Australian Government
Department of Agriculture, Water and the Environment

Ratification of the Minamata Convention on Mercury

Final Regulation Impact Statement

Department of Agriculture, Water and the Environment

December 2020

Cataloguing data

This publication (and any material sourced from it) should be attributed as: Department of Agriculture, Water and the Environment 2020, *Ratification of the Minamata Convention on Mercury: Final Regulation Impact Statement*, Canberra. CC BY 4.0.

ISBN 978-1-76003-359-0

This publication is available at https://www.environment.gov.au/protection/chemicals-management/mercury.

Department of Agriculture, Water and the Environment
GPO Box 858 Canberra ACT 2601
Telephone 1800 900 090
Web awe.gov.au

Acknowledgements

The authors thank participants for their input.

Contents

Tables

Figures

Map

1 Introduction

The Minamata Convention on Mercury is an international environmental agreement coordinated by the UN Environment Programme. The text of the Convention was agreed by countries in January 2013.

The Convention introduces global controls to protect human health and the environment from anthropogenic (human-caused) releases of mercury and mercury compounds. The total health cost of Australian mercury emissions to the domestic economy is estimated at approximately $52.7 million in 2020.

Australia signed the Minamata Convention in October 2013. The signature indicates that Australia will refrain, in good faith, from acts that would defeat the object and purpose of the Convention. The next step is to ratify the Convention, which would bind Australia under international law to meet the Convention's obligations.

Because Australia is not yet a ratified Party to the Convention, it is increasingly set apart from like-minded countries and key trading partners and is also unable to fully engage in, or influence, the direction of the Convention, including decisions about future global controls on mercury.

The Convention has been ratified by 125 countries, including the United States of America, the European Union, Japan, China, India and Indonesia. In particular, non-ratification sets Australia apart from the 30 out of 37 OECD countries that have ratified.

Since 2013, the Australian Government has been exploring possible pathways to ratifying the Minamata Convention. Australia's domestic treaty-making process requires the government to meet the specific obligations of the Convention before ratification.

The government must consider two options:

- to ratify the Minamata Convention, or
- to do nothing, maintaining Australia's current status as a non-Party to the Convention.

In deciding whether to ratify the Convention, the government's policy objectives are to:

1) Protect the environment and human health from the harmful effects of mercury exposure.
2) Reduce mercury pollution from human activity.
3) Continue Australia's role as an engaged and responsible global trading partner.
4) Ensure that any approach taken provides a net benefit to the community, including by minimising the impact and cost to business and industry while still achieving the other objectives.

The specific details of those key objectives, how they were identified and the benefits and regulatory impacts of the proposal for government action are explored in greater detail through this Regulation Impact Statement (RIS).

The government has conducted significant analysis and consultation over six years on the potential costs, benefits and impacts of Australia's ratification of the Convention. Consultation

found broad support among government, business, industry and other stakeholders for ratification.

Following public consultation on an exposure draft RIS in 2016 (Australian Government 2016), the Department of Agriculture, Water and the Environment has updated the options and analyses to take account of international and domestic developments, which include:

- cancellation by the Australian Pesticides and Veterinary Medicines Authority of the registration of Shirtan, which is a mercury-containing fungicide for sugar cane
- greater clarity on the likely market availability of mercury-added products from key trading partners
- the development of guidelines under the Convention on implementing some of its obligations, reducing uncertainty for industry.

Recognising the significant and ongoing threat that mercury pollution poses to human health and the environment, Australian governments have historically been active in seeking to reduce the Australian community's risk of exposure. Consequently, Australia is already broadly in alignment with many of the obligations of the Minamata Convention, so ratification will have a minimal impact on most industries.

While the lighting sector has been actively replacing high-pressure mercury vapour (HPMV) lamps with light-emitting diodes (LEDs), the proposed approach to ratifying the Convention would bring forward capital expenditure for the final stages of that transition by two years. The industry peak body has indicated its support for this transition strategy.

The impacts of the proposed ratification identified during consultations are outlined in this RIS. Our analysis concludes that ratifying the Convention would meet all the government's policy objectives and be beneficial to the Australian economy.

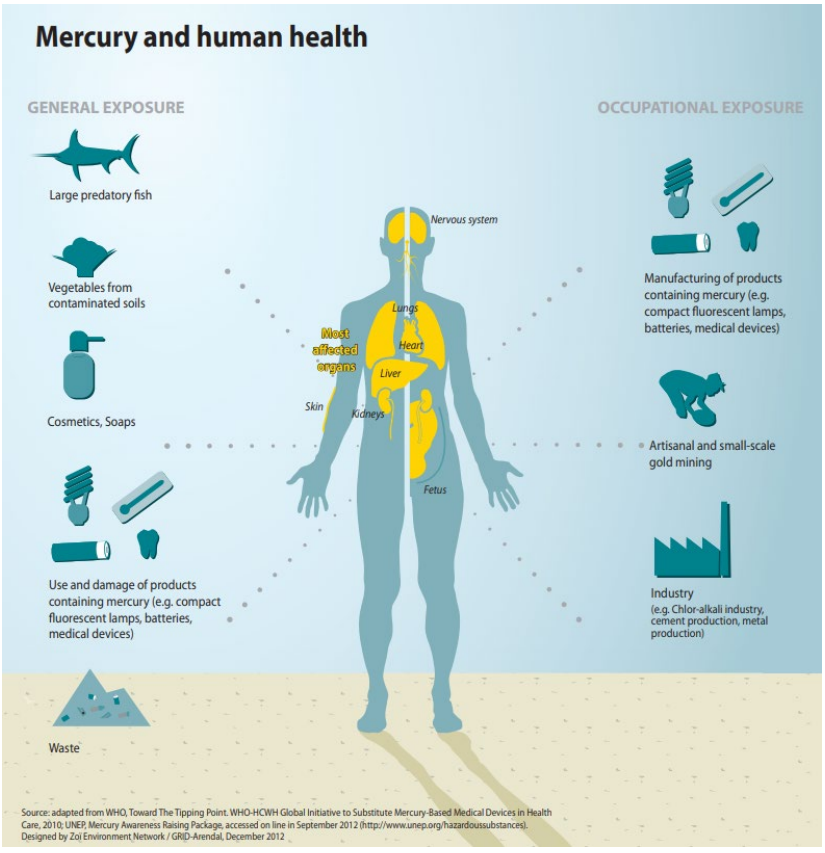
2 The problem

2.1 The need for global action on mercury

Mercury is a toxic pollutant that is released into the environment mainly through human activities such as industrial processes, including mining. It accumulates in the environment and in food chains, and circulates globally through the oceans and the atmosphere, causing significant harm to human health and the environment, sometimes at great distances from its point of origin. The World Health Organization lists mercury as one of the top 10 chemicals of major public health concern: acute or chronic exposure to mercury and mercury compounds can be fatal.

Humans can be exposed to mercury through emissions in the air, from contaminated land and water, and from eating contaminated foods (mostly marine fish; Figure 1). Mercury exposure can cause significant adverse health impacts and environmental damage. The UN Environment Programme estimates that human activity has increased mercury in Arctic marine animals by 10 to 12 times compared with pre-industrial levels. Mercury concentrations have also been increasing in the North Pacific Ocean over the past few decades, coinciding with the industrialisation of East Asia. Further increases in emissions would have 'long term consequences for commercial fisheries and all consumers of marine and freshwater foods' (UNEP 2013a).

Figure 1: Sources of mercury exposure and its impacts on human health



Source: UNEP (2013b:24).

In a globally coordinated effort to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds, the Minamata Convention contains provisions that relate to the entire life cycle of mercury. It includes controls and reductions for a range of products, processes and industries in which mercury is used, released (to land and water) or emitted (to air). The Convention also addresses the direct mining of mercury, its export and import, its safe storage and its disposal once it is waste.

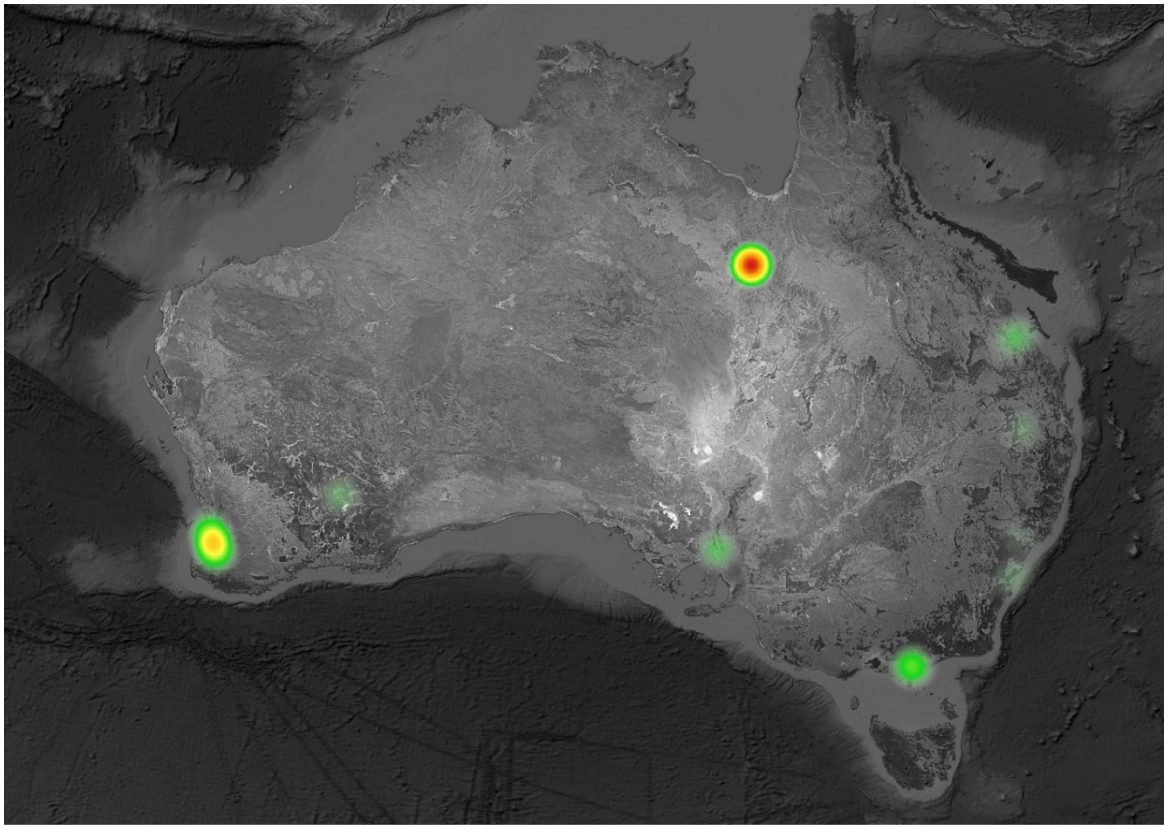
2.2 Mercury in Australia

This RIS draws on evidence gathered through a review of international and domestic literature; official economic, environmental and trade data; and consultations with government, business, industry and non-government organisations.

According to the National Pollutant Inventory, industry in Australia reported the emission and release of approximately 10 tonnes of mercury in 2018–19 (Australian Government 2020). Previous studies have developed a benefit transfer methodology that, when updated and applied to Australia, estimates the most likely impact of mercury emissions on human health to be $5,273 per kilogram of mercury (Australian Government 2018). Therefore, the impact from mercury emitted in 2018–19 alone equated to a human health cost of approximately $52.7 million per year to the Australian economy.

Common sources of mercury emissions and releases in Australia include air emissions from coal-fired power stations and non-ferrous metal smelters, the application of mercury-containing fungicide to sugar cane (which will not occur after the deemed permit ends in June 2021), the disposal of damaged fluorescent and low-energy lamps, leaking mercury-containing thermometers and batteries, and amalgam waste from dental practices. Map 1 shows ‘hotspots’ of mercury emissions in Australia.

Map 1: Mercury emissions hotspots in Australia, 2018–19



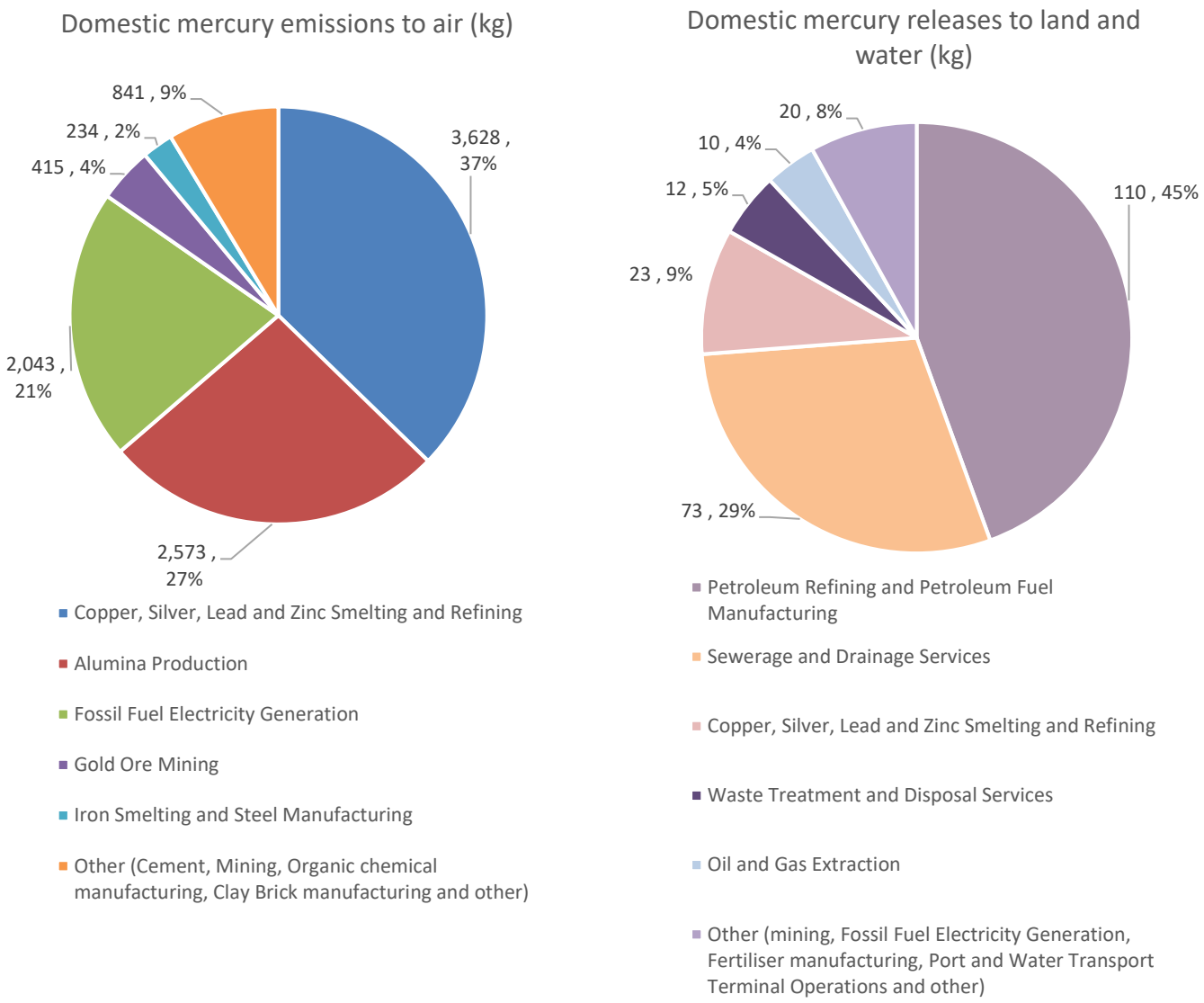
Note: The main point sources of mercury emissions are locations of metal smelting, alumina production and coal-fired power generation.
Source: National Pollutant Inventory 2018/19.

