregulated in Australia.

- Without some form of intervention, emissions from NRSIEE in Australia are projected to increase by between 40 percent and 80- per cent (depending on the pollutant) by 2035, with a consequent rise in overall air pollution levels and incidence of associated health impacts.

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[41] Environment Canada. (2003). *Off-road small spark-ignition engine emission regulations (SOR/2003-355)* retrieved August 19, 2014

[42] Transport Policy.net. (n.d.). *China: nonroad: emissions* retrieved August 19, 2014

[43] Anenberg, S. C., West, J. J., Yu, H. et al. (2014). Impacts of intercontinental transport of anthropogenic fine particulate matter on human mortality. *Air Quality Atmosphere and Health* 7,369-379

3 OBJECTIVES

3.1 Case for Action

Whereas on-road vehicles have been subject to increasingly stringent emission standards since the early 1970s, as well as state and territory emission reduction programs, non-road engine emissions have remained largely unregulated in Australia. This is in contrast to measures that have been taken internationally by the United States of America, the European Union and China amongst other countries.

As highlighted in Section 2, NRSIEE contributes to emissions of fine particles (PM) and ozone precursors, and that these exhaust emissions result in significant impacts on human health, as well as the potential for broader environmental effects. Despite consuming less fuel than on-road transport nationally, NRSIEE makes a significant contribution to emissions of air pollutants which is not currently being addressed.

The problem will get worse if the status quo is maintained as market forces within the NRSIEE sector in Australia have not driven the transition to lower emission engines, particularly for outdoor powered equipment. Further, increasingly strict international standards are likely to increase the cost differential between internationally-compliant NRSIEE and cheaper non-internationally-compliant NRSIEE. This is expected to impede the future uptake of lower emission NRSIEE in Australia.

Without some form of intervention, emissions from NRSIEE and the associated health impacts are projected to grow over the next two decades as set out in Section 2.

NRSIEE emissions are a national concern as they can be transported long distances, both within a state or territory, and between states and territories. Effective national management would deliver improvements in air quality, reduce health costs, deliver economic efficiency through reduced burden on industry from multiple approaches and provide consistency across jurisdictions.

Reducing this source of exhaust emissions into the future would result in a significant decreased impact on human health, particularly in areas of higher population density.

3.2 Objectives

The objectives in managing NRSIEE emissions are to:

1. Reduce the adverse impacts of NRSIEE emissions on human health and the environment

2. Ensure any emission-reduction measure/s provide for a consistent national approach and are commensurate with international trade requirements and accepted international standards

3. Ensure that any approach provides a net benefit to the community and meets the objectives of the Australian Government’s regulation reform agenda by minimising the impact and costs on business to the extent possible while still meeting objectives 1 and 2.

4 OPTIONS

This Section outlines the development, consideration and selection of the options for reducing emissions from NRSIEE.

4.1 Development of Options – Consultation RIS

The Consultation RIS (CRIS) set out three options for action, i.e. actions to reduce emissions:

- Business as usual
- Limiting the use of NRSIEE
- Establishing emission standards via:
- Voluntary industry agreement (restricted to the marine outboard industry)
- Commonwealth regulation
- National Environment Protection Measure (NEPM).

4.2 Development of Options – Decision RIS

Submissions on the CRIS were supportive of government action to reduce emissions from NRSIEE. However, there were diverging opinions regarding the timing of the implementation of full regulation, with some respondents preferring a phased approach, while other respondents favoured immediate regulation.

Only one submission out of some 91 submissions received stated a preference for no government intervention, while another three did not provide a clear statement on their preferred action. One submission supported the voluntary outboard industry agreement option with no other government action.

Of the submissions which were supportive of regulated emissions standards, none specifically mentioned whether implementation should be in the form of Commonwealth regulation or a NEPM. Comments were largely focussed on the stringency and timing of standards and the impacts that could result from the implementation of emissions standards.

Further consultations, including those with state and national bodies representing recreational fishing and boating groups, and other organisations, confirmed conclusions from the CRIS that:

- Limiting or banning the use of NRSIEE were not considered feasible or practical
- Individual State/territory-based regulations were not able to meet the objectives, and
- There was strong support for establishing NRSIEE emissions standards.

As noted above, a broader range of options were initially assessed to identify the most feasible options for establishing product emission standards. These were developed in response to comments received on the Consultation RIS and subsequent consultation with marine industry stakeholders between 2010 and 2013.

This assessment identified four main options that merited detailed assessment in the cost benefit analysis.

- Option 1 – No Policy Change Government and industry maintain current policy and practices into the future and do not take specific action to manage NRSIEE emissions
- Option 2 – Voluntary Voluntary scheme operated by industry where NRSIEE are voluntarily labelled if compliant with the emission standards, with the emission standards set by government
- Option 3 – Co-Regulation Legislation establishes emission standards with industry administering the arrangement
- Option 4 – Regulation Legislation establishes emission standards with government administering the arrangement

4.3 The Australian NRSIEE Emission Standards

Since 1995 the US has taken the lead in identifying the problems resulting from NRSIEE emissions, gathering the data necessary to understand consequences and options, and developing responses, particularly in the establishment of emission standards. Other countries have been able to follow this lead.

The EU standards have been developed based on the US standards and while they have deviated over the years, the EU is currently considering full alignment with the US standards. The Chinese standards are based on the EU standards and are likely to be updated as the EU standards are changed and, therefore, result in alignment to those in the US. The Canadian emission standards are already based on those of the US.

US standards continue to be the most stringent internationally, and are the default for most manufacturers due to the US market share for NRSIEE products.

Public consultation with Australian industry and community stakeholders on the Consultation RIS and in the development of this Decision RIS has indicated broad support for the adoption of US emission standards in Australia.

The proposed approach to establishing Australian NRSIEE emission standards is to align them with the US emission standards. Specifically to adopt those defined in Title 40 of the US Code of Federal Regulations or equivalent standards of other countries.

The US emission standards cover seven categories with only two relevant to Australian requirements to reduce emission from NRSIEE. The Control of Emissions from Non-road Spark-Ignition Engines and Equipment; Final Rule (2008) categories

relevant to this RIS are set out in Table 4.1. The US EPA seeks manufacturers and/or importers to submit an application for certification.

Table 4.1 US Non-road Spark-Ignition Engines and Equipment – Relevant Categories

Category	Coverage
Title 40 CFR Part 1045 - Marine spark-ignition (SI) engines and vessels	Gasoline boats and personal watercraft: pleasure boats, jet-skis, outboard engines, and stern drive/inboard engines
Title 40 CFR Part 1054 - Non-road small SI engines and equipment: ≤ 19kW, or ≤25 hp (approx)	Small gasoline lawn and garden equipment: lawnmowers, leaf blowers, chain saws, and string trimmers

It is proposed that Australian regulations would adopt the two relevant categories from the US emissions standards and recognise the equivalent standards of other countries (for example the Canadian standards are based on the US standards).

Certification by the US EPA or equivalent certification by other countries would provide sufficient evidence to enable the importation and sale of relevant equipment in Australia. It is not proposed that Australian standards would seek to be more stringent than those of the US or equivalent standards.

The US regime has the ability for averaging, banking and trading (ABT). This process enables manufacturers to average emissions across product families within their product lines. Additionally, manufacturers can use credits accrued in one year for engines that outperform standards to offset worse-performing engines in subsequent years. Manufacturers can trade credits so long as the product line, on average, does not exceed the weighted average, as allowed by standards, for the relevant product line. This allows them to maintain a supply of higher emission equipment for niche applications, such as olive shakers, which cannot be serviced with low-emissions equipment.

The introduction of this process would require applications, monitoring and reporting on ABT. This would add considerably to the complexity of the introduction of emission standards, additional cost to government and industry and a small reduction in benefits. However, not allowing ABT would arguably impose more stringent standards than those in the US. As such, whether some form of ABT is introduced is proposed to be considered during implementation, in consultation with industry.

In summary, it is proposed that the Australian NRSIEE emission standards encompass:

- adoption of the US Control of Emissions from Non-road Spark-Ignition Engines and Equipment; Final Rule (2008) Title 40 CFR Part 1045 and 1054 or the equivalent standards of other countries, and

- acceptance of US certification or equivalent from other countries as evidence of compliance prior to importation.

4.4 Option 1 – No Policy Change

The No Policy Change option represents the scenario where government and industry maintain current policy and practices into the future and do not take specific action to address the problem outlined in Section 2. This Option means:

- Government, at all levels, will continue with no change in policy regarding NRSIEE emission reduction;

- The market will continue to operate as is, including recognising that:

- import trends of NRSIEE follow overseas trends

- the growth in cleaner technologies largely driven by the US emission standards will continue

- the import of cheaper non-compliant units will continue.

4.5 Option 2 – Voluntary

The Voluntary option seeks to encourage the import and purchase of NRSIEE that are compliant with NRSIEE emission standards through voluntary labelling of NRSIEE compliant products. This approach would enable consumers to choose between a lower emission, compliant, labelled product and a higher emission, non-compliant, non-labelled product.

This option proposes the adoption of emission standards aligned with, or similar to, the US emission standards as the Australian voluntary standards. NRSIEE could continue to be imported even if non-compliant with the voluntary standards.

A voluntary approach was not supported during consultations. Industry was specifically concerned about the cost of setting up such an approach and to then have other businesses use the approach without contributing to the cost of its establishment and operation. Feedback indicated that should there be a voluntary approach that it should be underwritten by government regulation of the standards. This was seen as necessary to ensure credibility, assist in the development of clear rules and guidelines, and encourage uptake by industry (importers, retailers, etc).

Under this option, a regulatory framework would only provide for the:

- Setting of NRSIEE emission standards

- Development of guidelines for accreditation and for the labelling scheme/s

- Establishment of the role, responsibilities and powers of accredited organisation/s
- Accreditation of organisation/s to administer the voluntary arrangements
- Authorisation of the use of labels to identify NRSIEE compliant products if approved by an accredited organisation.

This approach is the deregulation option as the application of the government set NRSIEE emission standards is voluntary.

4.5.1 Role of Government

The role of government would be to:

- Establish the NRSIEE emission standards, in consultation with stakeholders
- Develop, in consultation with industry, the guidelines for accreditation and for the labelling scheme/s
- Develop and then administer the necessary regulations governing the voluntary approach
- Accredit suitable organisation/s to operate the scheme/s
- Oversee the compliance of accredited organisation/s with the regulations.

Under this approach national consistency is provided by the Commonwealth taking responsibility for the roles outlined above.

4.5.2 Role of Industry

The role of industry would be to voluntarily:

- consult with government on the NRSIEE emission standards and guidelines for accreditation and for the labelling scheme/s; and
- operate one or more labelling scheme/s as accredited by government.

An organisation or industry body would be free to apply to the government to become an accredited organisation. As an accredited organisation, it would have responsibility, under regulation, to administer a NRSIEE labelling scheme, including:

- promoting compliance with the standards and use of labels through education, information dissemination and marketing;
- assessing applications to use labels; and
- undertaking compliance functions to ensure correct use of labels and following up incorrect or misuse use of labels.

There may be multiple accredited organisations. This may reflect the category of NRSIEE, for example a marine engines accredited organisation and an outdoor powered equipment accredited organisation. This could, alternatively, reflect outboard marine engines retailers, or home garden powered equipment importers, or professional garden equipment operators. This aspect is dependent on response from industry to the opportunities of a voluntary approach.

Individual businesses (e.g. importers, retailers) will be:

- able to voluntarily apply for use of a NRSIEE compliant label for their products, and
- expected to only use a label signifying compliance with NRSIEE emission standards where they have approval from an accredited organisation for a specific product.

This provides the consumer with surety that products labelled meet the NRSIEE emission standards.

4.5.3 Role of the Consumer

The Voluntary approach promotes decision making by the consumer as the key to reducing emissions from NRSIEE. The consumer, through access to information at the point of sale (i.e. a compliance label), is empowered to choose whether to purchase a lower-emission compliant product or not.

4.6 Option 3 – Co-Regulation

The Co-Regulation option shares some of the same basic elements as the Voluntary option with the significant addition of mandating the NRSIEE emission standards. This would mean that only products that complied with the relevant NRSIEE emission standards would be allowed to be sold in Australia.

This option also proposes the adoption of emission standards aligned with, or similar to, the US emission standards as the Australian standards.

Under this option, a regulatory framework would provide for the:

- setting of NRSIEE emission standards;
- development of guidelines for the co-regulatory arrangements;
- accreditation of organisations to administer the co-regulatory arrangements; and
- establishment of the role, responsibilities and powers of accredited organisations.

This approach seeks to minimise regulation while ensuring only the sale of compliant products through co-regulatory oversight.

4.6.1 Role of Government

The role of government would be to:

- establish the NRSIEE emission standards, in consultation with stakeholders;
- develop, in consultation with industry, regulations for co-regulatory arrangements;
- develop and then administer the necessary guidelines governing the co-regulatory approach;
- accredit suitable organisations to operate as co-regulators; and
- ensure compliance of accredited co-regulators with the regulations.

Under this approach, national consistency is provided by the Commonwealth taking responsibility for the roles outlined above.