One of the main sources of mercury pollution in Australia has been agricultural run-off from sugar cane treated with Shirtan, which is a mercury-containing fungicide. Run-off released around 4.3 tonnes of mercury into the environment in 2017–18 (the estimate is based on Shirtan sales). Following the voluntary cancellation of the active constituent (containing mercury), the Australian Pesticides and Veterinary Medicines Authority cancelled the registration of Shirtan for use in Australia in June 2020 (APVMA 2020), although the product may continue to be supplied and used for 12 months under a deemed permit. The use of Shirtan has already declined significantly, as growers look to other (non-mercury-containing) fungicides.

Figure 2 illustrates the different industry contributions to domestic mercury emissions to air and releases to land and water in 2018–19, based on information provided to the National Pollutant Inventory. Note that total emissions to air are significantly greater than releases to land and water.

The smelting and refining of copper, silver, lead and zinc contributes the greatest proportion of mercury emissions to air. Petroleum refining and manufacturing contribute nearly half of mercury emissions to land and water, although that is a much smaller total.

Figure 2: Mercury emissions to air, land and water, Australia, 2018–19



Note: The releases to land and water do not include diffuse-source releases from sugarcane areas to which the fungicide Shirtan was applied (estimated at 4,300 kg in 2017–18). Those releases are not reported to the National Pollutant Inventory. With the expiration of the deemed permit for Shirtan from June 2021, run-off from sugarcane areas will no longer be a significant source of mercury pollution.
Source: National Pollutant Inventory (Australian Government 2020).

Studying the effects of mercury on human health and the environment is extremely challenging because, as it is an element, it is never destroyed and can transition into various forms as it cycles through the environment. For example, mercury that is deposited to soils, lakes, wetlands or oceans may later enter the food chain or be re-released into the atmosphere, from which it can then be redeposited elsewhere. Therefore, it is highly likely that Australians are being affected by mercury pollution from overseas.

Consumption of seafood and freshwater fish contaminated with mercury (which may be from local or global sources) is also a potential source of exposure in the Australian community. Traditionally, Australians are large consumers of seafood, annually consuming more fish and other seafood per capita than the world average (AIHW 2012). Australia's apparent consumption of seafood increased, on average, at an annual rate of 1.9% between 1998–99 and 2017–18, from an estimated 238,968 tonnes in 1998–99 to 341,272 tonnes in 2017–18 (Steven et al. 2020).

3 The need for government action

Through this RIS, the Australian Government is considering the possible benefits and implications of Australia's ratification of the Minamata Convention on Mercury. Given Australia's diplomatic position in the Indo-Pacific region, Australia's ratification would assist broader global efforts to reduce mercury pollution and ensure that ambition and accountability are maintained in the long term, as other countries develop improved mercury control strategies. Those global efforts to reduce mercury pollution will reduce the risk of mercury exposure to human health and the environment, domestically and internationally.

3.1 Policy objectives overview

The Australian Government's objective is to identify and implement the best policy approach for managing mercury pollution in Australia, considering the full range of social, environmental and economic impacts.

This RIS explores the four key policy objectives of the proposal to ratify the Minamata Convention:

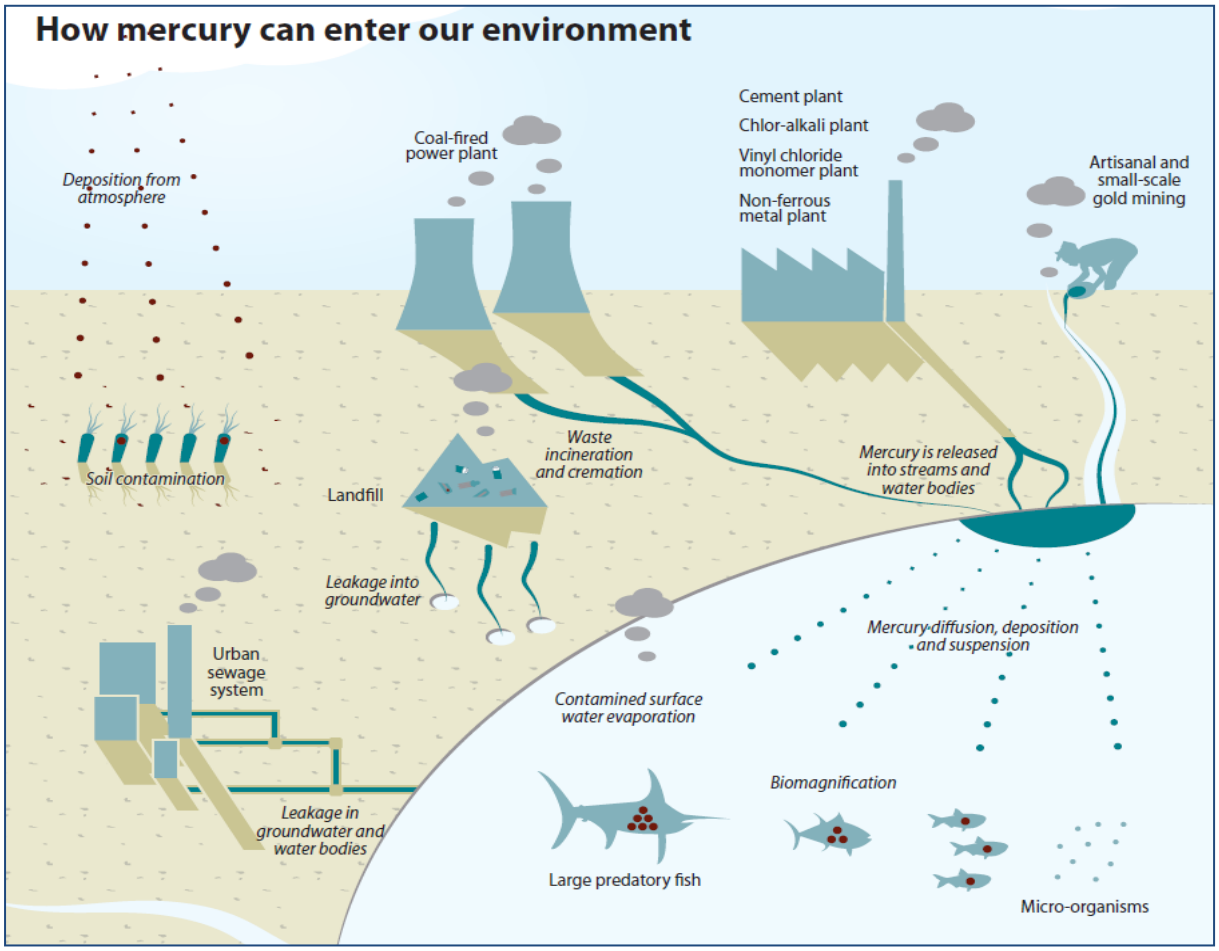
1) Protect the environment and human health from the harmful effects of mercury exposure.
2) Reduce mercury pollution from human activity.
3) Continue Australia's role as an engaged and responsible global trading partner.
4) Ensure that any approach taken provides a net benefit to the community, including by minimising the impact and costs to business and industry, while still achieving the other objectives.

3.2 Objective 1: Protect the environment and human health from the harmful effects of mercury exposure

Mercury is a naturally occurring element that can be emitted and released as a result of both natural processes and human activities (as shown in Figure 3). Approximately 90 per cent of the mercury emitted into the atmosphere each year is accounted to be from human activity (UNEP 2013a).

Mercury is a highly toxic heavy metal that can cause serious adverse effects on humans, ecosystems and wildlife, particularly because of its tendency to cause reproductive and developmental impairment. Inhaled mercury is readily absorbed into the bloodstream and can damage the central nervous system, thyroid, kidneys, heart, lungs, immune system, eyes, gums and skin. Neurological and behavioural disorders can also indicate mercury contamination; symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches and cognitive and motor dysfunction, and damage to the brain from mercury cannot be reversed (WHO 2013). In extreme cases, rapid onset insanity, paralysis, coma and death can also occur (UNEP 2013b).

Figure 3: Sources of mercury exposure to the environment



Source: UNEP (2013b:21).

There is no known safe exposure level for mercury in humans, and effects can be seen even at very low levels. Foetuses, newborn babies and children are among the most vulnerable and sensitive to the adverse effects of mercury (UNEP 2017).

Mercury is a chemical of global concern because, once emitted or released, it persists in the environment, where it circulates between air, water, sediments, soil and living organisms. It can travel far from its original source and becomes increasingly concentrated in the tissues of organisms as it rises up the food chain.

The most common source of direct mercury exposure for humans is through the consumption of contaminated fish and seafood. Once ingested, 95 per cent of the chemical is absorbed in the body (UNEP 2013b). Infants, children and pregnant women (due to transplacental contamination) are most vulnerable to the adverse effects of mercury. In children and infants, mercury can cause severe neurological damage resulting in mental retardation, seizures, vision and hearing loss, delayed development, language disorders and memory loss. Children with elevated mercury levels are also more likely to be diagnosed with attention deficit hyperactivity disorder (WHO 2013, Boucher et al. 2012).

The loss of IQ associated with *in utero* mercury exposure (Axelrad et al. 2007) and subsequent methylmercury toxicity is of primary concern, as the resulting loss of intelligence causes diminished economic productivity and persists over a person's lifetime. That lost productivity

has been estimated to cost US$8.7 billion annually in the United States alone (Trasande et al. 2005).

In the European Union, more than 1.8 million children are born each year with methylmercury exposures resulting in mercury levels in their hair above the recommended limit of 0.58 micrograms per gram (µg/g). It has been estimated that the total annual economic benefit of exposure prevention is between €8 billion and €9 billion per year (Bellanger et al. 2013).

Based on a global population of 7.8 billion and an Australian population of 25.4 million (or about 0.33% of the world's population), Australia's mercury emissions are less than 0.5 per cent of global emissions from industrial sources, and the nation's releases of mercury to land and water make up less than 1 per cent of global releases from such sources (UNEP 2019). However, due to its relatively small population, on a per capita basis, Australia's industrial mercury emissions are higher than the world per capita average.

As mercury pollution can travel long distances from source countries, it is a global problem that requires global solutions. Through participation in the Minamata Convention, Australia can work closely with other countries to mitigate the risk posed by mercury pollution at the global level.

3.3 Objective 2: Reduce mercury pollution from human activity

Due to its unique properties, mercury has been widely used in products such as measuring devices (barometers, hygrometers, manometers, thermometers, sphygmomanometers), switches, relays, some fluorescent light bulbs, batteries, cosmetics, pesticides, biocides, pharmaceuticals, jewellery and dental amalgam (used in tooth restorations). It has also been used in manufacturing processes that produce chlorine and sodium hydroxide (mercury chlor-alkali plants) or vinyl chloride monomer for polyvinyl chloride (PVC) production, and polyurethane elastomers.

Mercury can also be a by-product of raw material refining or production processes, such as oil and gas refining and non-ferrous metal production (lead, zinc, copper and industrial gold). It can also be emitted from coal-fired power stations and coal-fired industrial boilers.

In practice, Australia is already broadly in alignment with many of the obligations of the Minamata Convention. For example, primary mercury mining (which is prohibited by the Convention) no longer occurs in Australia. Mercury-using manufacturing processes prohibited by the Convention are also not conducted in Australia. Australia is also a Party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, aspects of which have been incorporated into the Minamata Convention.

Many government regulatory and policy measures and voluntary actions by industry are already in place to reduce mercury use, control industrial emissions of mercury and protect the Australian community and environment from harmful effects of mercury. For example:

- Since 2012, the maximum mercury content allowed in certain fluorescent lights has been set at levels equal to or less than those specified in the Minamata Convention.
- The Kalgoorlie Consolidated Gold Mines Gidji gold roasting facility (north of Kalgoorlie, Western Australia) was previously the largest single emitter of mercury in Australia,

emitting over 5 tonnes of mercury per year (KCGM n.d., KCGM 2015). Over recent years, the facility worked with the Western Australian Government to improve its gold processing methods and in 2017–18 emitted only 0.29 kilograms of mercury. The facility has also implemented a monitoring program for potential spill or leak sources and a wastewater treatment plant to ensure that it effectively controls mercury.

- Two new mercury waste treatment facilities have been constructed in Western Australia, bolstering Australia's capacity for managing mercury-contaminated materials.

Implementing the obligations of the Convention will therefore be relatively straightforward and low-cost, involving minor amendments to legislation or policies, or adjustments to the application of legislation in most instances. Proposed amendments to federal legislation relate to controls on the import and export of mercury and the phasing out of the import, manufacture and export of some mercury-added products (to which Part I of Annex A of the Convention refers). Under the Convention, a number of products are excluded from those listed in Annex A:

a) Products essential for civil protection and military use

b) Products for research, calibration of instrumentation, for use as reference standard

c) Where no feasible mercury-free alternative for replacement is available, switches and relays, cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for electronic displays, and measuring devices

d) Products used in traditional or religious practices and

e) Vaccines containing thiomersal as preservatives.

The Convention also requires that certain new or substantially modified industrial facilities (coal-fired power stations and boilers, non-ferrous metal smelting, waste incineration and cement clinker production) must apply the 'best available techniques' (BAT) and 'best environmental practices' (BEP) to control and, where feasible, reduce mercury emissions. The Conference of the Parties to the Minamata Convention has issued guidance on the application of BAT/BEP for the specified types of facilities.

Existing facilities in those categories in Australia operate under a range of pollution control measures similar to those specified in the Convention. Current regulatory and industry practice in Australia is to use BAT/BEP for new industrial facilities of those types, so it is reasonable to assume that the emissions requirements on any new facilities will align with Convention requirements.

3.4 Objective 3: Continue Australia's role as an engaged and responsible global trading partner

The Convention has been ratified by 125 countries and regional organisations, including the United States, the European Union, Japan, China, India and Indonesia.

As Australia is not a Party to the Convention, it is increasingly set apart from like-minded countries and key trading partners, particularly from the 30 out of 37 OECD member countries that have ratified. Australia is also unable to fully engage in or influence the directions of the Convention, including decisions on future global controls on mercury. As the Minamata Convention is a new treaty (entering into force in 2017), foundational guidance materials and definitions are still being negotiated and adopted by the Conference of the Parties.

Chemical pollution and wastes move across national borders, so global cooperation is necessary to protect the health of Australians and our environment. As indicated in Section 3.2 of this RIS, mercury emitted into the environment can circulate globally and create problems beyond national borders. Multilateral environmental agreements, such as the Minamata Convention, encourage best practice environmental protection, increase understanding of shared issues, reduce transboundary pollution impacts and align trade requirements to decrease regulatory burdens. Effective engagement with the Minamata Convention will help to optimise environmental, social and economic outcomes for Australia, bolstering our reputation as a responsible trading partner.

Being engaged in the international community through multilateral forums such as the Minamata Convention also ensures that the Australian Government is kept up to date on key scientific developments and emerging issues. This type of engagement fosters exchanges of knowledge and experience as we seek to tackle challenging problems that affect both the Australian and global communities. Furthermore, a Party to the Convention can guide associated scientific and technical bodies on the direction and content of work they are undertaking under the auspices of the Convention.

Global cooperation is now more important than ever as the world seeks to respond to the health and economic consequences of the COVID-19 pandemic. To support the multilateral system at this time, Australia has adopted a multilateral engagement strategy, recognising that our shared, global interests are not served by isolation and protectionism. Australia's full engagement on the Minamata Convention will assist in meeting the strategy's objectives.

3.5 Objective 4: Ensure that any approach taken provides a net benefit to the community, including by minimising the impact and costs to business and industry

The World Health Organization considers mercury to be one of the top 10 chemicals of major public health concern, as mercury contamination contributes to the overall global burden of diseases, injuries and risks attributed to hazardous chemical exposure. Mitigating and resolving those problems can be costly, particularly for remediation activities (WHO 2013). One such example is Japan's Minamata Bay (for which the Convention is named), where industrial contamination led to costs of approximately A$134 million per year over 30 years for remediation and compensation (Boston University 2020, UNEP 2013b).

The UN Environment Programme has reported that the global environmental costs of mercury pollution from human activity are extensive, estimated at US$22 billion in 2008 (UNEP 2013c).

Australians benefit from international efforts to reduce the global load of mercury pollution circulating in the environment and our food. Ratification of the Minamata Convention would bring the nation's management of the mercury life cycle into line with international best practice, provide greater certainty for business and industry and create opportunities for Australian businesses to take advantage of global prospects.

Ratification would impose some costs on industry and government. However, the detailed cost–benefit analysis in Section 6.1 calculates that ratification would deliver a net benefit to the Australian economy.

Given that Australia already has robust environmental and human health regulations, existing regulatory frameworks will be used to the extent possible to avoid additional or unnecessary regulatory burden on business and industry (see Appendix C).

4 Options identification and analysis

Since 2014, the Australian Government has explored a range of regulatory and policy options to address mercury pollution through ratifying the Minamata Convention.

The two options considered in this RIS are:

- **Option 1: Do nothing**. This option sets the base case, retaining Australia's current status as a signatory but non-Party to the Minamata Convention.
- **Option 2: Ratification**. This option considers the implications of Australia ratifying the Convention.

In this section, we summarise the benefit or regulatory impact of each option. We provide a quantitative and qualitative analysis of costs, benefits and regulatory impacts in Section 6 and Appendix A.

The 2016 exposure draft RIS (Australian Government 2016) considered other possible options that included a phase-out schedule for Shirtan liquid fungicide and a campaign to promote the voluntary installation of traps and separators to capture waste dental amalgam. Those additional options are not included in this final RIS because no registered agricultural products that contain mercury remain in the market, and Australia already complies with several measures required by the Convention to phase down the use of dental amalgam. For the purposes of ratification at this time, it is not necessary to pursue dental amalgam waste measures.

4.1 Option 1: Do nothing

Option 1 represents the base case under which there would be no changes to Australia's current controls on mercury, and Australia would not ratify the Minamata Convention. Current approaches to managing and monitoring mercury under federal, state and territory legislation cover some, but not all, aspects of the mercury life cycle:

- Regulation of mercury emissions and releases from industrial processes and other activities, and management of waste and contaminated land, occur under general pollution control measures. Not all regulatory frameworks contain specific mercury controls or policies.
- Australia controls the transboundary movement of hazardous wastes (which include mercury) under the Basel Convention (to which Australia is a Party).
- Australia exercises some controls on mercury exports under the Rotterdam Convention (to which it is a Party) and the Customs Regulations. However, there are gaps in the regulation of mercury exports and imports and in the provision of the certifications now required by Parties to the Convention that may export mercury to Australia. This is creating hurdles for the import of mercury for purposes allowed by the Minamata Convention (such as the manufacture of dental amalgam).
- There are gaps in Australia's regulation of mercury-added products, which include certain lighting products, pesticides, therapeutic goods such as antiseptics and thermometers, and devices such as barometers. Those products are a source of mercury pollution if not used or disposed of in an environmentally sound manner.

- Australia will continue to require industry reporting on mercury emissions and releases under the National Pollutant Inventory.

Under this option, Australia would retain its status as a signatory but non-Party to the Minamata Convention.

The cost–benefit analysis conducted for this RIS used this option as the reference point and considers all costs or benefits (including avoided costs) relative to this option.

While Option 1 would result in no direct changes to our domestic regulatory frameworks, the *status quo* would not continue for all Australian industries and stakeholders. Because 125 countries, including Australia's major trading partners, are now Parties to the Convention, there will be impacts on Australia's ability to trade in goods that are subject to controls under the Convention. Countries bound by the convention must phase out the import, manufacture and export of certain mercury-containing products by 31 December 2020. Those products will become less available in Australia, although some countries have obtained exemptions under the Convention to allow for additional time (expiring in 2025) to adjust to those prohibitions. There will also be complications to importing mercury for purposes allowed by the Minamata Convention, such as the manufacture of dental amalgam.

While the base case (by definition) has no costs or benefits, changes expected to occur in the next two to three years will result in increased difficulties in importing and exporting mercury-containing products. Those changes will increase the costs for some businesses compared with the current situation. Importantly, some of those costs will also be avoided under Option 2, as trade in mercury for acceptable uses is expected to be easier between Parties to the Convention.

4.2 Option 2: Ratify the Minamata Convention on Mercury

Under Option 2, the Australian Government ratifies the Minamata Convention, having taken the necessary steps to meet the Convention's obligations. The aim is for Australia to pursue ratification by the end of 2021. This would enable Australia to begin to contribute to, and advance Australia's interests in, the decisions of the Convention as soon as possible.

Under this option, Australia would meet the Convention's obligations through adjustments to existing regulatory frameworks. The main changes would be:

- additional federal legislation to implement Convention obligations for the import and export of mercury and the import, manufacture and export of certain mercury-containing products specified in the Convention
- some adjustments to the application of state and territory legislation related to mining, manufacturing processes, pollution control and storage and waste management involving mercury
- administration, information, reporting and planning for the implementation of the Convention.

Under Option 2, the department recommends that Australia register a three-year exemption (through to 31 December 2023) upon ratification for the import of HPMV lamps for general lighting purposes (see Appendix A to this RIS). This was based on advice received by industry

through the consultation process (see Appendix B). Exemptions of up to five years from 1 January 2021 are permitted in accordance with Article 6 of the Convention.

4.2.1 Benefits

Option 2 would deliver social, economic and environmental benefits such as:

- the qualitative benefit of Australia gaining a seat at the table to influence the future direction of the treaty, and displaying environmental leadership
- potential reductions in mercury emitted (note that the reductions appear to be low to none)
- energy and carbon emissions (CO_2e) savings from converting HPMV streetlights to LEDs
- qualitative benefits from converting to 'smart' street lighting, such as lower maintenance costs, lower failure rates and potential features such as dimming and remote fault notification
- potential health and environmental benefits arising from any reduction in mercury emissions and benefits accruing over a longer time as, for example, mercury-containing products are no longer imported
- the benefit of safeguarding Australians against future international increases in emissions and releases
- as identified by industry peak bodies, greater certainty for industry and, consequently, support for investment decisions
- reduced mercury in Australia's waste streams due to phasing out imports of non-essential mercury-containing products
- protection of Australia's ability to import and export permitted mercury-added products and an easier process for imports and exports of those products.

4.2.2 Comparison of costs and benefits

We conducted a cost–benefit analysis to quantify the costs and benefits and compare them over a 20-year period.

The cost–benefit analysis concluded that many of the potential impacts that were identified would in fact result in zero costs and zero benefits. This is due in large part to the high standard of environmental regulation that exists in Australia. The only quantified costs and benefits that were identified under Option 2 were an increase in administrative costs for the Australian Government and bringing forward both the costs and benefits for public lighting (street lighting as well as lighting at commercial and sporting facilities), as HPMV lamps would need to be changed to compliant alternatives. While domestic reductions of mercury emissions will be low to none; benefits will instead accrue over a longer period as, for example, mercury-containing products are no longer being imported and finding their way into Australia's waste streams.

Using a discount rate of 4%, the analysis concluded that Option 2 would deliver a net benefit to Australians of $5.9 million over 20 years. In addition, Option 2 has a benefit:cost ratio of 1.4, which effectively means that, for every $1.00 invested in reducing or controlling mercury pollution, the Australian community would receive a return of $1.40.

Option 2 is the recommended option, as it is expected to deliver a net benefit.

The cost–benefit analysis is set out in further detail in Section 6 and provided in full in Appendix A.

4.2.3 Regulatory impact

The regulatory impact on industry of ratifying the Minamata Convention will be minimal. There would be no cost to industry for the construction of new facilities or substantial modification of existing facilities, as emissions controls are already in alignment with the obligations of the Convention.

In order to minimise potential impacts on the lighting sector and maximise potential benefits to human health and the environment, the department recommends that Australia register a three-year exemption for the import of HPMV lamps upon ratification. The exemption would extend the time available to owners and operators of streetlights using HPMV bulbs to conduct the necessary upgrades to suitable alternatives, thus minimising potential risks to service provision. The changeover cost for some streetlight providers to transition from HPMV to LED streetlights would be brought forward by two years (relative to the base case) at a present value cost of approximately $7.5 million but deliver a present value benefit of around $17.3 million from energy savings and $4.4 million from carbon savings.

5 Consultations

Since 2010, the Department of Agriculture, Water and the Environment has conducted six stakeholder consultation rounds (both public and targeted), first to consider Australia's signing of the Minamata Convention, and then to consider ratification. The consultations included public workshops in every state and territory.

During the consultations, potential problems identified by government, industry and non-government organisations were documented, and informed the consideration and development of possible pathways to ratification (see Appendix B).

Additional targeted consultation was undertaken in 2020 with stakeholders potentially affected by recent developments, including on:

- the impacts on industry of the Convention's prohibition on the import, export and manufacture of certain mercury-added products, which comes into effect from 1 January 2021 for most Parties
- the development of guidance material to aid the interpretation of some articles in the Convention.

The consultations revealed broad support for ratification in government, business, industry and non-government organisations. In general, business and industry spokespeople indicated that ratification would provide much-needed certainty for business investment decisions and recommended that the government use existing regulatory frameworks to avoid incurring additional regulatory burdens.

As indicated in Section 4.2, the lighting industry's concerns about the Convention's impact on the use of HPMV lamps in streetlights have been factored into the ratification option. The proposed exemption for three years will give the industry additional time to make the transition away from HPMV lamps.

More detail on the consultation process and outcomes is included in the cost–benefit analysis in Appendix A.

6 Best option

Section 2 of this RIS outlines the serious environmental and human health problems arising from mercury pollution. Mercury is a problem that needs to be addressed across its entire life cycle in order to minimise the risk of exposure and provide meaningful benefits to the Australian community.