4.6.2 Role of Industry

The role of industry would be to:

- consult with government on the NRSIEE emission standards and regulations and/or guidelines for co-regulatory arrangements; and
- operate one or more co-regulatory arrangements as accredited by government.

An organisation or industry body would apply to the government to become an accredited co-regulatory organisation. As an accredited co-regulatory organisation, it would have responsibility, under regulations, to administer a co-regulatory arrangement, including:

- promoting understanding and compliance with the standards through education, information dissemination and marketing;
- assessing applications to import/sell compliant products; and
- undertaking compliance functions to ensure adherence with the regulations.

There may be multiple accredited organisations. This may reflect the category of NRSIEE product, for example a marine engines accrediting organisation and an outdoor powered equipment accrediting organisation. This could, alternatively, reflect outboard marine engines retailers, or home garden powered equipment importers, or professional garden equipment operators. This aspect is dependent on the response from industry to the opportunities of a co-regulatory approach.

Individual businesses (e.g. manufacturers, importers, retailers) would be required to:

- apply for approval to an accrediting organisation to manufacture or import compliant products for sale;

- produce and maintain evidence of compliance such as US certification or equivalent; and
- maintain records of NRSIEE products imported or manufactured for audit and compliance purposes.

Individual businesses will be expected to only sell products that have been approved by an accredited co-regulatory organisation as meeting the relevant NRSIEE emission standard/s.

4.6.3 Role of the Consumer

The co-regulation approach assures the consumer that all products imported and/or offered for sale will meet the relevant NRSIEE emission standard/s.

4.7 Option 4 – Regulation

The Regulation option proposes the setting of NRSIEE emission standards through regulation. Only products that comply with a relevant NRSIEE emission standard would be allowed to be sold.

This option also proposes the adoption of emission standards aligned with, or similar to, the US emission standards as the Australian standards.

Under this option, a regulatory framework would provide for the:

- setting of NRSIEE emission standards; and
- development of legislation and regulations establishing the role, responsibilities and powers of the regulator.

This approach seeks to minimise regulation and complexity through instituting a single regulator while ensuring only products that comply with NRSIEE emission standards are sold.

4.7.1 Role of Government

The role of government would be to:

- establish the NRSIEE emission standards, in consultation with stakeholders
- develop and then administer the legislation and necessary regulations to support the legislation
- promote understanding and compliance with the standards and legislation through education and information dissemination
- ensure compliance with the legislation and regulations.

Under this approach, national consistency is provided by the Commonwealth taking responsibility for the roles outlined above.

4.7.2 Role of Industry

The role of industry would be to:

- consult with government on the NRSIEE emission standards and guidelines;
- operate in compliance with the legislation and regulations.

Individual businesses (e.g. manufacturers, importers, retailers) would be required to:

- apply to the regulator to manufacture or import compliant products for sale;
- produce and maintain evidence of compliance such as US EPA certification or equivalent;
- maintain records of NRSIEE products imported or manufactured for audit and compliance purposes.

Individual businesses will be expected to only offer for sale products that are compliant with the relevant NRSIEE emission standard/s.

4.7.3 Role of the Consumer

The Regulation option assures the consumer that all products imported and/or offered for sale will meet the relevant NRSIEE emission standard/s.

5 APPROACH TO THE IMPACT ANALYSIS

A cost-benefit analysis has been undertaken on the four identified options. This Section sets out the cost benefit analysis methodology and the key assumptions and parameters underpinning the analysis.

5.1 Methodology and Key Assumptions

The basic methodology for the impact analysis is set out in the equation below:

NPVoption = PVmonetised health impacts + PVchange in consumer surplus + PVchange in producer surplus + PVchange in service and fuel costs + PVcompliance cost to business + PVcompliance cost to government

where NPV is the net present value of the changes, and PV is the present value.

The major standard factors with associated assumptions are:

- Compliance rates of the three options
- Period of analysis
- Population modelling
- Emissions profile of available engines
- Engine and equipment costs
- NSIREE demand response to regulatory changes
- Health impacts of emissions;
- Fuel costs; and
- Regulatory costs.

Other standard assumptions include that there will be:

- no major shift in combustion engine technology, as well as no major shift in sales demand to non-combustion motors (i.e. battery or electrically operated)
- on advice from industry, little or no Australian manufacturing of NRSIEE.

5.2 Compliance Rates

Within the cost benefit analysis, to be fully effective means that there is 100 per cent compliance with emission standards.

This is unrealistic for the Voluntary option as some businesses will opt not to apply the standard. The modelling, therefore, tests this differing level of compliance by setting a parameter value for different levels of compliance within the engine populations (not businesses).

The level of complexity of the administration of the regimes also impacts on the assumed compliance levels, particularly for the Co-Regulation option, as complexity can provide opportunities for avoidance. The Co-Regulation option with its assumption of compliance activity at multiple levels by multiple parties is likely to see higher rates of non-compliance than the Regulation option.

The compliance rates used in the analysis are:

- 100 per cent of engines for the Regulation option mainly due to the Commonwealth administering the arrangement, including compliance measures;

- 80 per cent for the Co-Regulation option reflecting the multiple party compliance processes that will enable some avoidance to take place; and

- 50 per cent for the Voluntary option reflecting overseas experience and its voluntary nature.

5.3 Period of analysis

All options assume a start date of 2016, and a 20 year period of analysis. That is, the impact of each option on each new cohort of engines introduced between 2016 and 2035 (inclusive) are examined in the analysis.

5.4 Population Modelling

Population modelling for the options estimates the annual populations of operating compliant and non-compliant engines for the period of interest, 2016 to 2035. The option models for both categories of NRSIEE are based on trend analysis of historical sales and trade data for the period 1989 to 2012. 'Scrappage' distributions are incorporated into the models to remove aging engines from the population over time, and are sourced from US EPA data [44]. The population models estimate the shift in engine technology and population size relative to the No Policy Change option when the other options are applied.

Approximately 80 per cent of marine engines and approximately 55 per cent of outdoor powered equipment are covered within this analysis. This represents mainly outboard engines and handheld garden equipment, including trimmers, brushcutters, blowers, vacuums and chainsaws. These categories include the majority of NRSIEE which are likely to be currently non-compliant with US and other international standards.

In relation to outdoor powered equipment, lawnmowers and pumps/generators are excluded from the cost-benefit analysis due to a lack of reliable data.

- For lawnmowers this is unlikely to cause a significant problem as industry advises that the vast majority of engines available in the Australian market are already compliant with US emission standards. As such, the inclusion of lawnmowers in the analysis would not significantly affect the estimated costs and benefits of the options.

[44] US EPA 2005, *Calculation of Age distributions in the Nonroad Model: growth and scrappage*, EPA420-R-05-018, December.

• For pumps and generators, it is likely that a subset of the models available on the Australian market currently do not comply with the proposed standards. However, the emissions profile and costs of the engines are similar enough to the outdoor powered equipment included in the analysis that their inclusion, while likely to change the magnitude of the modelled impacts, would not change the direction of the impacts. That is to say that if emissions standards are a good idea for blowers, trimmers and chainsaws, they are likely also to be a good idea for pumps and generators.

An additional element is introduced into the marine engine category sales model. Market data supplied by the marine engine industry shows that there is a small observable trend away from carburetted two-stroke motors to direct injection two-stroke and four-stroke motors. This is captured in the models as a compounding 2 per cent annual displacement of sales from the carburetted two-stroke models (non-compliant) to the "rest" or compliant engines (direct injection two-stroke and four-stroke motors), compared with business as usual.

Appendix A provides further information on what is included in NRISEE and which NRISEE have been covered in the analysis for this Decision RIS.

5.5 Emissions profile of available engines

The pollutant emissions of the various engine classes – both in the marine and outdoor powered equipment sectors – are based on US EPA data [45], [46]. It is assumed for the purposes of this analysis that all 4-stroke and all 2-stroke direct injection engines will comply with the proposed US emissions standards, and that all 2-stroke carburetted and indirect injection marine engines will not comply with the proposed standards. 2-stroke carburetted handheld engines will require improvements to meet the proposed standards in relation to evaporative losses.

5.6 Purchase Costs

The price of the two classes of marine engines, i.e. non-compliant engines (2-stroke carburetted - 2C) and compliant engines is based on the 2013 prices of 404 models of outboard motors available in Australia and reported on the online pricing site, Redbook [47]. Models are grouped according to their technology and power band.

The median price is determined for each group and used as the basis for comparison. Group size varies considerably, and some groups exhibit a large range of values or extreme prices. Outliers and large ranges in values in small groups will bias the mean rather than median. Therefore the median values are used in the current analysis. Submissions from industry indicate that the price difference between compliant and non-compliant engines is likely to average around $1,500 across engine power bands; this position is supported by the analysis of median prices discussed above. As such, the price of compliant engines ($7,866.11) is assumed to be, on average, $1,503.19

[45] US EPA 2010, *Exhaust emission factors for Nonroad engine modelling – spark ignition*, EPA420-R-10-019, July.
[46] US EPA 2010, *Median life, annual activity, and load factor values for Nonroad engine emissions modelling,* EPA420-R-10-016, July.
[47] Online pricing site, Redbook, accessed 8/05/2014

higher than the price of non-compliant engines ($6,362.92) for the purposes of the cost-benefit analysis, an average increase of 24%.

Outdoor powered equipment prices are sourced from an Australian online pricing site [48]. Equipment was collated into appropriate engine class and technology groups and the mean, median and inter-quartile prices determined. In the outdoor powered equipment category the distinction between compliant and non-compliant engines is not dependent upon a difference in engine technology as it is with marine engines. Rather, engine build quality and having evaporative emission compliant (more expensive) parts in place are the factors that determine their compliance with the US EPA emission standards. Price is considered a reasonable indicator of engine quality and compliance level and is used to distinguish between compliant and non-compliant models; in this analysis the cost of non-compliant engines is taken as the median price of available models in the Australian market ($348.31), while the price of compliant equipment is taken to be equal to the third quartile (75th percentile) of prices of available models ($585.20), an average increase of 68%.

The petrol price is set as the average Australian annual price of unleaded petrol (ULP) as reported by the Australian Institute of Petroleum [49]. This is set at $1.4791 (2013 AUD) in this analysis.

5.7 NRSIEE demand response to regulatory changes

The changes in regulation modelled in this analysis affect the availability of non-compliant engines and equipment. In the regulation option (Option 4), it is assumed that 100 per cent of non-compliant engine consumers will be affected; for the co-regulatory and voluntary options the proportions are 80 per cent and 50 per cent, respectively.

Affected consumers will be faced with a choice: pay a higher price for an equivalent compliant engine, or not buy an engine at all. The elasticity of demand for NRSIEE will determine how many consumers leave the market and how many opt to buy a more expensive engine. Based on data in US EPA studies [50] and on consultations with industry, the demand elasticity for NRSIEE in Australia is taken to be -1.2 as a central assumption, with elasticities of -1.0 and -1.4 included in the sensitivity analysis.

[48] Australian online pricing site, Myshopping, accessed 20/02/2014
[49] Australian Institute of Petroleum website, accessed 14/05/2014
[50] US EPA 2008, *Control of emissions from marine SI and small SI engines, vessels and equipment: final regulatory impact analysis*, EPA420-R-08-014, September.