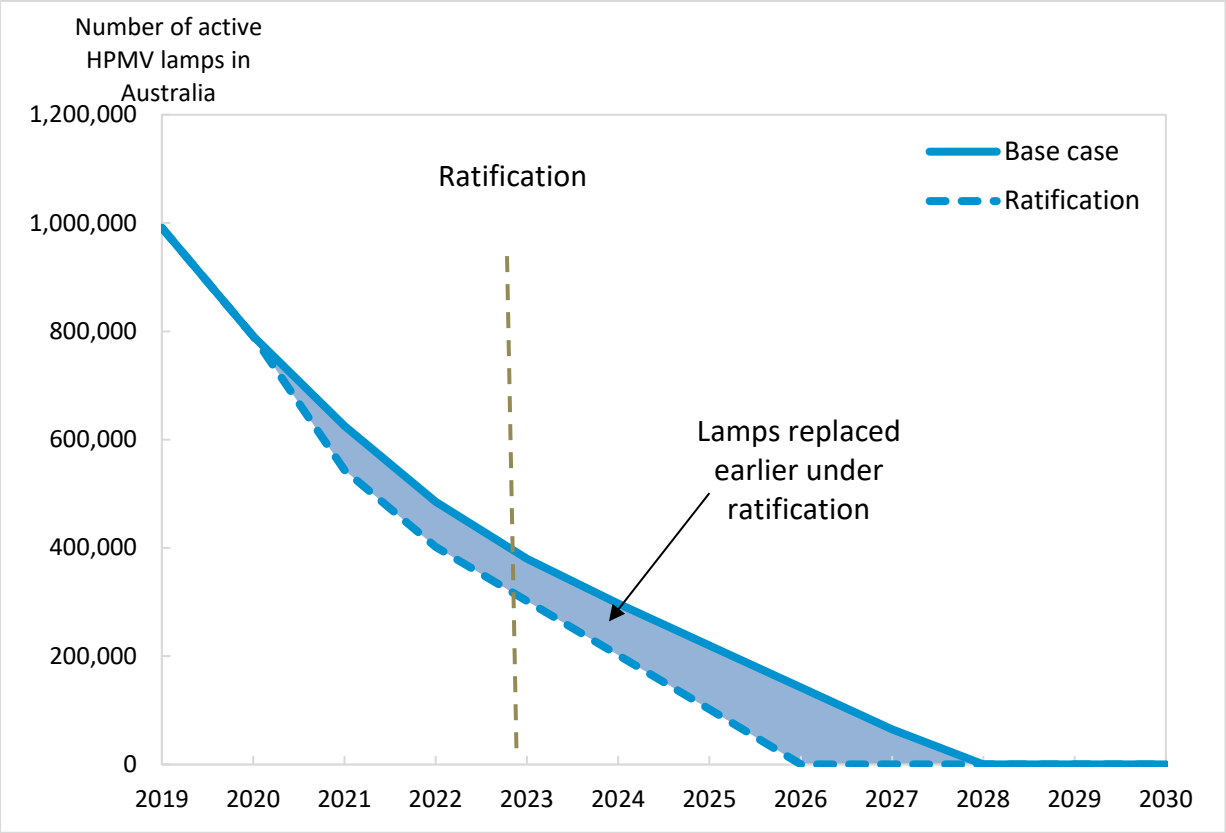
Based on the qualitative and quantitative analysis of benefits, costs and regulatory impacts discussed in this section, the department has determined that ratification of the Minamata Convention is in Australia's national interest.

Public consultation has confirmed broad support from stakeholders and has not identified any significant risks or disadvantages. Costs to industry are expected to be low, given global movements away from mercury-containing products and the use of mercury generally.

Australia's existing controls on environmental releases of mercury are already broadly in alignment with the obligations of the Convention. Implementing the obligations will therefore be relatively straightforward and low-cost, and only minor amendments to legislation or policies will be required in most instances.

Industry supports the department's recommendation to extend the time available to owners and operators of streetlights containing HPMV bulbs to conduct the necessary upgrades to suitable alternatives. Figure 4 compares the phase-out of HPMV lamps under Option 1 and Option 2. It illustrates that, under the base-case scenario (Option 1), industry will have phased out HPMV lamps by 2028.

Figure 4: Estimated phase-out of HPMV lamps under the base case and the ratification option, 2019 to 2030



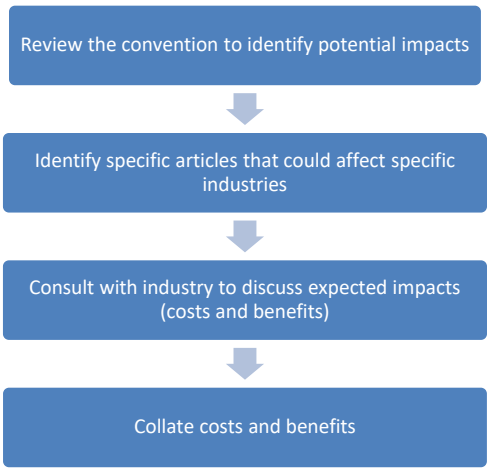
Source: Marsden Jacob Associates analysis based on industry consultation.

6.1 Cost–benefit analysis

We carried out a cost–benefit analysis (CBA) to consider the full range of impacts that would arise under the ratification option and compared those impacts to those under the base case (no ratification). This section summarises the processes and results; more detail is available in Appendix A.

In order to identify the full range of costs and benefits that would arise from ratifying the Convention, we took multiple steps to review the Convention, identify potential impacts, consult with industry to quantify each impact and then collate the full range of costs and benefits (as outlined in Figure 5).

Figure 5: Process to identify and collate the impacts of ratification versus non-ratification



The process used to identify potential impacts is set out in detail in Appendix A, along with a summary of consultations with stakeholder groups.

Following consultations with stakeholders, we collated information on each of the potential impacts. The CBA concluded that most of the potential impacts will result in zero costs and zero benefits. The full list of cost and benefit estimates for each stakeholder group is in Table 1.

Table 1: Quantitative summary of costs and benefits of Option 2

	Costs	Benefits
Australian Government	Estimated cost of $645,000 per year for the life of the analysis. This includes financial contributions, staffing and border permitting/registration.	Qualitative benefit of seat at the negotiating table and environmental leadership
State and territory governments	Estimated cost of $259,000 in 2021. Based on 8 jurisdictions each requiring 0.25FTE staff.	Qualitative benefit to industry by ensuring a nationally consistent approach
Industry with air emissions	$0	$0
Dental sector	$0	Qualitative benefits in increased ease of imports and exports.
Public lighting	Brings forward capital expenditure that would occur anyway Estimated present value of $7,498,747	Brings energy savings earlier. Estimated present value of $17,319,517. Brings emissions (CO2e) savings earlier. Estimated present value of $4,438,706. Qualitative benefits of lower maintenance costs, lower failure rates and potential 'smart lighting' features such as dimming and remote fault notification.
Waste and recycling	$0	$0
Oil and gas	$0	$0
Medical devices and pharmaceutical goods	$0	$0
Community	None identified	Reduced Health & Safety Costs. Estimated present value of $352,000
Environment	None identified	$0 (not quantified)

Note: Present values are show based on 20 year analysis and a 4% discount rate.

In order to compare the costs and benefits under different timings, we considered the net present value over a 20-year period and applied a discount rate to costs and benefits that appear after the initial year.

The net benefit of Option 2 over a 20-year period is estimated to be over $5.9 million, using a discount rate of 4%. This would also result in a benefit:cost ratio of 1.4, which effectively means that the Australian community would receive a return of $1.40 for every $1.00 invested in reducing mercury pollution.

The impact of alternative discount rates on the net benefit is shown in Table 2.

Table 2: Cost–benefit analysis results

Stakeholder		2% discount rate	4% discount rate	7% discount rate
Costs				
Australian Government	Compulsory financial contributions to the secretariat of the Convention	$1,950,227	$1,633,717	$1,285,634
	Department of Agriculture, Water and the Environment – staffing	$4,062,973	$3,403,577	$2,678,404
	Border permitting / registration / administration and data collection	$4,062,973	$3,403,577	$2,678,404
State and territory governments	Some policy and/or regulation amendments	$254,062	$249,177	$242,190
Industry	Modifications to existing and new plant to reduce air emissions	$0	$0	$0
	Dental sector	$0	$0	$0
	Public lighting (to replace HPMV lamps two years early)	$4,136,002	$7,498,747	$11,394,350
	Oil and gas	$0	$0	$0
Benefits / avoided costs				
Health outcomes	Reduction in mercury emitted and released	$0	$0	$0
	Reduced health and safety costs	$435,321	$352,448	$262,368
Environmental outcomes	Carbon savings (public lighting)	$4,814,712	$4,438,706	$3,949,905
	Energy savings (public lighting)	$18,786,663	$17,319,517	$15,412,249
	Environmental benefits	Not quantified	Not quantified	Not quantified
Totals	Total costs	$14,466,238	$16,188,794	$18,278,981
	Total benefits	$24,036,696	$22,110,672	$19,624,522
	Net benefits	$9,570,457	$5,921,878	$1,345,541
	Benefit:cost ratio	1.7	1.4	1.1

As well as the quantified benefits, there are unquantified benefits to ratification, such as being able to influence the future direction of the Convention. There are also a range of secondary benefits to Australia in ratifying the Convention. Phasing out imports of non-essential mercury-containing products will reduce mercury in Australia's waste streams. Conversely, Australia's

access to essential mercury-containing products will be protected as international controls on those uses of mercury increase over time. By ratifying, Australia would also strengthen global efforts to preserve fisheries and other critical ecosystems, contribute to protecting global human health and the environment, and maintain Australia's international reputation.

Because the CBA results in a net benefit of around $5.9 million and a benefit:cost ratio of greater than 1, our analysis indicates that Option 2 (ratifying the Convention) is expected to deliver a net benefit to the Australian economy. For that reason, Option 2 is the preferred option.

The CBA is set out in full detail in Appendix A.

6.2 Regulatory burden

Regulatory burden measurement was undertaken in line with Australian Government guidance (OPBR 2020). It focused only on costs that fall to businesses (including government-owned corporations), community organisations and individuals.

Based on our consultations with potentially affected industries, we estimate that no regulatory burden would be imposed under Option 2 (Table 3).

Table 3: Average annual regulatory costs (change from business as usual)

Change in costs	Business	Community organisations	Individuals	Total change in costs
Total, by sector	$0	$0	$0	$0

A regulatory burden estimate of $0 indicates that ratifying the Convention would not impose any additional regulatory burden (or 'red tape') on businesses in Australia over the initial 10-year period following ratification. This is a positive outcome and indicates that the Convention could be ratified with minimal impact on industry.

A detailed discussion of the regulatory burden is set out in Appendix A.

As ratifying the Minamata Convention would have limited direct impacts on industry and the broader community, no competition or equity impacts were identified.

6.3 Conclusion

The most effective means to reduce the risk of mercury exposure is to prevent its emission and release from anthropogenic sources. Accordingly, Australia's ratification of the Convention will fill gaps within the existing domestic regulatory framework and deliver significant benefits for human health and the environment both domestically and internationally.

Under Option 2 (ratification), industry would benefit from a more streamlined, transparent and predictable approach to the management of mercury. In addition, the Convention has the potential to create market opportunities related to mercury disposal and recycling, which will need industry solutions.

Ratifying the Convention would satisfy Australia's policy objectives by reducing the risks of mercury exposure to human health and the environment domestically while supporting the global phase-down of anthropogenic mercury emissions and releases.

Opting to do nothing to further address mercury pollution both domestically and internationally would minimise environmental, social and economic benefits in the short and long terms. Because many of the identified problems rely on global actions to reduce mercury pollution, Australia's voice as a ratified Party to the Minamata Convention is needed to maintain international momentum, particularly through regional leadership and engagement.

7 Implementation and evaluation

7.1 Implementation

The Australian Government is working with the states and territories to examine legislative approaches for implementing the preferred option, which is Australia's ratification of the Minamata Convention. Key considerations include the legislative design, coverage and the selection of the right policy instruments to achieve the objectives.

It is expected that the states and territories will use existing legislative frameworks to implement the preferred option within their areas of responsibility. All jurisdictions already have legislative frameworks for environmental protection and development approval. Licensing, compliance monitoring, investigations and prosecutions for breaches of relevant regulatory measures would be carried out by those authorised to do so under each jurisdiction's legislation.

At the federal level, the necessary legislative amendments covering the import and export of mercury and mercury compounds and the import, manufacture and export of mercury-added products will need to be completed before Australia deposits its instrument of ratification in accordance with Australia's treaty-making process.

The Australian Government has engaged with state and territory governments in developing an approach for satisfying Convention obligations. Following ratification, consultative arrangements will continue to assist states and territories in fulfilling current and future obligations in their areas of responsibility: mining; regulation of industry and mercury emissions and releases; regulation of mercury storage and waste; and management of contaminated sites.

The Department of Agriculture, Water and the Environment is also working more broadly with states and territories to progress the nationally consistent management of chemicals in the environment. The National Standard for the Environmental Risk Management of Industrial Chemicals will be put in place to establish management controls throughout the full life cycles of chemicals of concern, including mercury. The legislation will provide an effective framework to control and manage chemicals and hazardous substances, including import, export, manufacture, storage, emissions, releases, disposal and end-of-life management. This approach will be an efficient way to implement Australia's obligations under the Minamata Convention in the medium to long term.

The department will continue to draw on expertise and support provided by the Department of Foreign Affairs and Trade when developing Australian Government negotiating positions for decisions to be taken under the Minamata Convention.

7.2 Regular monitoring and reporting

Parties to the Minamata Convention are required to report to the Conference of the Parties every four years. Reports detail the measures a country has taken to implement the provisions of the Convention, the effectiveness of those measures, and any possible challenges in meeting the objectives of the Convention. Should Australia be a ratified Party to the Convention by the

end of 2021, we will be obliged to provide a report to the Conference of the Parties in the second reporting period (slated for December 2025).

As a Party to the Convention, Australia would also participate in periodic effectiveness evaluations conducted by the Conference of the Parties. The effectiveness evaluation framework allows the Conference of the Parties to consider whether the Convention will achieve its objective of protecting human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.

The lead role in overseeing implementation of the Convention and carrying out associated administrative and reporting requirements under the Convention will be performed by the Department of Agriculture, Water and the Environment.

Appendix A: Cost–benefit analysis

Background

A cost–benefit analysis (CBA) is a comprehensive economic appraisal technique used to consider alternative policy and regulatory approaches. It considers the full range of impacts that would arise under a reform option and compares them to a base case.

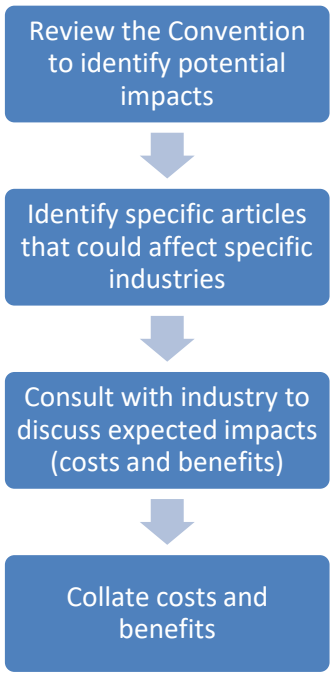
In undertaking the CBA for this RIS, we focused on the changes in costs and benefits that are attributable to the reform option (referred to as the 'marginal value'). Using this approach, the CBA identified the option that provides the largest net benefit to Australia.

The approach used to frame and quantify the CBA was based on Australian Government guidance (OBPR 2020). As the analysis considered ratifying an international convention, we considered that a 20-year analysis time frame was appropriate.