Fig 5-1: Modelled impact of mandatory standards on marine engine sales (Option 4)

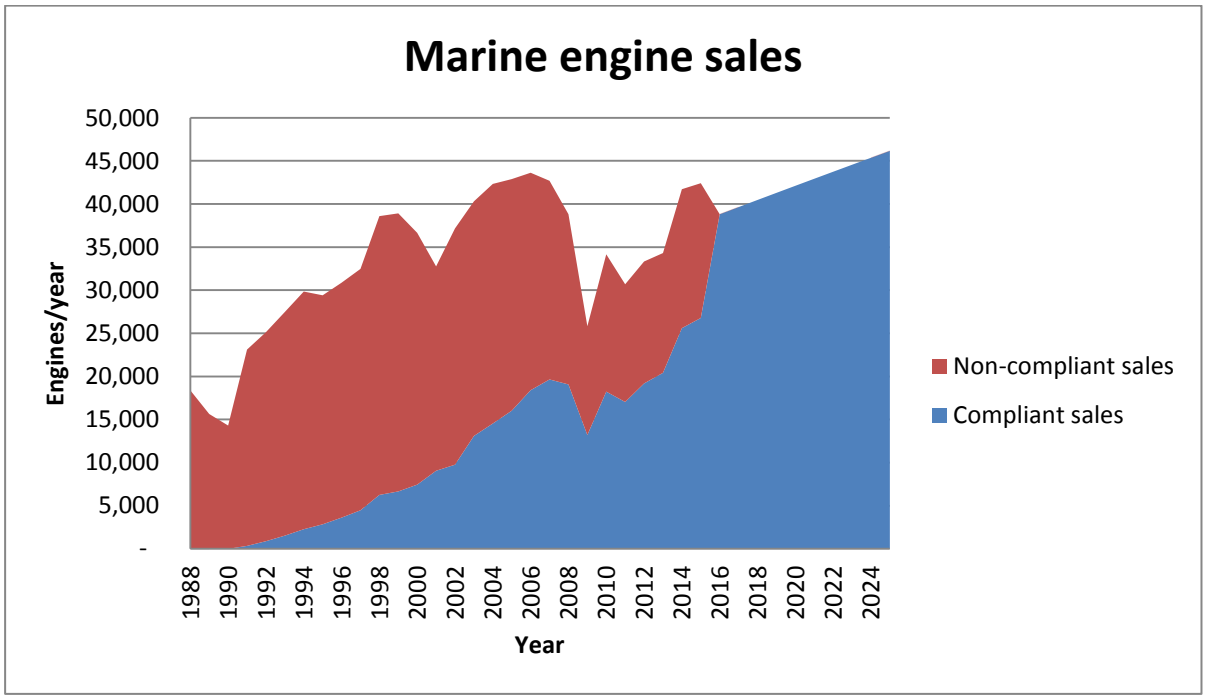
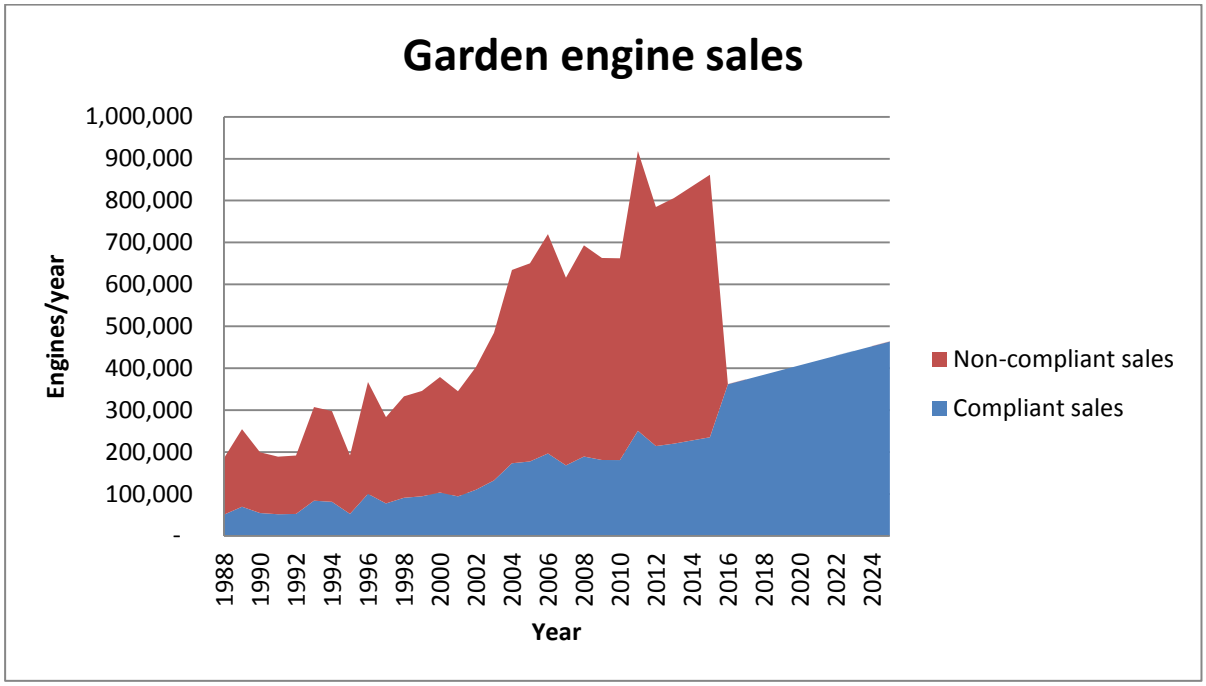


Fig 5-2: Modelled impact of mandatory standards on garden engine sales (Option 4)



Changed market demand for NRSIEE will have an impact on consumer surplus. Those consumers who choose to leave the market rather than pay a higher price for NRSIEE will forgo the utility they would have received had they been able to purchase a cheaper engine, while those who choose to remain in the market and purchase a more expensive engine will have their surplus reduced by an amount equal to the cost increase. These impacts are modelled in the cost-benefit analysis. The impact on sales for garden equipment is much higher than for marine engines because the cost

premium for compliant engines over non-compliant engines is higher (an increase of 68% for garden engines compared with an increase of 24% for marine engines).

5.8 Impact on Health Costs

The impact of pollutants on public health is related to the level of exposure, the age and health status of the exposed individuals, environmental conditions, including the presence or absence of other pollutants, and the length of exposure.

Estimating the value of benefits when reducing emissions involves high levels of uncertainty. As a result the total monetised benefits accrued to emission reductions are usually based on the mortality risk reductions for a few representative pollutants.

Most studies model individual pollutants because of the complexity in assessing possible impacts to an individual's health by a pollutant mixture, each constituent of which may have a different range of tissue targets. A chemical may also initiate or promote physiological impacts when part of a chemical mixture beyond those possible when acting alone. In addition, the ambient concentrations of many air pollutants are highly correlated.

There are significant challenges with estimating jurisdictional or regional variations in emissions from NRSIEE, and this Decision RIS analysis is based on aggregated national data. For example, imports into individual Australian ports do not represent state-based sales because of interstate distribution. Imports into Brisbane and Townsville may be distributed to Northern NSW, NT and north Western Australia, as well as locally. Furthermore, the proportions of total engine sales within an individual jurisdiction that represent each combination of technology type and power band may not equate to the proportions established within the aggregated national data. For example, boating conditions vary between the states so that outboard motor requirements may also vary. Therefore any estimates of emissions within an individual jurisdiction would have a high degree of uncertainty and have not been considered for this Decision RIS, which is focused on a national approach to reducing emissions from NRSIEE.

Avoided health cost is the accepted measure of benefit in cost benefit analyses involving emissions into ambient air and ambient air quality [51], and is determined by the following formula:

Avoided health cost (AUD) = emissions mitigated (tonnes) X unit health cost ($ per tonne).

[51] Australia. NEPC Service Corporation on behalf of the former Standing Council on Environment and Water (incorporating the National Environment Protection Council) (2013) *Economic Analysis to Inform the National Plan for Clean Air (Particles) Final Report*. Prepared by Pacific Environment Ltd and Marsden Jacob Associates. Commonwealth of Australia, Canberra, August 2013. Retrieved 11 December, 2014 from

The economic valuation of premature mortality is usually derived using a willingness to pay approach and expressed as a Value of a Statistical Life (VoSL).

Table 5.1 summarises the cost per tonne for the pollutants considered in the CBA to determine appropriate health costs for the various pollutants. The assumptions used in this analysis were based on those in the consultation RIS [52], adjusted for inflation. Also included in Table 5.1 are unit health costs from a variety of studies; this highlights the large variation in per tonne cost estimates among studies.

This RIS considers a subset of these pollutants that comprise PM2.5, non-methane VOC (i.e. hydrocarbons, abbreviated as HC), and NOx. These are primary pollutants that form the basis for exhaust emission testing related to emission standards certification in jurisdictions where this is carried out (e.g. Europe and the USA).

The CRIS CBA based the pollutant unit health cost values on the VoSL determined in the Clean Air for Europe (CAFE) study [53]. However, these values appear low compared to those reported in Australian studies on vehicular pollution. The CBA argued that the composite values they developed from CAFE incorporates a low sea case and a high land case and best represents Australia's urban and coastal environment for their central estimate. The CBA values are used as the standard unit health costs in this study. Upper and lower bounds were established about the standard values (+/- 50 per cent) for sensitivity analyses of the unit health costs.

Table 5.1 Estimated Average Health Costs – Per Tonne of Emissions - Capital Cities

Source	Health Cost by Emissions Type Per Tonne of Emissions (AUD per Tonne)		
	HC	NOx	PM10
CBA – this report central value	3,766	15,255	92,576 (for PM2.5)
This report – upper bound (CBA + 50%)	5,650	22,883	138,864
This report – lower bound (CBA – 50%)	1,883	7,628	46,288
Coffey Geosciences (2003)	2,200	59	232,000
NSW EPA (2013)			120,433
Watkiss (2002)	875	1,750	217,415
Beer (2002) – Ozone incl. Upper Bound Best Estimate	72,500	900	221,100

[52] MMA 2008, Cost benefit analysis of options to manage emissions from selected non-road engines, report to Department of Environment, Water, Heritage and the Arts, August.

[53] European Commission DG Environment (2005) *Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each EU25 Member State (excluding Cyprus) and surrounding seas*. Prepared by AEA Technology Environment. European Commission DG Environment, Brussels, March 2005. Retrieved 8 December, 2014

Source	Health Cost by Emissions Type Per Tonne of Emissions (AUD per Tonne)			
	HC	NOx	PM10	
Lower bond	19,331 11,700	870 280	147,429 108,300	
Beer (2002) – ozone excl.	18,719	11	147,429	
BTRE (2005)	na	na	167,626	
Environment Australia (2000)	12	1,440	1,385	17,600
NSW EPA (1998)	na	na	68	310
NSW EPA (1997)	25	960	1,490	1,810

Note: adapted from Department of Infrastructure and Transport, November 2010 and Beer, T. Valuation of pollutants emitted by road transport into the Australian atmosphere. In: Conference proceedings: 16th International Clean Air & Environment Conference; 2002; Christchurch, N.Z.. [Christchurch, N.Z.]: Clean Air Society of Australia and New Zealand; 2002. 86-90

NSW EPA [54] (2013) provides a recent review of pollutant unit health cost values for PM2.5. The authors reviewed the methodologies and values from major studies in the UK (DEFRA), Europe (CAFE) and U.S.A. (EPA). Australian studies were also reviewed with the authors noting the challenge in valuing air-quality related health impacts in Australian rural areas with low population densities. A weighted average value of the report's central damage cost for PM2.5 is $120,433 per tonne. It exceeds the central value ($92,576) used in this Decision RIS's cost benefit analysis. The weighting is based on the proportion of Australia's national population associated with each population adjusted damage cost value.

5.9 Fuel costs

US EPA testing has demonstrated that most compliant engines are more fuel efficient than their non-compliant counterparts. However this is not true of all hand-held powered garden equipment. These engines are constrained in technology by operational orientation and weight considerations. Four-stroke engines are unable to be operated in orientations approaching the horizontal plane and beyond. This and their greater weight make them unsuitable for many residential applications. Therefore the current US EPA phase three emission standard for hand-held NRSIEE require these engines to meet new stringent evaporative emission standards, but does not further control exhaust emissions. Phase two exhaust emission standards still apply to this equipment.

The costs or benefits of changes to fuel consumption patterns are determined for consumers only. The difference in value of fuel sales to the fuel retail sector with the

[54] NSW Environment Protection Agency Methodology for valuing the health impacts of changes in particle emissions – final report. PAE Holmes (February 2013)

introduction of a Policy Option relative to the No Policy Change case is not included in the calculation of the NPV. This is because this study is concerned with NRSIEE industries only. Additionally, the estimated annual volume of unleaded petrol used by NRSIEE represents less than 1% of the automotive fuels sold by Australian fuel retailers [55], with the average profit margin for retail fuel sales at 2.1% [56] meaning that the impact on the fuel retail section is minimal.

Finally, NRSIEE related retail businesses may also offer engine maintenance services. However, information on the level of this inter-relationship is unavailable therefore the two activities are treated as separate business activities in this assessment.

5.10 Impact on Business

The loss of sales translates to a loss of producer surplus for business, measured as a reduction in the net sales margin (i.e. profit) for businesses trading in NRSIEE. The cost-benefit analysis assumes a net sales margin of 12 per cent across the value chain for the marine and outdoor powered equipment sectors.

Business costs are also estimated for establishing, administering and/or complying with the standards and regulations. The cost to business for administering and/or complying with the standards and regulations is estimated using the Regulatory Burden Measurement Framework [57], an activities based model that collates the costs of all activities (and any supporting infrastructure) relevant to implementing each policy. It is assumed that NRSIEE importers and distributors will face start-up record-keeping costs when regulation is introduced. The co-regulatory and voluntary schemes are assumed to be more burdensome as business will need to administer the schemes.

[55] Office of the Chief Economist, Department of Industry and Science, Australian Petroleum Statistics, Issue 223, Canberra, February 2015.
[56] Australian Institute of Petroleum. (n.d.) *Facts about Australian retail Fuels Market and Prices*.
[57] Department of the Prime Minister and Cabinet – Office of Best Practice and Regulation. (2014). *Regulatory Burden Measurement Framework Guidance Note July 2014*. Canberra, Australia: Author

6 ASSESSMENT OF OPTIONS

This Section sets out the assessment of options and identifies and quantifies, where possible, the costs and benefits of the four options outlined in Section 4. This includes the cost to business, government and the consumer and the benefits to the community of any new regulations that are proposed, and identifies reductions in regulatory costs to offset these costs.

There are a number of differences between this analysis and that contained in the Consultation RIS. This analysis:

- includes the impact of the options on consumer and producer surplus;
- is updated to reflect feedback during consultations;
- includes the regulatory costs to business and the costs to government of each option; and
- is based on a period of analysis 2016-3035.

This Section provides a comparative assessment of the three options to deliver NRSIEE emission standards against the No Policy Change option.

6.1 Option 1 – No Policy Change

The No Policy Change option represents where government and industry maintain current policy and practices into the future and do not take specific action to address the problem outlined in Section 2. This option is not likely to see major changes in current trends and assumes that those trends continue. These trends include:

- Government, at all levels, will continue with no change in policy regarding NRSIEE emission reduction.
- The market will continue to operate as is, including recognising that:

- import trends of NRSIEE follow overseas trends;
- the growth in cleaner technologies largely driven by the US emission standards will continue, particularly in the marine engine sector; and
- the import of cheaper non-compliant units will continue, particularly in the outdoor powered equipment sector.

The, continuation of current policy and trends (Option 1) would see NRSIEE emissions continue to increase over the period 2015 to 2035. Emissions would:

- increase by around 40 per cent for HC, from an estimated 33,103 tonnes to 46,282 tonnes
- increase by almost 80 per cent for NOx from 756 tonnes to 1,346 tonnes
- increase by around 40 per cent for PM from 660 tonnes to 918 tonnes.

Much of the increase in PM and HC emissions is likely to be due to the outdoor powered equipment sector, while the increase in NOx emissions is mostly from the marine sector.

The increased emissions would also result in reduced health outcomes: the increase in annual health costs due to NSIREE emissions over the period 2015 to 2035 is estimated to be in the order of $83 million.

6.2 Option 2 – Voluntary

The Voluntary option seeks to encourage the import and purchase of NRSIEE that are compliant with NRSIEE emission standards through voluntary labelling of NRSIEE compliant products. This approach would enable consumers to choose between a lower emission, compliant, labelled product and a higher emission, non-compliant, non-labelled product.

This option also proposes the adoption of emission standards aligned with, or similar to, the US emission standards as the Australian voluntary standards. A NRSIEE product could continue to be imported if it is non-compliant with the voluntary standards. Under this option, a regulatory framework would provide for the:

- Setting of Australian NRSIEE emission standards
- Development of guidelines for accreditation and for the labelling scheme/s
- Establishment of the role, responsibilities and powers of accredited organisation/s
- Accreditation of organisation/s to administer the voluntary arrangements
- Authorisation of the use of labels to identify NRSIEE compliant products if approved by an accredited organisation.

This approach represents the deregulation option as the application of the government set NRSIEE emission standards is purely voluntary.

It is assumed that under the voluntary scheme there will be around 50 per cent compliance with the voluntary standards – that is, around 50 per cent of non-compliant engines would disappear from the market. This is likely to result in a smaller NSIREE market overall (as some of the consumers who would have previously purchased a non-compliant engine will leave the market), and will also see a reduction in emissions from NRSIEE as shown in figure 6.1.

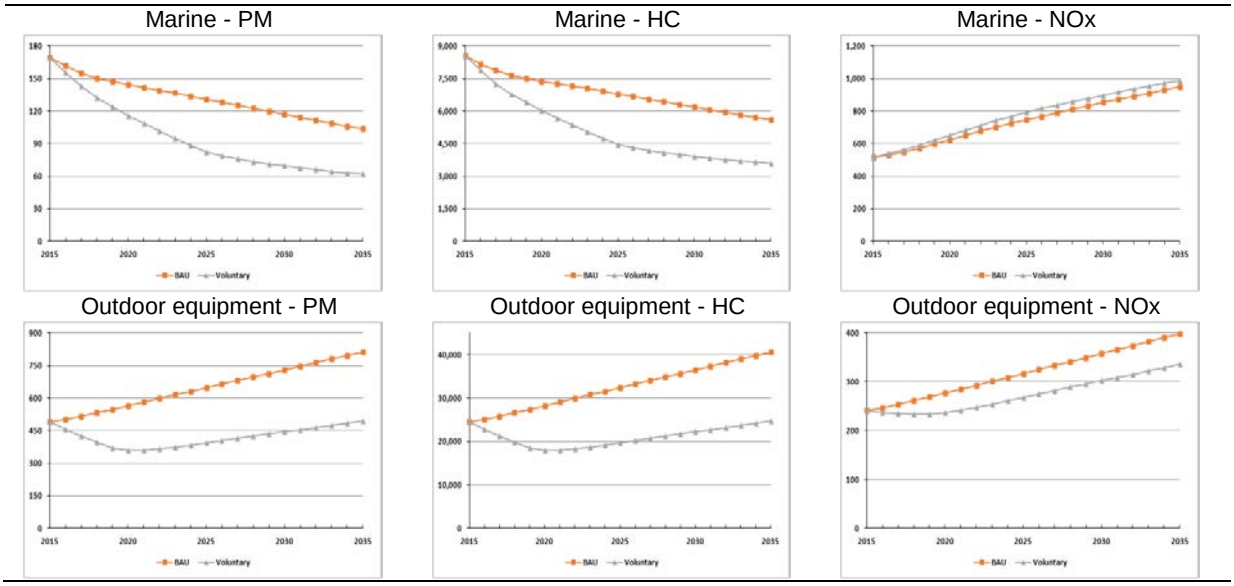
6.2.1 Impacts on Business

The reduction in consumer demand translates to a loss of sales to business. The value of sales in the marine sector is estimated to fall by around 2 per cent in the first year of the voluntary scheme, and be only marginally lower than BAU by 2035. This translates to a reduction in total producer surplus of $5 million over the projection period (using a 7 per cent discount rate). For the outdoor powered equipment sector, the fall in the

value of sales is estimated to be around 21 per cent over the period, and a reduction in total producer surplus of around $100 million.

Importers, manufacturers, distributors and/or retailers would voluntarily seek to join the accreditation and labelling scheme and operate within the relevant guidelines. Businesses would only bear costs where they choose to join. If they choose to join, the costs would include:

Figure 6.1: Emissions 2015-2035 under Voluntary option 2 (tonnes)



- Preparing application/s to join the accreditation scheme and maintaining membership
- Maintaining records of NRSIEE products imported or manufactured
- Producing and maintaining evidence of compliance such as US EPA certification or equivalent
- Producing and using accredited labels
- Audit and compliance activities.

The cost of compliance to business for the period 2016 to 2035 is estimated to be $23 million across the estimated 257 NRSIEE related businesses which were assumed to join the scheme out of a possible 515 businesses.

6.2.2 Impacts on Consumers

The model for this option assumes that 50 per cent of potential businesses will register for the scheme with a resulting reduction in the number of non-compliant products available. It is assumed that this will lead to a reduction in the number of sales of non-compliant products.

There is a loss in consumer surplus caused by the increase in prices for NRSIEE. This loss represents the loss in utility for those consumers who decide to leave the NRSIEE market rather than pay higher prices for a compliant product, as well as those who decide to pay a higher price to purchase a compliant product. The total reduction in consumer surplus over the period 2016-2035 (assuming a 7 per cent discount rate) is estimated to be:

- $75 million in the marine sector; and
- $487 million in the outdoor powered equipment sector;

Many compliant NRSIEE are more fuel efficient, and as such consumers who choose to purchase compliant engines will pay $497 million less in fuel over the period 2016 to 2035 compared with the No Policy Change option, but this is likely to be partly offset by higher total servicing costs over the period of $326 million.

The increase in service costs is significant for the outdoor powered equipment category due to the high percentage of NRSIEE moving from non-compliant to compliant technology; hence to NRSIEE that is more technologically advanced with attendant higher service costs. The converse is evident in the marine engine category reflecting the high current compliance levels together with savings flowing mainly from efficiencies in fuel usage.

Although there will be costs borne by consumers, consumers of NSIREE products will all receive health benefits due to lower emissions – these are included in the totals for the broader community.

6.2.3 Cost to Government

The government would need legislation to establish the accreditation scheme and would administer the legislation and/or regulations. There are also establishment and ongoing costs at implementation for business registration and audit activities.

The total cost to government for the period 2016 to 2035 is estimated to be $5 million.

Public health costs borne by government are likely to be lower as a result of lower emissions over the projection period – this effect has not been separately modelled in this analysis.

6.2.4 Benefit to the Community

This option will reduce the total annual emissions of PM and HC from the operating stock of engines and therefore exposure to these pollutants (Figure 6.1). NOx emissions may increase due to use of oxygenated fuels [58] or differences in engine technology and fuel delivery [59]. This only has a small impact on avoided health costs

[58] Gabele, P. (1997). Exhaust emissions from 4-stroke lawn mower engines. *Journal of Air and Waste Management Association 47*(9), 945-952

[59] Frey, H. C., and Bammi, S. (2002). Quantification of variability and uncertainty in lawn and garden equipment NOx and total hydrogen emission factors. *Journal of Air and Waste Management Association 52*(4), 435-448 and

because of the small amounts produced that are in excess of those from the No Policy Change option.

There are considerable benefits to the community through the avoidance of health costs totalling some $849 million over the period 2016 to 2035.

6.2.5 Summary of Costs and Benefits – Voluntary

As set out in Table 6.1, the Voluntary option provides for a net benefit of some $324 million over the period 2016 to 2035. The major contributor is the benefits to the community through the reduction in emissions, resulting in the avoidance of health costs of an estimated $849 million, and the major cost is the reduction in consumer surplus, estimated to be approximately $562 million over the same period.

Table 6.1 Voluntary Option - Cost Benefit Outcome

NRSIEE Category	Voluntary Option Cost Benefit Outcome 2016 to 2035 ($m NPV)							
	Fuel	Service	Avoided health costs	Change in consumer surplus	Change in producer surplus	Business compliance	Government administration	Total
Marine Engines	27	-19	102	-75	-5	-0.7	-0.1	30
Powered Outdoor Equipment	470	-308	747	-487	-100	-22.5	-4.8	294
Total NRSIEE	**497**	**-326**	**849**	**-562**	**-105**	**-23**	**-5**	**324**

Note: Assuming a 7 per cent discount rate. Totals may vary due to rounding

6.3 Option 3 – Co-Regulation

The Co-Regulation option shares some of the same basic elements as the Voluntary option with the significant addition of mandating the NRSIEE emission standards. This would mean that only products that complied with the relevant NRSIEE emission standard/s would be allowed to be sold in Australia.

This option also proposes the adoption of emission standards aligned with, or similar to, the US emission standards as the Australian standards.

Under this option, a regulatory framework would provide for the:

- Setting of Australian NRSIEE emission standards
- Development of guidelines for the co-regulatory arrangements

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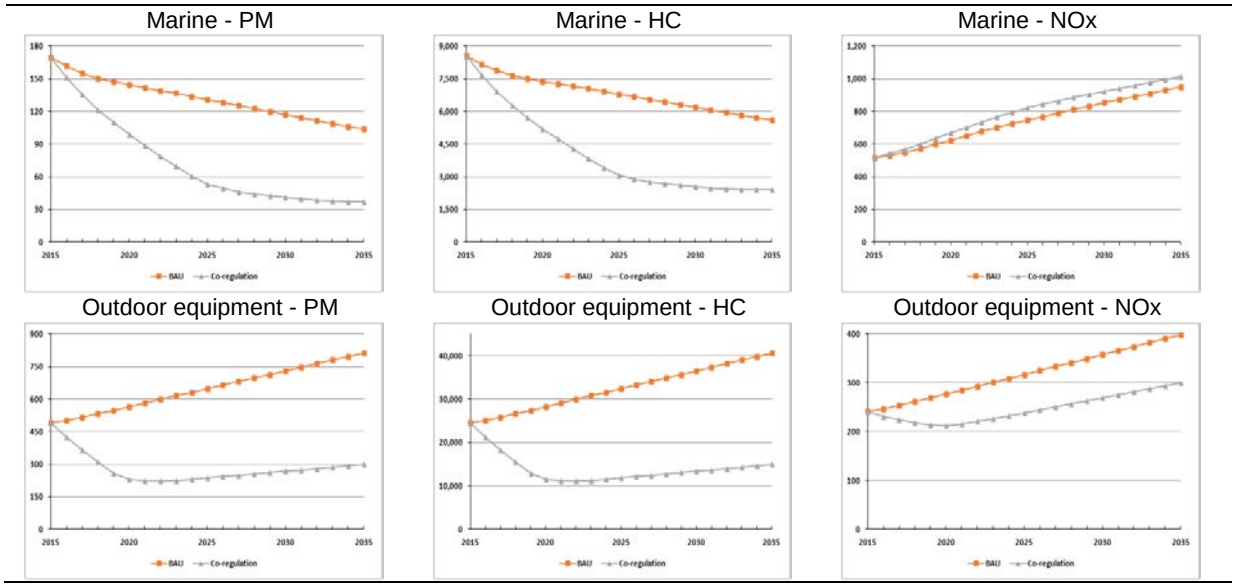
Welch, W., & Durban, T. D., (2004). Emission and demonstration of a emission control technology for small two-stroke utility engines. *Journal of Air and Waste Management Association 54*, 200–206

- Accreditation of organisations to administer the co-regulatory arrangements
- Establishment of the role, responsibilities and powers of accredited organisations.

It is assumed that under the co-regulatory scheme there will be around 80 per cent compliance with the voluntary standards – that is, around 80 per cent of non-compliant engines would disappear from the market. This is likely to result in a smaller NSIREE market overall (as some of the consumers who would have previously purchased a non-compliant engine will leave the market), and will also see a reduction in emissions from NRSIEE as shown in figure 6.2.