Approach used

In order to identify the full range of costs and benefits that would arise from ratifying the Convention, we used multiple steps to review the Convention, identify potential impacts, consult with industry to quantify each impact and then collate the full range of costs and benefits. Those steps can be considered as a process and are set out in Figure A1.

Figure A1: Flowchart summarising the approach used



Review of the Minamata Convention

The initial step was to review the Convention text as well as supporting material that assists in interpreting the Convention. The full text of the Convention is available on the Minamata Convention website, and specific articles of the Convention are also supported by guidance developed by the Conference of the Parties (UNEP 2020).

Based on our review of the Convention text, we identified four articles (Articles 4, 8, 9 and 11) as potentially affecting a limited number of industries. Table A1 summarises the potential impacts we investigated (based on specific Convention articles).

Table A1: Potential industry impacts that were investigated, by article of the Minamata Convention

Article	Dental sector	Coal-fired generation	Non-ferrous metals processing	Cement production	Other
4 **Mercury-added products**	Phase-down of amalgam (measures in Annex A, Part 2)				Street lighting Medical products
8 **Emissions (air)**		Existing plant New plant	Existing plant New plant	Existing plant New plant	Waste incineration and coal-fired boilers Existing plant New plant
9 **Releases (to water and land)**		Existing plant New plant	Existing plant New plant	Existing plant New plant	Oil and gas production
11 **Wastes**	Amalgam – sink waste interceptors	Fly ash	Wastes/tailings		Recycling

Note: While potential impacts are identified here, we determined (as set out below) that most of the potential impacts would not result in any costs or benefits.

In addition to the impacts on industry, we identified potential impacts on the federal, state and territory governments from establishing and implementing any reforms and reporting.

Articles that could affect specific industries

Having reviewed the Convention, we identified the potential impacts that may arise from ratification.

Key costs and benefits resulting from a reform of this kind arise from changes in government costs, changes in industry costs and wider resultant impacts, such as environmental and community benefits.

The potential impacts (both costs and benefits) that we investigated are summarised in Table A2 and considered in detail below.

As the impact of the Minamata Convention will depend on the numbers and types of future projects over a 20-year period, we encouraged stakeholders to consider best case, likely case and worst case scenarios for industries that are harder to predict. For each of the potential costs and benefits set out below, the table specifies (in square brackets) where the consultations revealed that no impact is expected to arise.

Table A2: Qualitative summary of potential cost and benefit impacts that were investigated, by stakeholder group

	Potential costs investigated	Potential benefits investigated
Australian Government	Some implementation costs identified. Reporting costs identified. Compulsory financial contributions under the Convention identified.	Qualitative benefit of seat at the negotiating table and environmental leadership identified.
State and territory governments	Some policy and/or regulation amendments identified. Potential implementation costs for existing facilities investigated. [No impact identified]	Qualitative benefit to industry by ensuring a nationally consistent approach identified.
Industry with air emissions	Potential costs investigated for some existing facilities that do not have emissions limit values. No cost identified for existing facilities due to broader Convention requirements. [No impact identified] Potential costs investigated for new or substantially modified facilities if emissions would not meet BAT/BEP guidance under the base case. [No impact identified]	Investigated potential reductions in mercury emitted. [No impact identified]
Dental sector	Potential operating/capital costs to align with Convention requirements investigated. [No impact identified]	Investigated potential reductions in mercury emitted. [No impact identified] Increased ease of imports and exports identified.
Public lighting	Changeover cost from HPMV lamps brought forward by two years (relative to the base case scenario).	Energy and emissions (CO_2e) savings identified. Qualitative benefit to industry of lower maintenance costs, lower failure rates and potential 'smart lighting' features such as dimming and remote fault notification identified.
Waste and recycling	Potential operating/capital costs to align with Convention requirements investigated. [No impact identified]	Potential reductions in mercury emitted investigated [No impact identified]
Oil and gas	Potential operating/capital costs to align with Convention requirements investigated. [No impact identified]	Potential reductions in mercury emitted investigated. [No impact identified]
Medical devices and pharmaceutical goods	Potential cost of reduced availability of mercury-containing devices / pharmaceutical goods to align with Article 4 of the Convention investigated. [No impact identified]	Potential reductions in mercury emitted investigated. [No impact identified]
Community		Health benefits arising from reduced mercury exposure identified.
Environment		Environmental benefits arising from reduced mercury exposure identified (qualitative).

BAT = best available techniques; BEP = best environmental practices.

In addition to the benefits listed above, several industry groups commented that ratification would provide certainty to industry and so support investment decisions. However, that benefit is not readily quantifiable.

Costs identified through consultations with stakeholders

Overview of impacts on industry

Australian jurisdictions have extensive legislative and policy mechanisms in place to protect the environment and human health from the harmful impacts of pollution and to improve environmental quality. There are well-established requirements for the assessment, approval and regulation of industrial facilities, including through licences or equivalent authorities that have conditions governing the conduct of the activity and the control of pollution. Regulators apply licence conditions to industrial facilities on a case-by-case basis, taking into account the individual circumstances and the requirements in legislation, regulations and policies. Depending on the legislation, licence conditions can include pollution emission controls, requirements for plant and equipment, pollution reduction plans, operational improvement plans and pollution monitoring.

The improved management of pollution over time and the application of best industrial practice to facilities lie behind many aspects of state and territory environmental protection legislation and the way it is applied in practice.

Industries with air emissions

Article 8 of the Convention concerns the control and, where feasible, reduction of mercury and mercury compound emissions to the atmosphere from sources listed in Annex D. Those sources are coal-fired power plants and coal-fired industrial boilers; smelting and roasting processes used in the production of non-ferrous metals; waste incineration facilities; and cement clinker production.

For **existing facilities**, the Convention takes a flexible approach by requiring a Party, within 10 years of ratifying the Convention, to implement one or more control measures 'taking into account its national circumstances, and the economic and technical feasibility and affordability of the measures'. In summary, those measures are:

- a quantified emissions goal
- emissions limit values
- the use of best available techniques (BAT) and best environmental practices (BEP)
- a multipollutant control strategy that would deliver co-benefits for mercury emissions control
- alternative measures to reduce emissions.

Following consultation with stakeholders, it was determined existing facilities in Australia would already meet the requirements of Article 8, such as through emissions limit values or multipollutant control strategies.

For **new facilities** (which include substantially modified existing facilities), a Party is required to apply BAT/BEP to control and, where feasible, reduce mercury emissions.

Non-ferrous metal smelting

For Annex D of the Convention, 'non-ferrous metals' refers to lead, zinc, copper and industrial gold.

Industry stakeholders generally agreed that ratification is likely to have no impact on existing facilities unless a change in emissions levels were to be imposed (which appears unlikely and is not included in this proposal by the department).

Based on advice from stakeholders, gold production is the only area in the non-ferrous metals sector likely to develop new facilities in the next 20 years. The Minerals Council of Australia indicated that a 'most likely' scenario would be 10 new gold projects (to produce gold doré, which includes processing, crushing and roasting). An 'optimistic' outlook was 20 new projects.

For lead, zinc and copper industry stakeholders, the optimistic scenario was that no facilities would close. A major upgrade of any facility would be dependent on the ore price rising.

Australia's ratification of the Convention would be unlikely to create additional impacts on new or substantially modified facilities. Following current trends for new industrial facilities in Australia, it is likely that regulatory authorities would require, and industry would expect, the use of BAT/BEP in new facilities whether or not Australia ratifies the Convention.

While each state and territory may set its own controls and policies on pollution levels, industrial air pollutants have been consistently targeted by state and territory environmental regulators due to their impacts on community and environmental health. In particular, acceptable limits of industrial air pollutants such as particulate matter (measured as PM 2.5 and PM 10), sulphur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO) and ozone (O_3) have consistently tightened over time, and emissions limits are generally set in line with BAT/BEP for new facilities.

This tightening of air emissions requirements is demonstrated by a recent upgrade of the Gidji gold-smelting facility north of Kalgoorlie that was developed in consultation with the Western Australian Government. The Gidji facility was once the largest single emitter of mercury in Australia, but, after an upgrade in 2017, the mercury emissions from the facility have been reduced to a very low level.

Based on the tightening of air emissions levels that has occurred in Australia over the past 20 years, requirements on new gold facilities are likely to align with BAT/BEP requirements under the base case due to controls on mercury and other industrial air pollutants.

Because it is expected that any new facilities built under the base case would meet BAT/BEP criteria and that ratification of the Convention would have no impact on existing facilities, we concluded that ratifying the Convention would have no impact on the non-ferrous metals industries, resulting in $0 costs and $0 benefits.

Cement clinker production

The Cement Industry Federation indicated that no new cement clinker production facilities are likely to be built in Australia in the next 20 years.

The federation indicated that ratification is likely to have minimal impact on existing facilities unless a change in emissions standards were to be imposed (which appears unlikely and is not included in this proposal by the department).

The federation noted that the definition of 'substantial modification' of existing facilities under Article 8 of the Convention would need to be clarified for industry to understand whether there are likely to be potential costs for current facilities. Under Article 8, 'new source' means any relevant source within a category listed in Annex D, the construction or substantial modification of which is commenced at least one year after the date of entry into force of the Convention for the Party concerned. 'Substantial modification' is able to be defined by a Party under Article 8(2)(d). During the implementation of the Convention, the Australian Government will consider this definition in consultation with relevant stakeholders, including state and territory governments.

While the definition of 'substantial modification' requires clarification, it appears likely that there would be no impact on existing facilities.

As it is expected that no new facilities will be built and the Convention would have no impact on existing facilities, we concluded that ratifying the Convention would have no impact on the cement clinker industry, resulting in $0 costs and $0 benefits.

Coal-fired power generation

The Australian Energy Council commented that 'if a reduction in mercury emissions to air was required from existing sources, such as through the installation of additional pollution control equipment, this would add substantial costs.' The council also highlighted the potential for costs to be incurred through multipollutant controls.

The Australian Energy Council also noted that a definition of 'substantial modification' under Article 8 of the Convention would be needed for industry to clarify whether there are likely to be potential costs for current facilities. Under Article 8, 'new source' means any relevant source within a category listed in Annex D, the construction or substantial modification of which is commenced at least one year after the date of entry into force of the Convention for the Party concerned. However, it appears likely that ratification of the Convention would have no impact on the regulation of existing facilities. As noted above, the Australian Government will set the definition of 'substantial modification' during the implementation of the Convention in consultation with relevant stakeholders, including state and territory governments.

The council indicated that no new coal-fired power stations or coal-fired industrial boilers were expected to be developed in Australia in the next 20 years. In addition, discussions with industry experts indicate that any interest in new coal-fired generation plants in the future is likely to be in new technology, such as high-efficiency, low-emissions (HELE) plants. As a new coal-fired generation plant using new HELE technology and burning Australian coal is likely to align with the Convention's BAT/BEP guidance, no additional cost for further pollution control would be required when investing in a new plant.

Because it is expected that any new facilities would be built in accordance with BAT/BEP guidance and the Convention would have no impact on existing facilities, we concluded that ratifying the Convention would have no impact on coal-fired power generators, resulting in $0 costs and $0 benefits.

Waste incineration

Incineration is a combustion process that uses rapid oxidation, excess air and high temperatures to produce conditions under which hazardous and toxic waste products are

thermally broken down and destroyed. Where waste contains mercury or traces of mercury, the incineration process releases mercury emissions.

Australia has not traditionally used waste incineration as a method for solid waste disposal. However, in the past decade a small number of waste-to-energy facilities (which may include incineration or other forms of energy capture) have gained environmental approvals. In addition, there have been some reviews of the policy and approvals required for waste-to-energy projects.

Both the Western Australian and Victorian environmental protection authorities have prepared guidance on the environmental criteria that would be used for waste-to-energy operations (WAEPA 2013, VEPA 2013).

From the authorities' advice, it appears that both Western Australia and Victoria already adopt best practice techniques in granting approvals. That view was confirmed in discussions with staff from the office of the Western Australian Environmental Protection Authority. Those discussions also suggested that similar advice and sources of information to the Convention's BAT/BEP guidance were used by the authority in approving the plants. For that reason, it is likely that any existing or new facilities already align with BAT/ BEP guidance, irrespective of whether Australia ratifies the Convention or not.

As legislative requirements for solid waste incineration have not been set for other jurisdictions, the Western Australian requirements are likely to be used as a starting point for other states. For that reason, we concluded that ratification would not impose any additional costs on new facilities.

Because it is expected that any existing facilities will have been constructed in line with BAT/BEP guidance, we concluded that ratifying the Convention would result in $0 costs and $0 benefits.

Dental sector

Under Option 2 (Australia ratifies the Convention), impacts to the dental industry would be driven by:

- any measures Australia chooses to undertake to facilitate the phase-down of amalgam, consistent with Article 4
- impacts on mercury for import and mercury products for export.

The Convention will potentially have some impacts on the international trade in mercury and mercury-added products; however, it appears that the impacts will be the same whether Australia ratifies the Convention or not. For that reason, potential Convention impacts on international trade do not affect the CBA and were not considered further.

Options to meet Article 4 measures

Under Article 4(3) of the Convention, Parties are required to undertake two or more specific measures (listed in Part II of Annex A) for phasing down the use of dental amalgam.

Australia is already compliant with at least two of those measures:

- Australia has updated its oral health plan (Health Council 2015) to cover 2015 to 2024 (aligning with measure (i)).
- Professional organisations and dental schools already educate and train dental professionals and students in the use of mercury-free dental restoration materials (aligning with measure (v)).

Given that Australia is already compliant with the requirement to meet two or more measures, no additional costs or benefits are expected to arise because of ratification under Option 2. This results in $0 costs and $0 benefits from ratifying the Convention.

Mercury-containing wastes and Article 11

We note that ratifying the Convention would mean that any mercury-containing wastes would need to be treated in line with Article 11. That requirement would potentially affect mercury-containing wastes such as wastes from sink interceptors, which are used by some dentists. However, previous reviews of sink interceptors, such as the Victorian Dentists for Cleaner Water Program (DCWP n.d.), indicated that the wastes are correctly disposed of and so would not be affected by the ratification of the Convention.

Mercury imports and exports

In 2014, the Australian Dental Industry Association indicated that there is only one Australian producer of dental amalgam: SDI Limited (ADIA 2014:7).