Figure 6.2: Emissions 2015-2035 under Co-regulation option 3 (tonnes)



6.3.1 Impact on Business

The reduction in consumer demand translates to a loss of sales to business. The value of sales in the marine sector are estimated to fall by around 3 per cent in the first year of the co-regulatory scheme, and be around 1 per cent lower than BAU by 2035. This translates to a reduction in total producer surplus of $8 million over the projection period (using a 7 per cent discount rate). For the outdoor powered equipment sector, the fall in the value of sales is estimated to be around 34 per cent over the period, and a reduction in total producer surplus of around $161 million.

Importers and/or manufacturers would be required to abide by the legislative requirements to join the co-regulatory arrangement and operate within its guidelines. Costs to business may include:

- Preparing applications to be an accredited organisation to administer a co-regulatory arrangements
- Individual businesses (e.g. manufacturers, importers, retailers) would be required to:

- Apply for approval to an accrediting organisation to manufacture or import compliant products for sale

- Produce and maintain evidence of compliance such as US certification or equivalent

- Maintain records of NRSIEE products imported or manufactured for audit and compliance purposes.

The cost of compliance to business for the period 2016 to 2035 is estimated to be $23 million.

6.3.2 Cost to Government

The government will incur costs associated with the development and implementation of legislation, including licensing of appropriate entities as accredited organisations.

It is assumed that the government regulatory and co-regulatory administrators will cost recover operational costs and that these may flow through to industry as notification fees or levies. Compliance and enforcement activities are excluded from costs to be recovered.

The total cost to government for the period 2016 to 2035 is estimated to be $5 million.

Public health costs borne by government are likely to be lower as a result of lower emissions over the projection period – this effect has not been separately modelled in this analysis.

6.3.3 Impact on Consumers

The model for this option assumes that 80 per cent of potential businesses will register for the scheme. Grey imports and other non-traditional suppliers will maintain the availability of some non-compliant product within the marketplace. Therefore, sales of NRSIEE will reduce among those consumers accessing product through the traditional retail outlets. It is assumed that there are slightly higher prices for compliant products which will moderate over time as competitive pressures come to bear in the market.

The impacts of removing cheaper non-compliant equipment form the marketplace on total sales value and fuel usage efficiencies is expected to show similar trends to those described above in the Voluntary Option.

There is a loss in consumer surplus caused by the increase in prices for NRSIEE. The total reduction in consumer surplus over the period 2016-35 (assuming a 7 per cent discount rate) is estimated to be:

- $120 million in the marine sector; and

- $780 million in the outdoor powered equipment sector;

Many compliant NRSIEE are more fuel efficient, and as such consumers who choose to purchase compliant engines will pay $671 million less in fuel over the period 2016 to

2035 compared with the No Policy Change option, but this is likely to be offset in part by higher total servicing costs over the period of $441 million.

Although there will be costs borne by consumers, consumers of NSIREE products will all receive health benefits due to lower emissions – these are included in the totals for the broader community.

6.3.4 Benefit to the Community

This option will reduce the total annual emissions of PM and HC from the operating stock of engines and therefore exposure to these pollutants (Figure 6.2). Again, NOx emissions in the marine sector may increase due to use of oxygenated fuels or differences in engine technology and fuel delivery. This only has a small impact on avoided health costs because of the small amounts produced that are in excess of those from the No Policy Change option.

There are substantial benefits to the community through the avoidance of health costs totalling some $1.37 billion over the period 2016 to 2035, largely as a result of emission reductions from the outdoor powered equipment sector. It is likely that the bulk of the health benefits will be in the form of reduced rates of ischaemic heart disease, stroke, and chronic obstructive pulmonary disease.

6.3.5 Summary of Costs and Benefits – Co-Regulation

As set out in Table 6.2, the Co-Regulation option provides for a substantial net benefit of some $503 million over the period 2016 to 2035. The major contributors are the benefits to the community through the reduction in emissions and resulting avoidance of health costs of an estimated $1.37 billion. These benefits are partly offset by, among other factors, a reduction in total surplus (consumer and producer) of $1.07 billion over the same period.

Table 6.2 Co-Regulation Option - Cost Benefit Outcome

NRSIEE Category	Co-Regulation Option Cost Benefit Outcome 2016 to 2035 ($m NPV)							
	Fuel	Service	Avoided health costs	Change in consumer surplus	Change in producer surplus	Business compliance	Government administration	Total
Marine Engine	43	-30	164	-120	-8	-0.7	-0.1	49
Outdoor Powered Equipment	627	-411	1,205	-780	-161	-22.5	-4.8	454
Total NRSIEE	**671**	**-441**	**1,369**	**-900**	**-169**	**-23**	**-5**	**503**

Note: Assuming a 7 per cent discount rate. Totals may vary due to rounding

6.4 Option 4 – Regulation

The Regulation option proposes the setting of NRSIEE emission standards through Commonwealth regulation. Only products that complied with a relevant NRSIEE emission standard would be allowed to be sold.

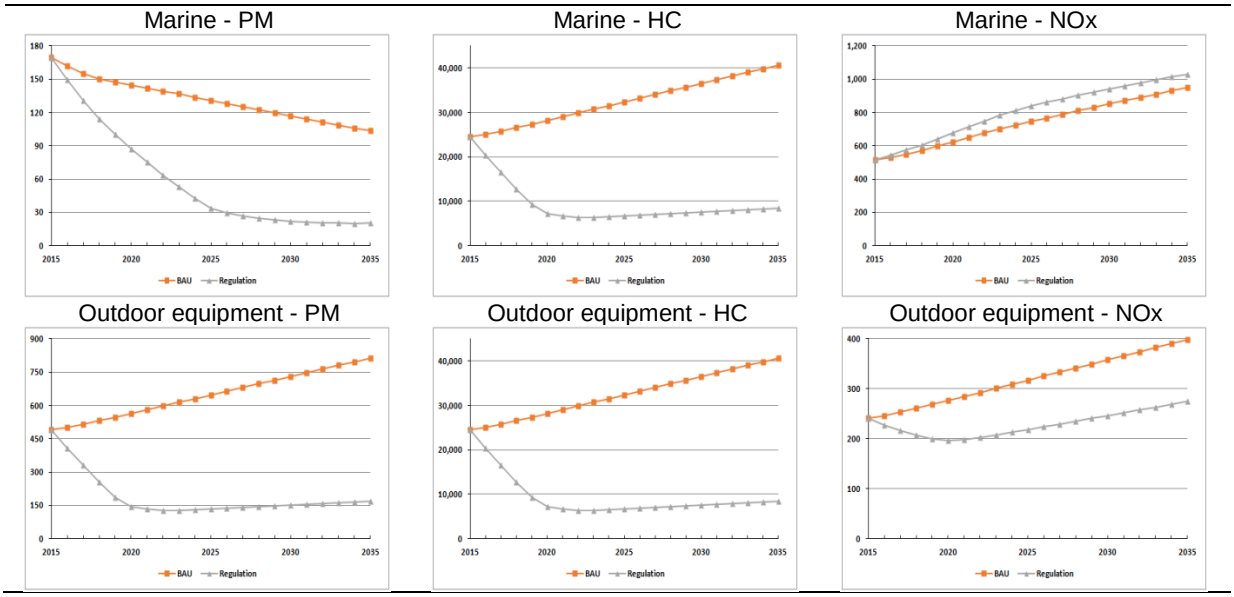
This option also proposes the adoption of emission standards aligned with, or similar to, the US emission standards as the Australian standards.

Under this option, a regulatory framework would provide for the:

- setting of Australian NRSIEE emission standards; and
- development of legislation and regulations establishing the role, responsibilities and powers of the regulator, including ensuring compliance.

It is assumed that under the regulatory option scheme there will be virtually 100 per cent compliance with the regulated standards – that is, 100 per cent of non-compliant engines would disappear from the market. This will result in a smaller NSIREE market overall (as some of the consumers who would have previously purchased a non-compliant engine will leave the market), and will also see a reduction in emissions from NRSIEE as shown in figure 6.3.

Figure 6.3: Emissions 2015-2035 under Regulation option 4 (tonnes)



6.4.1 Impact on Business

The reduction in consumer demand translates to a loss of sales to business. The value of sales in the marine sector are estimated to fall by around 4 per cent in the first year of the regulatory scheme, and be around 1 per cent lower than BAU by 2035. This translates to a reduction in total producer surplus of $10 million over the projection period (using a 7 per cent discount rate). For the outdoor powered equipment sector,

the fall in the value of sales is estimated to be around 42 per cent over the period, and a reduction in total producer surplus of around $201 million.

Importers and/or manufacturers would be required to abide by the legislative requirements and to operate within its guidelines.

- Individual businesses (e.g. manufacturers and/or importers) would be required to:

- Apply to the regulator to manufacture or import compliant products

- Produce and maintain evidence of compliance such as US EPA certification or equivalent

- Maintain records of NRSIEE products imported or manufactured for audit and compliance purposes.

The cost of compliance to business for the period 2016 to 2035 is estimated to be $5 million.

6.4.2 Cost to Government

The Commonwealth would develop legislation to establish the Australian NRSIEE emission standards, and the regulations to administer them. There are also establishment and ongoing costs for compliance and enforcement activities.

The modelling assumes that the government may require importers and manufacturers to register engines and equipment with the regulator prior to their importation or manufacture.

The total cost to government for the period 2016 to 2035 is estimated to be $9 million.

6.4.3 Impact on Consumers

The model for this option assumes that 100 per cent of potential businesses will operate within the regulations. It is also assumed that as there will be no non-compliant products available the rate of growth of sales of NRSIEE will reduce. It is assumed that there are higher prices for compliant products which will moderate over time as competitive pressures come to bear in the market.

There is a loss in consumer surplus caused by the increase in prices for NRSIEE. The total reduction in consumer surplus over the period 2016-35 (assuming a 7 per cent discount rate) is estimated to be:

- $150 million in the marine sector; and

- $975 million in the outdoor powered equipment sector;

Many compliant NRSIEE are more fuel efficient, and as such consumers who choose to purchase compliant engines will pay $786 million less in fuel over the period 2016 to 2035 compared with the No Policy Change option, but this is likely to be offset in part by higher total servicing costs over the period of $517 million.

Although there will be costs borne by consumers, consumers of NSIREE products will all receive health benefits due to lower emissions – these are included in the totals for the broader community.

6.4.4 Benefit to the Community

This option will reduce the total annual emissions of PM and HC from the operating stock of engines and therefore exposure to these pollutants (Figure 6.3). Again, NOx emissions in the marine sector may increase due to use of oxygenated fuels or differences in engine technology and fuel delivery. This only has a small impact on avoided health costs because of the small amounts produced that are in excess of those from the No Policy Change option.

There are substantial benefits to the community through the avoidance of health costs totalling some $1.72 billion over the period 2016 to 2035, largely as a result of emission reductions from the outdoor powered equipment sector. It is likely that the bulk of the health benefits will be in the form of reduced rates of ischaemic heart disease, stroke, and chronic obstructive pulmonary disease.

6.4.5 Summary of Costs and Benefits – Regulation

As set out in Table 6.2, the Regulation option provides for a substantial net benefit of some $636 million over the period 2016 to 2035. The major contributors are the benefits to the community through the reduction in emissions and resulting avoidance of health costs of an estimated $1.72 billion. These benefits are partly offset by, among other factors, a reduction in total surplus (consumer and producer) of $1.34 billion over the same period.

Table 6.3 Regulation Option - Cost Benefit Outcome

NRSIEE Category	Regulation Option Cost Benefit Outcome 2016 to 2035 ($m NPV)							
	Fuel	Service	Avoided health costs	Change in consumer surplus	Change in producer surplus	Business compliance	Government administration	Total
Marine Engines	54	-37	205	-150	-10	-0.1	-0.3	61
Outdoor Powered Equipment	732	-480	1,511	-975	-201	-4.4	-9.2	574
Total NRSIEE	**786**	**-517**	**1,716**	**-1,125**	**-211**	**-5**	**-9**	**636**

Note: Assuming a 7 per cent discount rate. Totals may vary due to rounding

6.5 Sensitivity Analysis

Specific model parameters may be important determinants in the value of the NPV for each policy option in the marine engine and outdoor powered equipment sectors. The

parameters annual engine sales, cost difference between compliant and non-compliant engines, demand elasticity, discount rate, and unit health costs were subjected to sensitivity analysis. Parameter values were varied within the standard model for each option.

Table 6.4 summarises the results of this analysis. The model results are reasonably robust – that is, the NPV remains positive – to changes in the key parameters, with the following exceptions:

- Difference in engine costs: The sensitivity analysis indicate that when the cost difference between compliant and non-compliant marine engines is increased by 50 per cent, the NPV becomes slightly negative.

- Discount rate: When the higher discount rate is used – that is, when future values are discounted more heavily than in the central case – the NPV for marine engines becomes negative. This is because for any given engine purchased the increased cost is incurred up front, while the benefits in terms of improved health outcomes and reduced fuel costs accrue over the life of the engine.