Some of the mercury used by SDI Limited for the production of dental amalgam is imported, and there was broader industry concern that imports of mercury for dental amalgam could be affected if Australia does not ratify the Convention. Under the base case, it remains unclear whether recycling could generate sufficient mercury to meet demand for dental amalgam in the absence of mercury imports.

In addition to supplying the Australian market, SDI Limited manufactures dental products for export, including mercury-based amalgam. In 2017, it was estimated that approximately 95% of its products were exported.

Australia's ability to import mercury for the continued manufacture of dental amalgam depends largely on decisions by other countries. The Convention does not restrict trade in mercury for dental amalgam (subject to consents being agreed between the trading entities). A range of stakeholders commented that imports and exports of mercury for accepted uses and accepted mercury-containing products are likely to be easier if Australia ratifies the Convention. However, that benefit is not easily quantified.

Lighting sector

Lighting import exemption

Article 4 of the Convention requires Parties to phase out the import, export and manufacture of mercury-added products specified in Part I of Annex A by the end of 2020, unless a Party has obtained an exemption under Article 6. Unless they are for a shorter period, exemptions will expire at the end of 2025 and may be extended only once, if agreed by the Conference of the Parties.

Public lighting will be affected by Article 4, as HPMV lamps will cease to be manufactured and exported by the end of 2020. Since we considered this issue in 2018 (Australian Government 2018), a number of countries have obtained exemptions for the manufacture, import and/or export of HPMVs, as summarised in Table A3.

Table A3: Exemptions sought for high-pressure mercury vapour lamps

Country	Category	Duration
Botswana	Import	2025
China	Import and export	2025
Ghana	Manufacture, import and export	2025
India	Manufacture, import and export	2025
Iran	Manufacture, import and export	2025
Lesotho	Import	2025
Madagascar	Import	2025
Thailand	Manufacture, import and export	2025
Swaziland	Import	2025

Source: UNEP (2020b).

From discussions with stakeholders, we concluded that distribution network service providers (DNSPs; the managers and operators of streetlights) are generally aware of the impact of the Minamata Convention on the availability of HPMV lamps. In addition, lighting suppliers noted that HPMV lamps are already becoming more difficult to source as other countries ratify the Convention.

We estimated the total number of HPMVs currently installed from data provided directly from the DNSPs. The number of HPMV streetlights installed in Australia is shown in Table A4 and Table A5. The CBA developed in 2017 assumed, on the basis of estimations by the industry, that there were a further 200,000 to 500,000 public lights installed in industrial and commercial premises. For the purposes of modelling, we applied an estimate of 400,000 public lights with an assumed wattage of 50 watts.

Table A4: Mercury vapour streetlight stocks, by state, 2017, 2020 and 2021

	Estimated number of mercury vapor lights		
State/territory	**2017**	**2020**	**2021**
Queensland	248,798	220,000	176,000
Western Australia	158,068	146,813	146,813
Victoria	153,909	71,189	66,469
New South Wales	219,439	111,445	44,745
Tasmania	25,830	23,416	23,416
Northern Territory	6,812	6,175	6,175
Australian Capital Territory	6,696	3,003	3,003

Table A5: Mercury vapour light stocks, Australia, 2017 and 2020

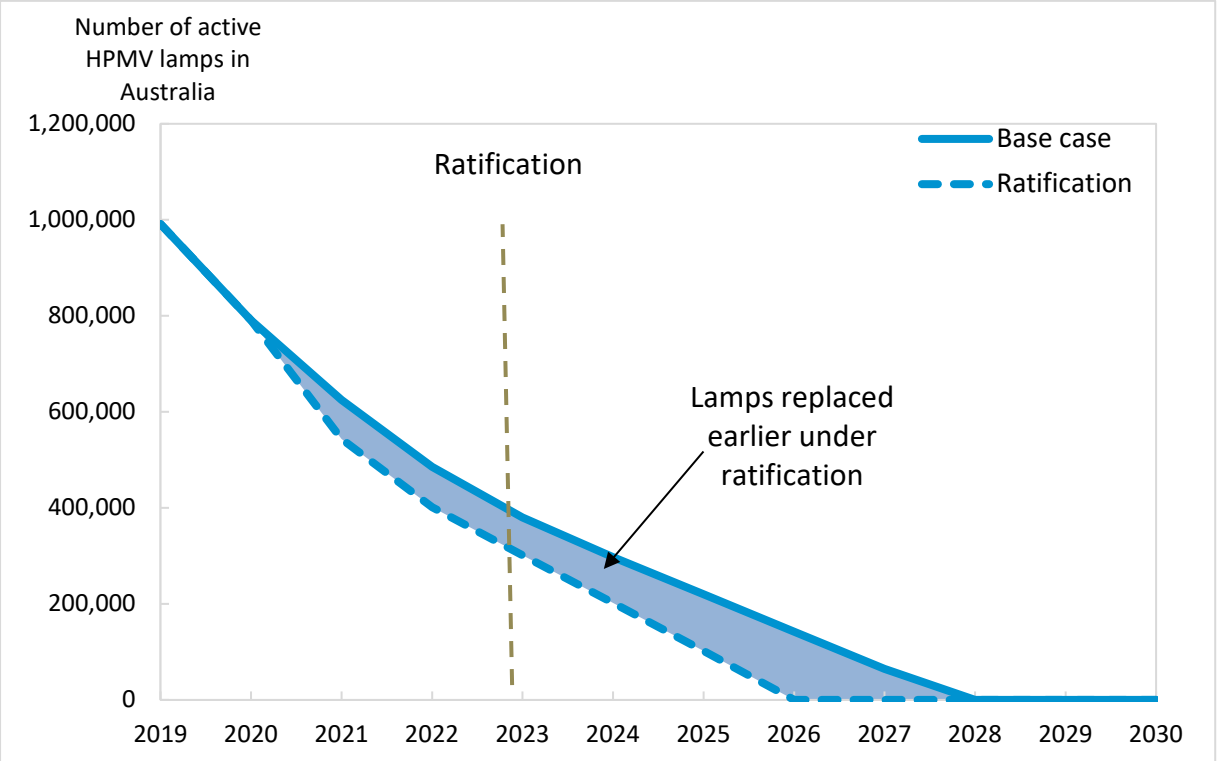
Type of light	Type of HPMV lamps	Number of HPMV lamps (2017)	Number of HPMV lamps (2020)	Proportion of HPMV lights (2020)
Industrial and commercial sites	50 W	400,000	168,750	21.3%
P4/5 Residential roads	80 W	783,382	577,897	73.1%
P3 Intermediate roads	125 W	78,877	38,116	4.8%
V3 Low-traffic main roads	250 W	33,177	5,099	0.6%
V1 Medium-traffic main roads	400 W	14,438	497	0.1%
V1 High-speed, high-traffic main roads	700 W	714	249	0.0%

The reduction in HPMV lights since 2017 is based on real numbers provided through consultation and best estimates:

- The Lighting Council Australia indicated that there was about a 25% reduction year on year in both Australia and New Zealand in the use of HPMV lamps in public lighting, such as at commercial premises and sporting fields.
- Next Energy commented that, while some states had made significant progress in switching out HPMVs in favour of LEDs, Western Australia and Queensland had fallen behind in the changeover.
- HPMV streetlight figures, current and expected as of July 2021, were provided by a number of DNSPs across the country. The phase-down of HPMV lamps for other DNSPs has been modelled by applying similar phase-down proportions to other networks in the relevant state.

The expected phase-down of HMPV lights under the two options is shown in Figure A2.

Figure A2: Estimated phase-out of HPMV lamps under the base case and the ratification option, 2019 to 2030



Replacement assets

LEDs are the most common replacement for HPMV streetlights. For other forms of public lighting, a range of high-pressure sodium, metal halide and LED filament lamps are direct replacements for HPMV lamps and can be operated on the same control gear (which would ease the transition away from HPMV lamps). The replacement asset, energy savings and cost of replacement of HPMV lamps are shown in Table A6.

Table A6: Replacement asset, energy savings and changeover costs for HPMV lamps

Type of light	Type of HPMV lamps	Average LED wattage of replace-ment (W)	Energy savings (Kw)	Energy savings (2020 $)	Changeover cost (2020 $)[1]
Industrial and commercial sites	50 W	18.5	205.62	23.01	$400
P4/5 Residential roads	80 W	18.5	317.60	35.54	$400
P3 Intermediate roads	125 W	41	353.73	39.59	$450
V3 Low-traffic main roads	250 W	86	524.09	58.65	$750
V1 Medium-traffic main roads	400 W	147	1065.03	119.19	$750
V1 High-speed, high-traffic main roads	700 W	237	1684.55	188.52	$ 900

Note: 1. Pers. comm., Graham Mawer, Next Energy, 13 August 2020.

Therefore, the cost incurred by the lighting sector if Australia ratifies the Minamata Convention is the bringing-forward of capital expenditure required to change over the existing stock of HPMV lamps. As shown in Table A4, some stakeholders are rapidly changing over their stocks, particularly in NSW and Victoria. However, the market may be changing more rapidly than

some of the stakeholders realise. It appears that some are still uncertain about the defined way forward, without a clear policy to modify their replacement programs or base lighting stocks.

Waste and recycling

Article 11 of the Minamata Convention ('Mercury wastes') covers mercury waste management, recovery, recycling, reclamation and re-use.

Under paragraph 3(a) of Article 11, Parties are required to take appropriate measures so that mercury waste is managed in a sound manner, taking into consideration guidelines developed under the Basel Convention (to which Australia is already a Party). At the international level, the Conference of Parties to the Minamata Convention will cooperate with the Basel Convention.

Australia's compliance with the Basel Convention means that any incremental impacts arising from Australia's ratification of the Minamata Convention are likely to be minimal.

Waste sector operators raised concerns about the way that the Minamata and Basel Conventions will interact. Under the Minamata Convention, separate processes for transporting waste need to be established for countries that have ratified the Minamata Convention but not the Basel Convention. However, the only country currently in that position is the United States.

Another concern raised was whether the Minamata Convention and associated Basel Convention technical guidelines will limit re-use options for wastes containing or contaminated with mercury, such as coal fly ash.

While a small number of potential concerns were identified, Article 11 appears unlikely to have an impact on Australian waste management, given that Australia already has waste management legislation and processes in each state and territory and a number of licensed facilities that treat mercury waste. For that reason, no additional costs or benefits are expected to arise because of ratification under Option 2. This results in $0 costs and $0 benefits from ratifying the Convention.

Oil and gas production

While oil and gas production is not specifically mentioned in the Minamata Convention, those sectors are potentially affected by Article 9 ('Releases'), which focuses on controlling land and water releases of mercury. Under Article 9, a Party is required to take measures to control mercury releases from 'significant anthropogenic point sources'. Those measures are to include one or more of the following, as appropriate:

- release limit values to control and, where feasible, reduce releases from relevant sources
- the use of BAT/BEP to control releases from relevant sources
- a multipollutant control strategy that would deliver co-benefits for the control of mercury releases
- alternative measures to reduce releases from relevant sources.

A variety of pollution control measures are applied in oil and gas production, depending on the jurisdiction. In Commonwealth waters and state waters where the state has conferred powers on the National Offshore Petroleum Safety and Environmental Management Authority, pollution is managed through environmental plans under the Offshore Petroleum and Greenhouse Gas

Storage (Environment) Regulations 2009. Onshore oil and gas production is managed under the relevant state environmental legislation.

Pollution control measures include measures specified in project environmental plans, conditions on environmental authorities and adherence to the ANZECC Water Quality Guidelines. In many operations, mercury is captured during processing and sent to treatment facilities. Mercury waste treatment facilities that treat mercury captured in oil and gas production have recently opened in Karratha and Kwinana in Western Australia.

Article 9 relates to significant anthropogenic point sources of releases, and Parties are required to identify those sources within three years of the date of entry to the Convention. Article 9 also applies to 'substantial modification' of a source of releases and allows 'substantial modification' to be defined by a Party. As the oil and gas industry is already subject to environmental regulation, it is unlikely that those actions would result in additional regulation and costs to the industry should Australia ratify the Convention.

During the implementation of the Convention, the Australian Government would set the definition of 'substantial modification' in consultation with relevant stakeholders, including state and territory governments.

Article 9 does not stipulate that new sources must comply with BAT/BEP (unlike Article 8 in relation to emissions to air). The use of BAT/BEP is one of a range of control measures that may be adopted by a Party. While Article 9 requires the Conference of the Parties to adopt BAT/BEP guidance for controlling releases to land and water 'taking into account any differences between new and existing sources', that guidance has not yet been adopted and its timing is uncertain. Therefore, any potential future requirements for the use of BAT/BEP are unknown and beyond the scope of this CBA.

We note that the legislation covering petroleum activities in Commonwealth waters sets a requirement that all risks be managed to be 'as low as reasonably practicable' (ALARP) and that some proponents appear to state that they are managing risks that are reduced to ALARP where they are using BAT (see Woodside 2014:55).

Under Article 9, a Party must establish and maintain an inventory of releases within five years of becoming a Party. The oil and gas industry already reports on mercury releases through the National Pollutant Inventory.

Based on currently available information, no additional costs or benefits are expected to arise for the oil and gas sector under Option 2 (ratification). This results in $0 costs and $0 benefits from ratifying the Convention.

Medical devices and pharmaceutical goods

The Therapeutic Goods Administration identified some medical devices and one brand of pharmaceutical goods that could be affected by Article 4 of the Convention (which covers specified types of mercury-containing products).

The potentially affected devices are mercury-containing thermometers and sphygmomanometers (which are used to measure arterial blood pressure). Using information drawn from the Australian Register of Therapeutic Goods, we contacted 10 sponsors of these imported devices who potentially might be affected by ratification.

Two medical device suppliers responded and, while they had little knowledge of the Minamata Convention, they both indicated that they would not be affected. They commented that most medical devices containing mercury have already been superseded by non-mercury-containing devices. While the response rate was low, multiple attempts were made to reach other sponsors, so it appears that the ratification of the Convention is not a concern for this industry segment.

We also contacted the supplier of the mercury-containing topical antiseptic, Gold Cross Mercurochrome (merbromin), in Australia. They indicated that they 'have plans in place to discontinue Gold Cross Mercurochrome 2%'. This is consistent with the actions of many other countries, such as the United States, Switzerland, France, Germany and Brazil, that have already phased out the sale of merbromin due to its mercury content.

Based on the responses provided, no additional costs or benefits are expected to arise for the medical devices and pharmaceutical goods sector under Option 2 (ratification). This results in $0 costs and $0 benefits from ratifying the Convention.