- Unit health costs. In both models, whether the NPV is positive depends heavily on the assumptions around the unit health costs. When lower unit health costs are assumed, the NPVs in both the marine and outdoor powered equipment models become negative.

Table 6.4 Sensitivity Analysis of the NRSIEE model

Equipment category	OPTION	Net Present Values ($ millions)										
		Net Present Values for the Central Policy Options implemented from 2016	Extrapolated annual engine sales[a]		Difference in engine cost between compliant and non-compliant NSIREE (relative to central case)		Demand elasticity		Discount rate		Unit health costs[b]	
Variation			Low	High	50%	150%	-1.0	-1.4	3%	10%	Low	High
Outboards	Voluntary	30	27	34	66	-2	30	30	146	-35.8	-21	81
	Co-regulation	49	44	55	106	-2	49	48	235	-57	-34	131
	Regulation	61	56	69	133	-2	61	61	294	-70	-41	164
Variation			Low	High	50%	150%	-1.0	-1.4	3%	10%	Low	High
Outdoor powered equipment	Voluntary	294	260	328	443	273	244	344	598	171	-79	451
	Co-regulation	454	403	505	692	420	374	534	924	264	-149	715
	Regulation	574	511	637	872	532	475	674	1,155	340	-181	905

Note. a. The low and high population scenarios represent the upper and lower bounds of the 95% confidence interval. By 2035 this is equal to +- 14 % for marine, and 11% for outdoor powered equipment. b. The low and high scenarios for the health costs are those depicted in Table 5.1 of this report.

The unit health costs result is particularly important given the uncertainty around the monetised health impacts of ambient air pollution (see, for example, Table 5.1). A

particular issue that has been identified in similar studies is the correlation between the health impacts of different pollutants [60]. Put simply, if someone dies as a result of inhaling PM, they can't also die as a result of inhaling HC. To the extent that such a correlation exists, simply adding the health costs of different pollutants – as is done in this analysis – will tend to overstate the heath impacts. A more conservative approach taken in some other studies is to only quantify the health impact of one pollutant – this would necessarily underestimate the total health impact. If such an approach were taken in this study, and only the impact of HC emission reductions were quantified, the introduction of marine engine emission standards would return a negative NPV, while outdoor powered equipment would still be positive.

6.5.1 Potential for perverse incentives

One further sensitivity is to the risk of the policy options creating perverse incentives in the use and replacement of engines. For every engine, the effect of ordinary wear and tear is that emissions tend to increase as the unit ages (particularly if emissions control components or seals get damaged). If older engines are more polluting than newer engines, then there is some air quality advantage to having a rapid replacement of engines. Where policy drives up significantly the price of new engines, such as these options do, there is a risk that the average engine lifespan will increase due to an increase in the incidence of owners:

- servicing faulty engines to extend their lifespan (it's no longer always cheaper to buy a new one than to pay a technician to repair); and

- choosing to carry on using less-effective equipment, such as if it gets harder to start (because solving these annoyances no longer justifies the expense of replacement); and

- selling old engines on the second hand market, since their resale value is increased in a market where new alternatives are much more costly.

While the elasticity of demand modelled in section 5.7 above shows that the perverse incentives effect is likely to be of real consequence in the case of garden engines (annual unit sales are expected to be around half their pre-regulation levels), no data is available for estimating the size of the effect.

However, a guide to the impact of perverse incentives is provided in the sensitivity analysis in terms of the unit health benefit impacts, as it provides a proxy for increased emissions from the population of engines that remain in use over the study period. The perverse incentives problem is expected to have, at most, a marginal impact on emissions. Using an extreme assumption as a test, we find that a 20% increase in total garden engine emissions (across the whole population) would decrease the net benefit of option 4 from $574 million to $272 million. So, even in this most pessimistic test, the NPV remains positive.

[60] See, for example, Morgan, G. Broome, R. and Jalaludin, B., *Summary for Policy Makers of the Health Risk Assessment on Air Pollution in Australia*

7 CONSULTATION

There are three main Australian industry peak bodies that represent the recreational marine engine and powered outdoor equipment sectors: AMEC, OEDA, and OPEA. These associations support the establishment, through regulation, of exhaust and evaporative emission standards that harmonise with established overseas standards, particularly those of the US. Their views diverge between those that advocate implementing standards in Australia as soon as possible and those that favour a phased introduction of standards.

7.1 Initial Consultations

The Consultation RIS, released in May 2010 and published on the then EPHC website [61] , set out three options for action and four options for delivering emission standards:

1. Business as Usual
2. Limiting Use of NRSIEE
3. Establishing Emission Standards
    a. Voluntary Industry Agreement
    b. Individual State/Territory-based Regulations
    c. Commonwealth Regulation, or
    d. National Environment Protection Measure

The Consultation RIS sought information and feedback on those options as well as:

- Sales data for NRSIEE
- Likely compliance with overseas standards of NRSIEE purchased in Australia
- Purchase costs of compliant and non-compliant NRSIEE
- Methodology for determining emissions performance of compliant and non-compliant NRSIEE
- Methodology for determining health costs of emissions from non-compliant NRSIEE
- Costs of implementing different policy options
- Feasibility and associated costs for industry to meet US emission standards, through phased and non-phased approaches on various starting dates.

[61] Former Standing Council on Environment and Water. (n.d). EPHC archive – spark ignition consultation. Retrieved November 24, 2014

Eighty-six submissions were received with non-confidential submissions made available on the EPHC website. The submissions indicated broad support for the adoption of US emission standards in Australia. The main concern was the timing of implementation, with some stakeholders supporting immediate adoption of US emission standards and others requesting delays of up to several years.

In 2012, additional consultation was undertaken with key stakeholders, including community groups, and clarification sought on issues that were raised during the 2010 consultation period. Sixteen organisations associated with recreational fishing and boating were contacted. Five additional submissions were received from fishing associations and are available for public view [62]:

- Australian National Sportfishing Association
- Game Fishing Association of Australia
- RecFish Australia
- South Australian Recreational Fishing Advisory Council
- Tasmanian Association for Recreational Fishing.

During consultation in 2010 and 2012, consumer groups indicated that they were generally supportive of measures to reduce pollution and would accept price increases so long as there would not be price gouging.

A consultation summary report, which provides an overview of the main matters raised in submissions, was released in November 2012.

7.2 Further Consultations

Further consultations have occurred since 2012 up until mid-2015 with industry, community organisations and some major retailers/suppliers, including global peak bodies, for example, through correspondence and briefing sessions.

In October 2013 the Minister for the Environment received representations from the BIAA, AMEC, OPEA, and Briggs and Stratton on NRSIEE. The Department of the Environment held talks with AMEC, OPEA and the OEDA in November 2013. Additional market data was provided by two industry peak bodies in December 2013 and January 2014 to support the project's current cost benefit and sensitivities analyses and ensure these reflect changes in data and market dynamics since the Consultation RIS.

In August 2014, the Department of the Environment met with OEDA, AMEC and OPEA representatives, as well as Surf Life Saving Association and the BIAA to discuss the options considered in the RIS, introducing a modified voluntary option and a co-regulatory option not considered in the Consultation RIS.

[62] Environment Protection and Heritage Council. (2012).*Reducing emissions from non-road spark ignition engines and equipment regulation: Consultation summary report.* Retrieved November 24, 2014

In mid-late 2014, the Department of the Environment consulted major retailers, including ALDI and Bunnings. Consultation with industry has indicated that supply chains would adapt to the introduction of emission standards in Australia and that it is not envisaged to pose any major problems.

In early 2015, the Department of the Environment released a discussion paper for public comment Working Towards a National Clean Air Agreement for public comment. Work on reducing emissions from NRSIEE is anticipated to be incorporated within the Agreement once the Agreement is finalised, and as such, provided a further opportunity for public comment.

The following issues were raised in consultations:

- Exemptions for low weight marine engines be considered in introducing standards. This is based on concern for those who may require access to the cheaper, lighter, more robust and easier serviced two-stroke marine engines when travelling long distances and for those living in remote communities, but also transition arrangements and timing - seeking time to allow industry to adapt.

- Transit issues - seeking to avoid the need for having marine engines in bond storage when transiting Australia, particularly for New Zealand and the Pacific Islands.

- Noting that new technology, such as electronically controlled carburettors and fuel-injection systems allowing greater fuel efficiency and better servicing, is not a significant change but just continuance of the current trend.

- The market was only just recovering to pre-2009 levels (i.e. before the global financial crisis and the 30 per cent drop in sales at the time of the crash), although two-stroke sales were down while four-stroke sales were increasing.

- Noted the marine outboard sector is promoting new technology through their Voluntary Emission Labelling Scheme.

- The need for controls on local manufacturers, not just imports – noting that manufacturing was limited and isolated to a small component of the marine engine category.

- The development of an effective compliance and enforcement regime to prevent non-compliant models (including brand copies) entering the market was essential.

- The need to fund the implementation approach.

7.3 Summary of Consultations

Australian industry remains highly supportive of the development of Australian emission standards for NRSIEE that harmonise with established overseas standards, particularly those of the US. Some sectors are promoting the adoption of these standards as soon as possible whereas others are seeking a phased implementation approach. Community groups are similarly supportive of the introduction of emission standards to reduce pollution.

As a result of consultations, this RIS updates the earlier 2010 analysis, in the following ways:

- The policy options that introduce emission standards or guidelines are expanded in the current RIS to consider voluntary action by industry, co-regulation or regulation to better meet the objectives of the Australian Government's regulation reform agenda.

- An additional cost benefit analysis was undertaken to accommodate the expanded options.

- The RBM is calculated in accordance with the new government guidelines [63] and offsets identified.

- Consideration of implementation issues.

[63] Commonwealth of Australia, Department of the Prime Minister and Cabinet (2014) *The Australian Government Guide to Regulation*,
Council of Australian Governments. (2014).*COAG Communique 10 October 2014*

8 SUMMARY AND CONCLUSION

All alternative options will reduce the total annual emissions of PM and HC from the operating stock of engines, and therefore exposure to these pollutants, compared with business as usual. NOx emissions may increase, as observed in NRSIEE due to use of oxygenated fuels or differences in engine technology and fuel delivery. This only has a small impact on avoided health costs because of the small amounts produced that are in excess of those from the No Policy Change option. The options will also deliver increased fuel use efficiencies across the operating stock of new engines.

The analysis indicates that on a per-engine basis the benefits (largely in terms of lower emissions and better fuel economy) of replacing old engines with less-polluting new engines outweigh the costs (reduced consumer and producer surplus). This is true for both types of NRSIEE, but particularly so for outdoor powered equipment due largely to the significant HC emissions from older engines in this sector. As a result, the more non-compliant engines that can be removed from the market, the higher the net-benefit.

The lower compliance levels likely under the Voluntary (50 per cent) and Co-Regulation (80 per cent) options mean that fewer non-compliant engines are removed from the market than under the Regulation option. As such, it is likely that the net benefit of these options is lower than the Regulation option (Table 6.8), and it follows that the preferred alternative option is to develop emissions standards for NRSIEE. In addition, the Voluntary and Co-Regulation options impose higher regulatory burdens on industry.

Table 6.5 Net present value of regulatory options

Option		Cost Benefit Outcome - NPV 2016 to 2035 ($ million)							
		Avoided health costs	Change in consumer surplus	Change in producer surplus	Fuel	Service	Business compliance	Govt. Admin.	Total (NPV)
Voluntary	Marine	102	-75	-5	27	-19	-0.7	-0.1	30
	Outdoor equipment	747	-487	-100	470	-308	-22.5	-4.8	294
	Total NPV								324
Co-Regulation	Marine	164	-120	-8	43	-30	-0.7	-0.1	49
	Outdoor equipment	1,205	-780	-161	627	-411	-22.5	-4.8	454
	Total NPV								503
Regulation	Marine	205	-150	-10	54	-37	-0.1	-0.3	61
	Outdoor equipment	1,511	-975	-201	732	-480	-4.4	-9.2	574
	Total NPV								636

Note: Totals may vary due to rounding

Are national standards better than no policy change? As discussed in relation to the sensitivity analysis (section 6.4), this depends on the assumptions around how much costlier compliant engines are to purchase, unit health costs of the various pollutants

and the discount rate used. If the health impact of ambient air pollution is significantly lower than that assumed in the central case in this analysis, then the benefits from reduced emissions may not exceed the costs. The same is true if a 10% discount rate is used or if the difference in cost between compliant and non-compliant engines is 150% greater relative to the value used in the central case. In such circumstances, no policy change would be preferred.

However, the discount rate used in the central case is the standard 7% and the assumed increase in compliant engine costs are based on online pricing information (with industry submissions also informing outboard engine costs) and seem reasonable. The unit health costs modelled in this analysis are consistent with the range of costs used in other studies. In addition, other likely benefits from the reduction in emissions from NRSIEE – namely environmental and climate change benefits – are not quantified. On balance, while highlighting some uncertainties, including around the health impacts of reduced ambient air pollution and the lack of more current data on the level of non-compliant engines in the outdoor power equipment category, the analysis provides guarded support for the introduction of national standards.