Government costs

The federal, state and territory governments all play roles in Australia's regulation of mercury use and pollution. Currently, most responsibility for the management of mercury resides with state and territory governments. State and territory legislation applies to industrial activities and manufacturing with potential mercury emissions or releases; mining for mercury or the use of mercury in processing; the storage of mercury; and the management of mercury wastes and contaminated sites. The Australian Government shares some responsibility for the management of mercury wastes under the Basel Convention (to which Australia is a Party). It is also responsible for the management of mercury-related activities on areas under federal jurisdiction.

The Australian Government would have overall responsibility for meeting international obligations under the Minamata Convention and for the reporting and administration required under the Convention. It is directly responsible for meeting obligations associated with international trade in mercury and mercury-added products.

Based on discussions with agencies in all jurisdictions, we consider that current federal, state and territory legislative frameworks will be sufficient to satisfy the Convention's obligations. The making or amendment of some legislative instruments, policies, and administrative actions (such as the application of licence conditions) may be required to fully give effect to the Convention's obligations. The department continues to engage with other jurisdictions on the detail of these actions.

The main government costs associated with ratification fall to the Australian Government. Those costs are attributed to the financial contribution associated with being a Party to the Convention and to the allocation of four ongoing full-time equivalent staff within the Australian Government to manage the administration of Australia's obligations, including:

- the ratification and maintenance of the Convention
- developing a general notification process for mercury imports
- monitoring and reporting

- ongoing liaison and coordination with federal, state and territory government agencies on the implementation of the Convention
- managing international activities, such as reporting to the Conference of the Parties to the Convention, information exchange and monitoring data
- evaluating effectiveness.

Those costs are detailed in Table A7.

Table A7: Summary of impacts on government

Activity	Estimated annual cost (2020 $)	Notes on estimation and references in the 2018 CBA
Article 13 – Financial contributions	$125,000	Australia's contribution is estimated to be a biannual (once every two years) payment of US$175,000.
Department of Agriculture, Water and the Environment budget	$260,000	Two full-time equivalent (FTE) staff for the department to cover set-up costs, such as ratification costs, and ongoing costs, such as the costs of administration and reporting for the Convention.
Permitting, audit and enforcement of imports and exports; administration; and data collection	$260,000	Two FTE staff for the Australian Government. The Australian Government currently monitors imports for a broad range of other hazardous chemicals, such as asbestos-containing materials and chemicals banned under the Stockholm Convention. Within this framework, it has been proposed that the ratification of the Minamata Convention would add a small additional cost. It is estimated that two additional staff would be needed to undertake the permitting of mercury imports and exports and to oversee the audit and enforcement of restrictions on mercury trading.
State and territory governments	$259,000	Based on eight jurisdictions each requiring 0.25FTE staff. Some policy and/or regulation amendments required to implement Convention obligations within existing legislative frameworks.
Total	**$904,000**	

It should be noted that the estimate of two FTEs for permitting, audit and enforcement (including administration and data collection) within the Australian Government is based on a 2018 CBA and consultation. That estimate has not been updated and is included as the current best estimate. It is not clear that the relevant budgets would be increased by two staff. If the organisational budget is not increased, then this increase in workload represents an opportunity cost, as it would divert staff away from other tasks.

Benefits

Australia's ratification of the Minamata Convention can be expected to result in benefits to human health, workplace safety, the environment and energy consumption, as well as some qualitative and reputational benefits for Australia. Some of those benefits could be achieved under Australia's current arrangements, but would be broadened and deepened by ratification.

Health benefits of phasing down mercury

Health effects of mercury

Mercury exposure has been associated with a range of health effects, including neurological effects, effects on the kidneys and cardiovascular effects (USEPA 2011). Ingestion of methylmercury from eating seafood and freshwater fish is a major source of human health effects due to mercury contamination.

In estimating the value of mercury's impacts on human health, the CBA that was published with the exposure draft RIS in December 2016 focused on the impact of mercury on cognitive development, expressed as the loss of intelligence quotient (IQ) points (see sections 6.4.2 to 6.4.4 of the December 2016 CBA; Australian Government 2016). That has remained our central estimate of the value of mercury's impacts on health in Australia. In addition, we considered new research on the impact of mercury on acute myocardial infarctions (heart attacks) and the possible impact on the CBA results of introducing a delay between the release of mercury and the development of health impacts.

Evidence of effects on cognitive development

The most studied health effects of mercury are its impacts on cognitive development in children, particularly loss of IQ, and developmental effects. The effects of mercury on the developing brain are like those observed for lead exposure. Loss of IQ, impacts on motor activities and attention disorders are the most commonly observed outcomes associated with biomarkers of mercury exposure, such as blood mercury and hair mercury. Therefore, loss of IQ is commonly used as the basis of health risk assessments for mercury and associated CBAs.

Three longitudinal developmental studies on mercury and IQ have been conducted, in Seychelles, the Faroe Islands and New Zealand:

- The subjects of the Seychelles longitudinal prospective study were 779 mother–infant pairs from a fish-eating population (Myers et al. 1995abc; Davidson et al. 1995, 1998). Infants were followed from birth to 5.5 years of age and assessed at various ages on a number of standardised neuropsychological endpoints. The independent variable was maternal hair mercury levels.

- The Faroe Islands study was a longitudinal study of about 900 mother–infant pairs (Grandjean 1997). The main independent variable was cord-blood mercury, although maternal hair mercury was also measured. At 7 years of age, children were tested on a variety of tasks designed to assess functioning in specific behavioural domains.
- The New Zealand study was a prospective study in which 38 children of mothers with hair mercury levels during pregnancy greater than 6 parts per million (ppm) were matched with children whose mothers had lower hair mercury levels (Kjellstrom et al. 1986, 1989). At 6 years of age, a total of 237 children were assessed on a number of neuropsychological endpoints similar to those used in the Seychelles study.

Health effects in other cost–benefit analyses

In all those CBAs, the health outcome used as the basis of the health risk assessment was loss of IQ in children. All the health risk assessments used dose–response relationships that relate loss of IQ in children with maternal blood or hair mercury levels or cord-blood mercury levels. The dose–response relationship varied among the studies.

The dose–response relationship used by a 2011 US Environmental Protection Authority (EPA) study was derived using data from the Faroe Islands, Seychelles and New Zealand cohort studies (USEPA 2011). The resulting dose–response relationship is a loss of 0.18 IQ points/ppm maternal hair mercury per child. What this means is that for each child there is a loss of IQ associated with a 1 ppm increase in mercury levels in its mother's hair. It is assumed that no adverse effects are observed at maternal blood mercury levels below 3.5 micrograms (μg) per litre.

A study conducted by Trasande et al. (2006) derived dose–response relationships from the Faroe Islands and Seychelles studies only and consequently obtained results higher than those derived by the US EPA. The dose–response relationship used in the Trasande study suggests a loss of 0.465 IQ points/ppm maternal hair mercury and 0.093 IQ points/ppb (parts per billion) of mercury in cord blood. Those values are higher than those used in the US EPA study.

For this CBA, both sets of dose–response relationships were used. The US EPA study estimates were used for the core analysis, and the Trasande study values were used in a sensitivity analysis to give an upper bound for the potential impact.

Mercury levels in the Australian population

The only available Australian data on maternal blood mercury levels is from a study conducted in Perth and the south-west of Western Australia (Hinwood et al. 2013). That study found that mean maternal blood mercury levels were 0.83 μg/L; the highest value was 5.8 μg/L.

The US EPA has determined that the conversion of maternal blood mercury to maternal hair mercury occurs at a ratio of 1:250. Converting the maternal blood mercury levels in the Western Australian cohort to maternal hair mercury results in concentrations of 0.21 ppm (mean) and 1.5 ppm (maximum).

The Western Australian study found that 5% of women in the cohort had blood mercury levels above the no-effects level of 3.5 μg/L. The blood mercury was attributed to the consumption of fish and seafood. Those findings are consistent with other studies conducted overseas.

If the Western Australian results are applicable to the general Australian population, the loss of IQ and associated economic costs due to mercury in Australia can be estimated. The Australian Total Diet Survey concluded that seafood is the major dietary contributor to mercury exposure in Australia (FSANZ 2013, 2019). As that is consistent with the findings of the Western Australian study, we extrapolated the blood and hair mercury levels found in the Western Australian study to the whole Australian population, as follows:

- There were 315,147 births in Australia in 2018 (ABS 2019).
- Assuming that 5% of women of childbearing age, as found in the Western Australian study, have blood mercury levels above the no-effects level of 3.5 μg/L, this translates to 15,757 children born in 2018 in Australia who may be affected by exposure to mercury.

We then used that calculation to estimate the loss of IQ and associated economic costs of mercury health impacts in Australia.

Calculation of IQ losses in Australia

To calculate the loss of IQ related to maternal hair mercury, the following equation was applied (consistent with the approach used in the US EPA study):

$$\textit{Loss of IQ per child} = \textit{dose–response} \times \textit{maternal hair mercury concentration}$$

Using this approach and applying Australian birthrates for 2018, we calculated the loss of IQ for four scenarios based on the US EPA study's dose–response relationship and the Trasande study's dose–response relationships for the mean and maximum hair mercury levels estimated from the Western Australian study, as follows:

1) US EPA dose–response relationship (loss of 0.18 IQ points/ppm maternal hair mercury per child) and *mean* hair mercury levels (0.21 ppm)
2) US EPA dose–response relationship and *maximum* hair mercury levels (1.5 ppm)
3) Trasande dose–response relationship (loss of 0.465 IQ points/ppm maternal hair mercury) and *mean* hair mercury levels (0.21 ppm)
4) Trasande dose–response relationship and *maximum* hair mercury levels (1.5 ppm).

Assuming a linear dose–response relationship above maternal blood mercury levels of 3.5 μg/L, the results of the risk calculations for the estimated number of affected children in 2018 in Australia are shown in Table A8. Essentially, the table outlines the current expected annual loss of IQ points for Australia, given the current mercury levels in the population.

Table A8: Annual loss of IQ points in the Australian population due to maternal exposure to mercury

Scenario	Loss of IQ points
1. US EPA dose–response relationship and *mean* hair mercury levels	596
2. US EPA dose–response relationship and *maximum* hair mercury levels	4,254
3. Trasande dose–response relationship and *mean* hair mercury levels	1,539
4. Trasande dose–response relationship and *maximum* hair mercury levels	10,991

Source: Analysis by Toxikos Pty Ltd prepared for the 2015 CBA, updated for current population.

Valuation of loss of IQ

The loss of IQ in children has been valued as part of previous analyses of the impacts of mercury and other heavy metals.

In 2008, Spadaro and Rabl identified five estimates ranging from US$11,245 to US$22,300 per IQ point, all in 1999 or 2000 US$:

- US$11,245 (Griffiths et al. 2007)
- US$14,500 (Grosse et al. 2002)
- US$15,000 (Muir & Zegarac 2001)
- US$16,500 (Rice & Hammitt 2005)
- US$22,300 (Trasande et al. 2005).

Spadaro and Rabl concluded that US$18,000 per IQ point was a suitable value (Spadaro & Rabl 2008). Converting this to Australian dollars and applying the Consumer Price Index to obtain a 2020 A$ value gives a total of $31,633 per IQ point lost. This value is for the United States and so cannot be applied to Australia without further consideration.

Estimation of the value of IQ loss caused by mercury

Based on the value per IQ point lost and developing a dose–response formula, Spadaro and Rabl provided a 2008 estimate of the value of the harm caused by mercury of US$4,380 per kilogram of mercury released to the environment in the United States and a global estimate of US$1,500 per kilogram, assuming a threshold above which mercury levels have an impact on the child's IQ.

Table A9: Spadaro and Rabl's estimate of harm caused per kilogram of mercury released into the environment (2008 US$/kg)

	United States	Global average
With threshold	$4,380	$1,500
Without threshold	$9,993	$3,400

Source Spadaro & Rabl (2008).

Spadaro and Rabl also proposed a formula for identifying the likely cost in other countries (referred to as 'benefit transfer').

The United States costs based on the IQ decrement are adjusted to other countries using the gross domestic product (GDP) per capita expressed as purchasing power parity (PPP) as a weighting factor:

$$C_i = C_{USA} \quad \frac{(GDPppp / capita)_i}{(GDPppp / capita)_{USA}}$$

where C_i is a damage cost in a specific country and C_{USA} is the damage cost in the United States.

Using that formula, the value of mercury costs in Australia is A$5,273 per kilogram (2020 A$, see Table A10).

Table A10: Australian estimate of harm caused per kilogram of mercury (benefit transfer)

	US$ (2008)	A$ (2020)
With threshold	$2,028	$5,273
Without threshold	$4,598	$12,031

Source: Marsden Jacob analysis.

Incorporating cardiovascular effects

Assessments of the health benefits of phasing down mercury have focused primarily on the loss of IQ in infants, which is associated with the exposure of pregnant women to mercury. Mercury exposure has also been associated with a range of other health effects, including effects on kidneys and cardiovascular effects. Due to a lack of reliable dose–response relationships, those other effects have not been included in the central analysis. However, recent research (particularly by Giang and Selin in 2016) indicates that it is feasible to quantify, in economic terms, the cardiovascular effects of mercury exposure. Based on the algorithms applied by Giang and Selin for the United States, an analysis of the annual effects of mercury exposure in Australia on fatal acute myocardial infarctions (heart attacks) yielded a preliminary estimate of about 400–500 deaths per year, or about 2% of all premature deaths due to coronary heart disease in Australia. That has an estimated cost of about $1.3 billion per year.

To reliably calculate the impacts of phasing down mercury on avoided acute myocardial infarctions, there needs to be a reasonable estimate of the relationship between changes in emissions and changes in exposure. That data is not available for Australia. Instead, we have drawn on data in Giang and Selin's paper to provide an indicative estimate of avoided cardiovascular health impacts in Australia from reducing mercury emissions.

A key difference in the assumptions we have applied in our analysis from those applied by Giang and Selin is that, whereas they have assumed a risk factor in all adults for acute coronary events per milligram of hair mercury concentration of 0.1 (based on equal risk for males and females), we have assumed a risk factor of only 0.05. This is consistent with the literature, which shows little or no correlation between mercury exposure and cardiovascular disease in females.