The introduction of national NRSIEE standards would result in a net benefit of over $600 million in NPV terms over the period 2016-2035, under the central case assumptions. Much of the cost of the change would be borne by NRSIEE consumers, who would pay more for compliant equipment, and producers/importers/retailers who sell less equipment, while much of the benefit would accrue to the broader community in the form of reduced adverse health impacts from ambient air pollution.

Option 4 is recommended.

9 IMPLEMENTATION AND REVIEW

9.1 Implementation

It is proposed that NRSIEE emission standards be implemented through a Commonwealth-only legislated regulatory scheme to control the importation and/or supply of products. The Commonwealth may seek to rely on a combination of powers under the Australian Constitution to support the scheme, including the corporations power (s 51(xx)), the trade and commerce power (s 51(i)) and the external affairs power (s 51(xxix)). The nature of constitutional coverage will ultimately depend on the structure of the regulatory framework that is adopted, and in particular whether the scheme seeks to regulate NRSIEE products at the point of import and manufacture or at the point of supply/distribution.

A Commonwealth regulatory approach has an advantage over the other options because it can be more efficiently applied, for example, at the border or post-border. Border or post-border controls provide a mechanism for direct intervention at a point in the supply chain before distribution of product. Intervention at this point is the most efficient and effective – reducing cost, complexity and administrative burden.

Returning the product to place of origin may therefore be a simpler matter for any regulatory authority as well as for the business as returning product after it is distributed becomes logistically more difficult and more expensive.

As indicated in this analysis, national controls, in the form of emission standards, provide net health benefits to the community with the best net gain made through regulation. The emission standards will be developed in consultation with an industry working group, with a preference for alignment with existing US or equivalent emissions standards. The working group will also provide advice on whether and how to incorporate ABT into the emission standards. This is consistent with the principle to adopt or align with accepted international standards to reduce regulatory burden for business and remove barriers to trade.

Should ministers agree to proceed with some form of action, there will be further consultation and engagement with affected stakeholders as part of implementation. The legislation and/or regulations will set out the nature and timing of any transitional arrangements to give industry sufficient time to prepare for the new regime.

9.2 Review

Under the COAG Principles and Guidelines for National Standard Setting and Regulatory Action by Ministerial Council and Standard-Setting Bodies, all standards and regulatory material must be reviewed at intervals of no more than ten years. To complement the COAG principles, it is recommended that legislation and/or regulations be reviewed at an interval of not less than five years from the date of implementation.

Appendix The NRSIEE industry

A.1 What is included in NRSIEE?

Non-road emission sources comprise a wide variety of engines including compression ignition (diesel) engines, spark ignition (petrol and gas) engines and aircraft engines (e.g. jet or turbofan) and have a broad range of applications.

Spark ignition engines ignite the compressed air/fuel mixture with a spark produced by a spark plug. They may, however, differ in their design, i.e. as rotary or reciprocating (two stroke and four stroke) engines, and in the fuels they use, i.e. petrol, ethanol blended petrol, compressed natural gas (CNG), liquefied petroleum gas (LPG, i.e. propane), liquefied natural gas (LNG), methanol, ethanol and hydrogen (some rotary engines).

Table A 1.1 Matrix of potential NRSIEE characteristics

Engine design		Fuel
rotary reciprocating (two-stroke or four-stroke) fuel delivery (carburettor or indirect injection or direct injection)	X	petrol, ethanol blended petrol CNG, LPG, LNG methanol, ethanol, hydrogen

Spark ignition marine engines under the US EPA SI non-road classification include outboard motors, personal watercraft (e.g. jet skis) engines, and petrol based stern-drive and inboard engines in marine vessels. Within the outdoor powered equipment category there are five model classes – these are listed in Table A.1.2.

Table A.1.2 Outdoor Powered Equipment – Model Classes

Model class	Displacement (cc)	Power Range (hp)	Source classification
Class I, Non-Handheld	< 225	3 - 6	All engines **except two-stroke** trimmers / edgers / cutters, chainsaws, leaf-blowers, and snow-blowers
Class II, Non-Handheld	> 225	6 – 16 16 - 25	All engines **except two-stroke** trimmers / edgers / cutters, chainsaws, leaf-blowers, and snow-blowers
Class III, Handheld	0 - 20	0 - 1	All engines
Class IV,Handheld	20 - 50	1 - 3	All engines
Class V, Handheld	> 50	3 - 6	All two-stroke trimmers / edgers / cutters, chainsaws, leaf-blowers, and snow-blowers

Source: Adapted from US EPA 2010b

Classification into a model class depends on engine displacement and whether the equipment or engine is handheld or non-handheld. This category includes all engines less than or equal to nineteen kilowatts (i.e. ≤19 kW) that is ≤25.48 hp when based on US horsepower.

The engines in this category while primarily used in lawn and garden equipment may also be found in farm, construction and commercial equipment, machinery, sawmilling and woodworking applications, in air and gas compressors and powering pumps and electrical generators. A more comprehensive list of engines and equipment included in this category is found in Table A.1.3.

Table A.1.3 Types of NRSIEE

Category	Equipment
Small Engines (19kW/25hp or less)	• Lawnmowers • Rear engine riding mowers • Shredders (<5HP) • Lawn & garden tractors • Tillers (<5HP) • Front mowers • Chainsaws (<4HP) • Commercial turf equipment • Trimmers/edgers/brush cutters • Wood splitters • Snow blowers • Other lawn & garden equipment
Marine Recreational Engines	• Outboard motors • Personal watercraft (Jet-skis) • Inboard/stern-drive motors

This category does not include engines for recreational applications such as motorcycles or snowmobiles, for marine propulsion or for toy boats and aeroplanes.

This RIS deals only with non-road spark ignition engines in the following product classes:

- Marine engines for recreational craft [64]
- Outdoor powered non-road small engines under 19 kW.

Two stroke and four stroke reciprocating engines are the principal engine types employed across these two product classes.

Approximately 80 per cent of marine engines and approximately 55 per cent of outdoor powered equipment are covered within this analysis [65]. These categories include the

[64] This approach is based on the one used by the US EPA
[65] One major class of garden equipment that was not included in the CBA was mowers (around 40 per cent of the total garden sector) because this class usually uses 4-stroke engines and therefore are considered compliant.

majority of NRSIEE which are likely to be currently non-compliant with US and other international standards.

Although the make-up of the marine engine populations is clear, that of the outdoor powered equipment population is more complex. Non-handheld equipment (Class I and II) such as lawnmowers have recently presented a significant shift in engine technology to lower emitting four stroke engines. Modelling based on this equipment would not result in any change in emissions with the application of emission standards.

One major class of garden equipment that is not included in the CBA is mowers (approximately 40 per cent of the outdoor powered equipment category) because this class usually uses 4-stroke engines and therefore are considered mostly compliant. If mowers were excluded from the total NRSIEE because of their high compliance rate, then approximately 90 per cent of the outdoor powered equipment category is covered in this analysis.

Handheld equipment, however, represents a significant source of 2-stroke engines, with improvements possible in their overall emissions profile. So modelling is restricted to handheld equipment (engine classes III, IV and V). Handheld equipment is covered by three classes of engines, based on engine size (not power):

- Class III: handheld equipment with engines less than 20 cc
- Class IV: handheld equipment with engines greater than or equal to 20 cc but less than 50 cc
- Class V: handheld equipment with engines greater than or equal to 50 cc.

Class III handheld engines are not considered in this analysis. There are now very few models available in the marketplace that represent this class. For example, there were no models with engines less than 20 cc in the 2012 Specification Guide published in the Australian trade magazine “Power Equipment Australia”. This publication listed 927powered lawn and garden products. A similar trend is observed in the US EPA engine certification database. Of the 1,144 engine families recorded in the 2013 small non-road spark ignition engine spreadsheet only one is listed as a Class III handheld engine. Table A.1.4 provides a summary of the included and excluded equipment regarded in this study.

Table A.1.4 Engine Categories included and excluded in the modelling

	Marine Engines	Outdoor Powered Equipment
Engine Types or Classes – included	Outboard motors are divided into two groups: • 2-stroke - carburetted or with indirect fuel injection • Rest - 2-stroke engines with direct fuel injection, or 4-stroke engines Each group is divided into power-bands according to US EPA definitions	Hand-held Class IV and V garden engines and equipment, namely: • trimmers • garden blowers and vacuums • brush-cutters • chainsaws
Engine Types or Classes – excluded	Personal Water Craft (PWC), e.g. jet skis Inboard/outboard motors Stern-drive motors	Hand-held (Class III) Hand-held (Class IV and V) equipment not listed above All Non-hand held equipment (Class I and II)

A.2 Nature of the NRSIEE Industry

This sub-section provides further information on the NRSIEE industry. It includes information collected for the Consultation RIS and updated for this RIS, and provides additional information.

As noted in Section 2 NRSIEE is defined for the purposes of this RIS as the combination of the marine engine and outdoor powered equipment categories of the NRSIEE market. These two categories account for the majority of NRSIEE manufactured, imported, distributed and sold in Australia. The information provided in this sub-section is set out by NRSIEE category.

A.2.1 Marine Engine Category

Table A.2.1 Marine Engine Category

Units imported in 2014	Business size[1]	Estimated Annual Volume	Number of Low Emission units
Major Manufacturers/Importers - ≥54% market share for four-stroke/direct injection product			
Mercury, Yamaha, Tohatsu, BRP, Suzuki, and Honda	MBE	33,000	17,820
	Total	**33,000**	**17,820**
Major Other Brand/Importers - ≥80% for two-stroke product			
Parsun - Island Inflatables Distributor	SBE	1,200	Not available
Parsun (retailed through BCF retail chain)	MBE	1,200	Not available
Vortex (Parsun) Telwater	MBE	500	Not available
Others	SBE	100	Not available
	Total	**3,000**	**600**
Independent boat/motor importers - ≥80% market share for four-stroke/direct injection product			
	Total	**500**	**400**
Individuals importing - ≥90% market share for four-stroke/direct injection product			
	Total	**500**	**450**
	Grand Total	**37,000**	**19,270**
Percentage Meeting an International Standard			***52%***

Source: ABS: SBE = Small Business Enterprise of up to 20 people employed; MBE = Medium Business. Enterprise of 20 to up to 200 people employed.

Table A.2.2 Marine Engine Dealerships in Australia

Type of Dealership	Number
Represent the six major outboard marine companies in Australia	≥500
Independent boat and engine importers - both new and used	30-50
BCF retail chain	100

A 2015 Ibisworld Report on the marine retail sector notes that operators planning to enter the marine retail sector have experienced low barriers to entry over the past five years. This has largely stemmed from the sector's low level of competition and low market share concentration. Other factors that have kept barriers to entry to a minimum include low capital intensity and low technological changes. Unlike other retail industries, retailers of marine equipment are subject to a low level of external competition, primarily due to the specialised product range on offer. Internally, operators in the industry compete on the basis of price and product range. Externally, the industry has only recently come under mounting competition from grey imports [66].

For the analysis for this Decision RIS, the total number of marine engines sold each year is estimated from the extrapolation of available market data. The data comprised industry supplied sales data that was augmented with import/export data for those years that sales data was unavailable. This data covers the period 1988 to 2013.

The recent global financial crisis had a significant impact on outboard motor sales in Australia. The Consultation RIS CBA recorded annual sales exceeding 50,000 units. This number reduced sharply to about 32,000 units in 2009. Import figures suggest that sales have increased in Australia since then, but have not regained the previous high sales mark. Because marine engine sales and import data was highly variable the regression analysis to forecast sales from 2013 to 2050 was carried out on the output of a moving 10 year average of the collated data. Actual sales and import figures were used for the period 1988 to 2013 to establish the operating engine populations in the period 2014 to 2050.

A.2.2 Outdoor Powered Equipment Category

The outdoor powered equipment category covers a number of industry sectors, i.e. lawn and garden and hardware retail sectors to name the main two. They present a more diversified group of businesses that may specialise in the lawn and garden area, or present powered lawn and garden equipment as part of a broader range of product offerings for sale.

There is also a divergence in product quality and price between home consumer and garden professional markets. For example, Husqvarna has developed a strategy to

[66] See IBISworld (2015) IBISworld website summary of the May 2015 report*: Marine Equipment Retailing Market Research Report*

target the professional garden care market as a means of increasing net sales income as the domestic market slows in the US [67].

Broadly this category comprised approximately 9,206 businesses in June 2009. Ibisworld 2012 proposes that annual growth for the hardware and retailing supplies industry for the period 2009 to 2014 averages at 1.3 per cent. In August 2013 the trend estimate in Australia rose for hardware, building and garden supplies retailing by 0.6 per cent from the previous year [68]. The outdoor powered equipment category had an estimated value of $248 million in 2009-10 [69].

A summary of the major characteristics of small spark ignition engines and their Australian industry and market is presented in Tables A.2.4 and A.2.5.

Table A.2.4 Outdoor Powered Equipment Retailers and Industry Representation

Outdoor Powered Equipment Retailers and Industry Representation			
	Main Players	**Total Membership**	**Australian Representative Organisations**
Hardware and Nursery / Garden Industry / Outdoor Retailers	Bunnings, Masters	9,000+ (many of these retailers do not carry outdoor power equipment)	Hardware Federation of Australia, Hardware Association (State), Nursery and Garden Industry Australia, Australian Retailers Association, Australian National Retail Association
Distributors / Australian representatives of overseas manufacturers	Briggs and Stratton (includes VICTA), Honda, Stihl, Yamaha	35+	Outdoor Power Equipment Association (OPEA)

Table A.2.5 Outdoor Powered Equipment Categories (based on number sold in 2012)

Most popular equipment categories	2012 sales	As % of total sales
Line-Trimmers and Brushcutters	266,421	26%
Chainsaws	139,278	13%
Blowers and vacuums	137,616	13%
Hedge trimmers	56,510	5%

Note: Based on sales in 2012 from data supplied by industry. Total outdoor powered equipment sales in 2012 in the data supplied by industry was 1,035,679 units. Push rotary mowers and tractor or ride on mowers were the other major categories but are not included in the table above as they are not included in this DRIS analysis. See xx for further information. (Source: OPEA 2012)

An estimate of sales of outdoor powered equipment (those covered in the analysis supporting this Decision RIS) to 2050 is shown at Table A.2.6. OPEA made available Australian market data it commissioned for a broad range of outdoor powered equipment [70]. However, OPEA conceded that this data may represent less than 60 per

[67] Kinnander, O. (2011, November 11). *Husqvarna Chief Sees U.S. Chainsaw, Lawnmower Demand Growth (1)*.

[68] ABS data

[69] Based on Australian Bureau of Statistics. (2010). *Australian customs value*.Canberra, Australia. ABS.

[70] The source was Datamotive 2013 Homepage.

cent of the Australian market. Therefore, a subset of the ABS import data spreadsheet, also supplied by industry, was used covering 1988 to 2012. This data comprises two groups of equipment identified in the ABS spreadsheet under the following tariff codes:

- 8467.89.0060 - Hand held blowers, sweepers or vacuum (excl. those with a self-contained electric motor)

- 8467.89.0028 - Garden trimmers with line or blade head with self-contained non-electric motor.

These data relate to most hand-held engines of interest in this analysis and was used as the base population in the model. However chainsaws, which are included in this analysis, are not included under these statistical codes and are not listed in either data set. Therefore, this model under-represents the operating engine population and provides a low estimate of Australian emissions produced by these equipment types. An off-setting factor is the re-export of some of this equipment, mostly to neighbouring Indo-Pacific countries, which is not accounted for in this data set. The forecast sales 2013 to 2050 are estimated using linear regression of the 10 year moving average values of the import data

A.3 Consumer choice and the cost of goods

This section provides a discussion on the basis of the modelling assumptions on sales demand. It focuses on consumer behaviour in the face of changes in equipment choice and price with the introduction of product emission standards. Finally it provides an estimate of the cost to consumers (loss of utility) for each policy choice, based on the assumptions discussed below.

A.3.1 Assumptions regarding engine populations within the outboard and outdoor powered equipment sectors

Market data supplied by the marine engine industry shows that there is a small observable trend away from carburetted two-stroke motors to direct injection two-stroke and four-stroke motors. This aspect of consumer choice is captured in the population model for outboard motors in the No Policy Change case.

However supplied sales data for outdoor powered equipment shows only total sales for each equipment category and could not be disaggregated into compliant and non-compliant engines. Consequently related trends in that market could not be observed and the relative proportion of compliant to non-compliant sales is based on US EPA NRSIEE market studies. It is assumed in this market that the proportion of compliant to non-compliant sales remains constant in the No Policy Change population model.

A.3.2 Consumer behaviour

Consumer behaviour is hard to gauge with respect to the increased price of alternative compliant engines relative to the non-compliant models they replace under a policy option. It is assumed in the modelling that there will be a loss in sales when consumers are faced with buying the more expensive compliant engines, which they may choose not to do.

Consumers who previously bought these engines will face a choice when replacing such an engine. Utility costs are associated with each alternative:

• buy an equivalent compliant engine at the time a new engine is desired

- requires extra expenditure that could have been used on other purchases, or saved (average value estimated in the distributional analysis)

• wait for a longer period to save the additional money required to buy the compliant engine

- requires extra expenditure that could have been used on other purchases, or saved (average value estimated in the distributional analysis)

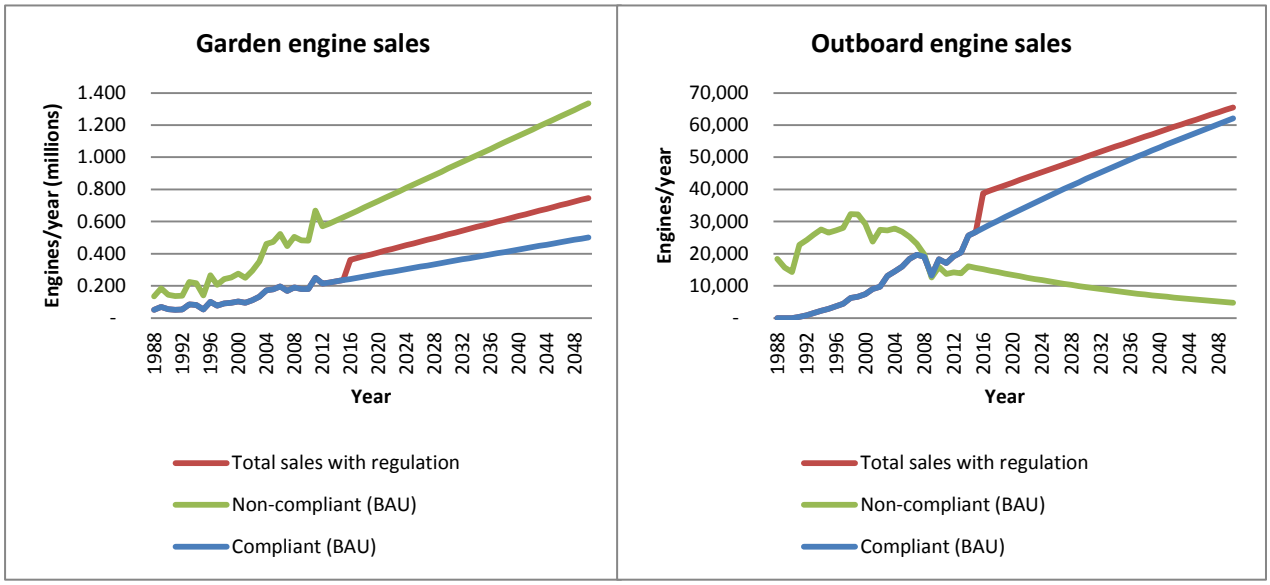
- the delay in satisfaction in acquiring and using a new engine

• leave the market for these engines altogether

- loses the utility of engaging in a preferred activity.

Figure A.3.1 shows past and projected sales of compliant and non-compliant engines under business as usual (BAU) conditions, and total sales of engines with the regulation scheme (Option 4) in place. Note that when the regulation takes place (in 2016) sales of non-compliant engines drop to zero.

Figure A.3.1 Sales of garden and marine engines under BAU and regulation (Option 4)



The level of utility loss experienced by a consumer because of delayed or foregone consumption is dependent on many factors that are relevant at the time the decision is made, including;

• level of preference for the original activity

• level of preference for available alternative activities and consumption

- impact of family and wider social circle on the consumer's activity and consumption choices
- impact of work/job/career on the consumer's activity and consumption choices
- impact of current residence on consumer's activity and consumption choices.

There is a significant degree of uncertainty in any assumptions that would underlie a quantitative analysis of the factors above – for example, in modelling the difference in desire between the utility associated with an outboard motor (for example) and the utility of the second best choice on spending the money if a consumer is "priced" out of the market regarding his/her first choice. The issue of consumer choice must establish the proportion of consumers that are truly priced out of the market against those faced with alternatives of equal or greater desirability. Australian market and sociological data on factors such as those above is very limited, and relevant studies are either qualitative or semi- quantitative.

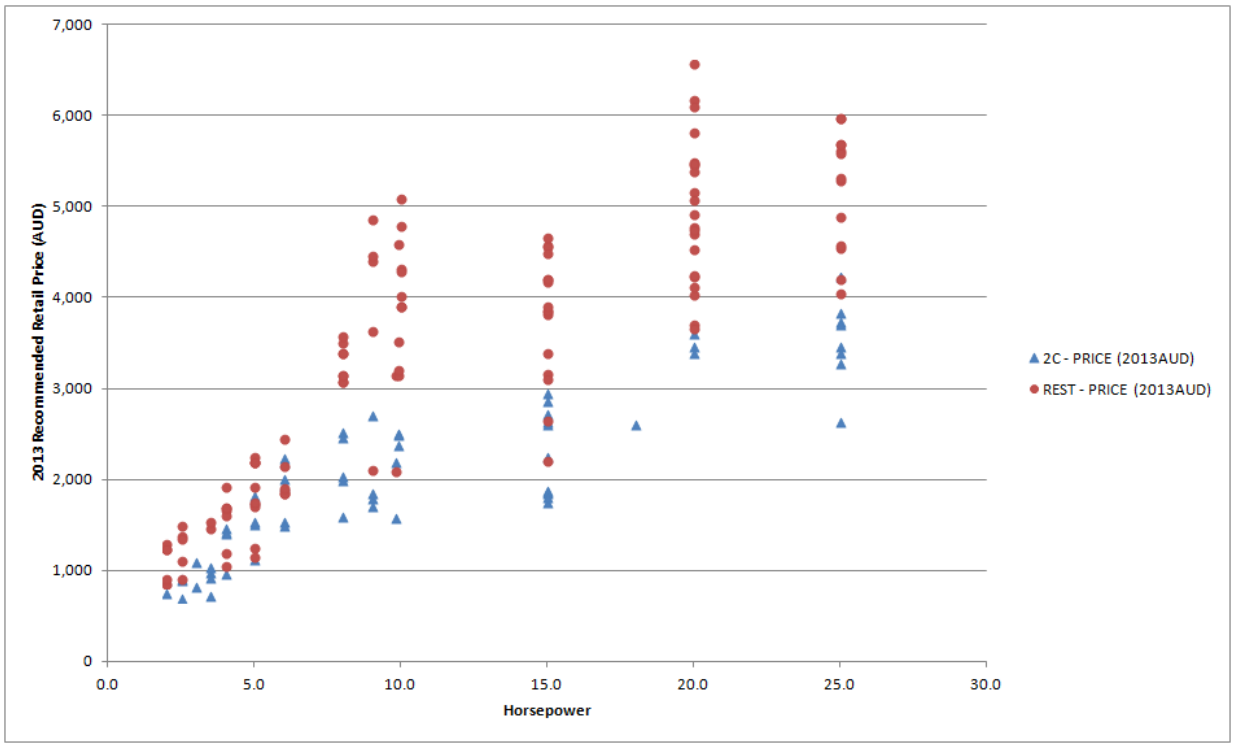
A study from the marine engines sector provides further insight into the issue of consumer choice and lost utility. The results of two surveys of recreational boaters in Queensland [71] suggest that some are leaving boating and that a smaller proportion of households are choosing to take it up. A variety of reasons were given (i.e. price was only one of several reasons), including:

- Work or family commitments
- Alternative leisure activities
- Crowded fishing areas
- Distance to fishing areas
- Poor fishing
- Can't afford to fish more often
- Cost of equipment.

Further, there is an overlap in the price range of compliant outboard engines with their non-compliant counterparts in motors to 20 hp (Figure A.3.1). Consumers, who are considered by some industry respondents to the Consultation RIS to be the most vulnerable to potential price rises of compliant outboards, may therefore continue to buy within a familiar price range.

[71] Sutton, S.G. 2006 An Assessment of the Social Characteristics of Queensland's Recreational Fishers. CRC Reef Research Centre Technical Report No 65. CRC Reef research Centre, Townsville, and
- Taylor, S., J. Webley and K. McInnes (2012) 2010 Statewide Recreational Fishing Survey. State of Queensland, Department of Fisheries, Agriculture and Forestry

Figure A.3.2 Distribution of outboard motor prices between 2-stroke carburetted engines and the "Rest" (4-stroke and direct injection 2-stroke engines) for engines 25 hp or less.



There will be limited impact on choice within the outboard market even as regulation displaces 2-stroke carburetted outboard models from the market. Two-stroke technology will still be available in the form of direct injection two-stroke. Also outboard manufacturers have been reducing 2-stroke carburetted models for some time, especially in the higher power bands where they are in the minority (Figure A.3.2). Direct injection 2-stroke and 4-stroke models have increased substantially in recent years to replace discontinued 2-stroke models.

It is more difficult to develop similar insight into the outdoor powered equipment market. The current study focuses on hand-held equipment only. Compliance with the US EPA phase three emission standard for hand-held equipment requires that they meet the substantial reduction in evaporative emissions requirements while continuing to meet the phase two exhaust emissions limits for these engines. Therefore carburetted 2-stroke hand-held engines will continue in this market.

However for some equipment relatively cheap alternative electric and battery powered alternatives are now available. There is some anecdotal evidence that these are continuing to displace some combustion technology in the Australian market. Currently, there is no evidence that this has had any significant impact on the Australian outdoor equipment market and as such has not been investigated further.

Figure A.3.3 Australian Outboard market 2013