Our analysis produced an approximate 9:1 ratio of avoided cardiovascular health effects from reducing mercury emissions to avoided IQ health effects.

Incorporating an exposure time lag

In our analysis, we assumed that there is no time lag between reductions in mercury emissions and releases and reductions in human exposure. There is some debate as to whether that is an appropriate approach, as in real-world ecosystem dynamics the delay in responses of ecosystems to changes in mercury inputs can range from a few months to decades. Some analysts suggest that, because of that uncertainty, time lags that account for ecosystem and ocean response timescales need to be incorporated into any analysis of the benefits and avoided costs of reducing mercury emissions, releases and exposure (Giang & Selin 2016).

Introducing time lags raises more questions than it resolves from an economic and policy perspective, particularly in relation to intergenerational impacts and the appropriate use of discount rates and analysis time frames. For example, the approach of the US EPA is generally not to introduce time lags (OECDWP 2017).

Nevertheless, consistent with the approach adopted by Giang and Selin, we adopted a 10-year exposure time lag in our sensitivity analysis when estimating both IQ and cardiovascular health benefits for Australia. We assumed the achievement of a full response to a change in emissions and deposition only after the lag time and a linear increase in response throughout the lag period.

Conclusion on health benefits

Human exposure to mercury in Australia occurs primarily through the ingestion of seafood and freshwater fish containing methylmercury. Although anthropogenic emissions of mercury tend not to be bioavailable, all forms of mercury can be transformed into methylmercury through aquatic processes.

While mercury exposure has been associated with a range of health effects, including neurological effects, effects on the kidneys and cardiovascular effects, the loss of IQ in the population resulting from methylmercury intake by pregnant women is of primary concern, as there is a direct impact on the developing foetus *in utero*.

As discussed in this analysis, previous studies have developed a benefit transfer methodology that, when applied to Australia, estimated the likely impact of mercury emissions on IQ loss at $5,273 per kilogram of mercury.

Based on the 9:1 ratio discussed above, we estimated the impact of mercury emissions on heart attacks in Australia to be $23,730 per kilogram of mercury.

As has been discussed in this RIS, domestic reductions of mercury emissions will be low to none; benefits will instead accrue over a longer period as, for example, mercury-containing products are no longer being imported and finding their way into Australia's waste streams.

By contributing to the long-term success of the Minamata Convention in protecting human health and the environment from anthropogenic emissions and releases of mercury, there will also be an added benefit of safeguarding Australians against future international increases in emissions and releases.

Workplace safety benefits

Ratification appears likely to reduce the exposure of some workers to mercury, such as by reducing the use of mercury vapour lamps. In contrast, there would potentially be a small increase in the number of workers employed in mercury disposal and mercury recycling.

As a basis for estimating costs and benefits, we used data from the National Data Set for Compensation-Based Statistics on incidences of compensation paid that relate to 'mercury and mercury compounds'.

Over the period from 2003–04 to 2017–18, the total number of accepted claims was 40 and the total compensation paid was $158,700. Over the 15-year period, that equated to an average of 2.7 claims per year and an average annual value of compensation paid of $10,580.

The frequency of claims and average compensation have fallen in comparison with the previous reported period. Over the period from 2000–01 to 2011–12, the total number of accepted claims was 59 and the total compensation paid was $687,167. Over the 11-year period, that

equated to an average of 5.3 claims per year and an average value of compensation paid of $57,264.

Using the same multipliers applied in the CBA for the 2016 exposure draft RIS (Australian Government 2016), the average total value of workplace injuries and illnesses relating to mercury and mercury compounds is $105,800 per year.

It is reasonable to assume that under the base case there would be some reduction in workplace incidents as imported mercury products are phased out. Australia's ratification of the Convention could reduce those incidents further, but the extent of that reduction is not easily determined. We have assumed that a 30% reduction in workplace incidents could be attributable to ratifying the Convention, leading to a reduction in workers compensation claims with a net present value (NPV) of $262,568 (2020 $). These calculations assume that the benefit would commence in 2024, given that the timing of the reduction of exposure would vary among industries.

We conducted further sensitivity testing by applying a lower (10%) and higher (60%) reduction in incidences attributable to ratifying the Convention. Given the low number of claims, the impact on the CBA is marginal, as shown in Table A11.

Table A11: Reduction in work incidents involving mercury

Scenario	Percentage reduction in incidents	Annual benefit (commencing 2019)	Present value (2020–2040, 4% discount rate)
Low	10%	$10,580	$117,483
Medium	30%	$31,740	$352,448
High	60%	$63,480	$704,896

7.2.1 Disposal of mercury vapour lamps

In the CBA, we assumed that all mercury vapour lamps would be either recycled or disposed of to appropriate landfills. Based on that assumption, we did not include any health benefits from the phasing-out of mercury-containing lamps.

Environmental benefits

In Australia, there is a paucity of data on environmental levels of mercury. This restricts a comprehensive quantitative analysis of the likely environmental benefits arising from a national phase-down of mercury and Australia's ratification of the Convention. With the exception of carbon and energy savings from the adoption of more energy-efficient (non-mercury-containing) lighting, environmental benefits are discussed only qualitatively here. The quantitative results of this CBA should be viewed in that light.

Marine ecosystems are increasingly subject to a wide range of pressures, including overexploitation, ocean acidification, climate change, invasive species and pollution (Worm et al. 2005). The relative longevity of marine mammals, coupled with their predator positions in food chains, results in a higher likelihood of the bioaccumulation of contaminants such as mercury (Das et al. 2003). Mercury is of particular concern because it is highly toxic and has detrimental health effects in mammals, including neurological disorders, suppression of the immune system and reproductive disorders that can all lead to death (Monk et al. 2014). Mercury contamination

in coastal waters represents a potential major health risk to marine mammal populations (Monk et al. 2014).

Street lighting benefits

The approach that we used to quantify benefits from accelerating the phase-down of HPMV streetlights is explained in this section.

7.2.2 Energy consumption savings

Assuming that streetlights across Australia are active for an average of 11 hours per day (the average number of dark hours) and that the cost of supply for electricity to streetlights remains consistent with current tariff rates:

- 186,116 MW of electricity would be saved between 2020 and 2030
- those energy savings would be valued at $17.3 million (NPV at 4% discount rate).

7.2.3 Greenhouse gas emissions

Our analysis of the value of emissions reductions resulting from the early replacement of mercury vapour streetlights with more efficient non-mercury-containing alternatives indicates that early replacement could result in greenhouse gas savings of approximately 140,295 tonnes of carbon dioxide equivalent (tCO_2-e). This analysis is based on the nominal cost of carbon set by the Australian Treasury in 2011 at $29/tCO2-e ($38/tCO2-e in 2020 $), reflecting a medium-term abatement cost.

7.2.4 Qualitative street lighting benefits

Replacing street lighting with more advanced technology will have a number of further benefits, which we have identified qualitatively.

'Smart' street lighting has lower maintenance costs and lower failure rates. Other 'smart lighting' features, such as dimming and remote fault notification, can further improve safety and energy usage.

Since lighting technology is continuously evolving and the 'smart' function of replaced assets will be variable, we have conservatively excluded those benefits from our analysis. We expect the net impact to be minimal, but worth noting.

7.2.5 Disposal of mercury vapour lamps

In the CBA, we assumed that all mercury vapour lamps would be either recycled or disposed of to appropriate landfills. Based on that assumption, we did not include any health benefits from the phasing-out of mercury-containing lamps.

Qualitative benefits of international engagement

A range of qualitative benefits (that are not readily quantifiable) have been identified for Australia's ratification of the Convention (Option 2).

Chemical pollution and wastes move across national borders, so global cooperation is necessary to protect the health of Australians and our environment. Multilateral environmental

agreements such as the Minamata Convention on Mercury encourage best practice environmental protection, increase understanding of shared issues, reduce transboundary pollution impacts, and align trade requirements to decrease regulatory burden and further build Australia's reputation as a responsible trading partner. Effective engagement with the Minamata Convention would help to optimise environmental, social and economic outcomes for Australia, improve access to international markets and create opportunities for Australian industry and business to take advantage of global prospects.

Multilateral institutions (such as the UN Environment Programme and World Trade Organization), particular UN specialised agencies and other international standards-setting bodies deliver outcomes that are vital to global prosperity, stability and our shared interests. When working as they should, multilateral institutions underpin global rules and norms and ensure a level playing field. They regulate international cooperation in key sectors, including civil aviation, maritime transport, intellectual property, telecommunications and agriculture, among others, and promote universal values, such as human rights. Multilateral institutions also play critical roles in responding to emerging global challenges, as we have seen recently with the global health pandemic and the role of the World Health Organization.

Further, the Australian Government's *2017 Foreign Policy White Paper* sets out a comprehensive framework to address challenges in the increasingly unpredictable and shifting global climate. It identifies 'an environment under strain' as one of the main contributors to the contested nature of the contemporary world (Australian Government 2017). Climate change, environmental degradation and the scarcity of natural resources are acknowledged as political, economic and security disrupters that could have significant implications for long-term peace and stability (particularly in our immediate region).

The White Paper stresses that multilateral environmental challenges, such as those being addressed through the Minamata Convention, will continue to shape our world, demanding shared, global policy responses.

Being engaged in the international community through multilateral forums such as the Minamata Convention also ensures that the Australian Government is kept up to date on key scientific developments and emerging issues. This type of engagement fosters frank and genuine exchanges of knowledge and experience as we seek to tackle 'wicked' problems as a part of the global community.

Global cooperation is now more important than ever as the world seeks to respond to the health and economic consequences of COVID-19. To support the multilateral system at this time, Australia has adopted a multilateral engagement strategy, recognising that our shared, global interests are not served by isolation and protectionism.

Results of the cost–benefit analysis

The full list of cost and benefit estimates by each stakeholder is set out in Table A12. The table uses the same format as used in Table A2 to allow direct comparisons. Note that, based on consultation on the identified potential impacts, most of the potential impacts will result in zero cost and zero benefit.

Table A12: Quantitative summary of cost and benefit impacts that were identified

	Costs	Benefits
Australian Government	Estimated cost of $645,000 per year for the life of the analysis. This includes financial contributions, staffing and border permitting/registration.	Qualitative benefit of seat at the negotiating table and environmental leadership
State and territory governments	Estimated cost of $259,000 in 2021. Based on 8 jurisdictions each requiring 0.25FTE staff.	Qualitative benefit to industry by ensuring a nationally consistent approach
Industry with air emissions	$0	$0
Dental sector	$0	Qualitative benefits in increased ease of imports and exports.
Public lighting	Brings forward capital expenditure that would occur anyway Estimated present value of $7,498,747	Brings energy savings earlier. Estimated present value of $17,319,517. Brings emissions (CO2e) savings earlier. Estimated present value of $4,438,706. Qualitative benefits of lower maintenance costs, lower failure rates and potential 'smart lighting' features such as dimming and remote fault notification.
Waste and recycling	$0	$0
Oil and gas	$0	$0
Medical devices and pharmaceutical goods	$0	$0
Community	None identified	Reduced Health & Safety Costs. Estimated present value of $352,000
Environment	None identified	$0 (not quantified)

Note: Present values are show based on 20 year analysis and a 4% discount rate.

In order to compare the costs and benefits with different timings, we considered the NPV over a 20-year period and applied a discount rate to costs and benefits that appear after the initial year (Table A13).

Table A13: Cost–benefit analysis results

Stakeholder		2% discount rate	4% discount rate	7% discount rate
Costs				
Australian Government	Compulsory financial contributions to the secretariat of the Convention	$1,950,227	$1,633,717	$1,285,634
	Department of Agriculture, Water and the Environment – staffing	$4,062,973	$3,403,577	$2,678,404
	Border permitting / registration / administration and data collection	$4,062,973	$3,403,577	$2,678,404
State and territory governments	Some policy and/or regulation amendments	$254,062	$249,177	$242,190
Industry	Modifications to existing and new plant to reduce air emissions	$0	$0	$0
	Dental sector	$0	$0	$0
	Public lighting (to replace HPMV lamps two years early)	$4,136,002	$7,498,747	$11,394,350
	Oil and gas	$0	$0	$0
Benefits / avoided costs				
Health outcomes	Reduction in mercury emitted and released	$0	$0	$0
	Reduced health and safety costs	$435,321	$352,448	$262,368
Environmental outcomes	Carbon savings (public lighting)	$4,814,712	$4,438,706	$3,949,905
	Energy savings (public lighting)	$18,786,663	$17,319,517	$15,412,249
	Environmental benefits	Not quantified	Not quantified	Not quantified
Totals	Total costs	$14,466,238	$16,188,794	$18,278,981
	Total benefits	$24,036,696	$22,110,672	$19,624,522
	Net benefits	$9,570,457	$5,921,878	$1,345,541
	Benefit:cost ratio	1.7	1.4	1.1

The net benefit of the proposed ratification over a 20-year period is estimated to be over $5.9 million, using a discount rate of 4%. This would also result in a benefit:cost ratio of 1.4, which effectively means that the community would receive a return of $1.40 for every $1.00 invested.

Because the CBA results in a net benefit of around $5.9 million and a benefit:cost ratio of greater than 1, the analysis indicates that Option 2 (ratifying the Convention) is expected to deliver a net benefit to the Australian economy. Given both the quantitative and qualitative benefits, Option 2 is the preferred option and the Minamata Convention should be ratified.

Regulatory burden

Regulatory burden is another measure of the costs of proposed reforms on industry. We performed regulatory burden measurement (RBM) related to Australia's ratification of the Minamata Convention in line with Australian Government guidance (OPBR 2020). We focused

only on costs that fall to businesses (including government-owned corporations), community organisations and individuals.

The RBM values are provided as a simple average of costs to industry over the first 10-year period (2021 to 2031) using 2020 values.

They have been disaggregated by cost type:

- Administrative compliance costs are primarily driven by the need to demonstrate compliance with the Minamata Convention, such as through annual reporting.
- Substantive compliance costs are directly attributable to ratification and fall outside of usual business costs. Those costs may include the capital costs of plant upgrades as well as operational costs from process changes or additional staff training.
- Delay costs include the time taken for the preparation of applications (referred to as 'application delay') and the time taken for approvals (referred to as 'approval delay'). Estimating the cost savings relating to removing delays requires a strong understanding of the realistically achievable time frames, the likely delays that could be avoided and the value (potential cost) of any avoidable delay.

Industries with air emissions

For industries with potential air emissions of mercury, the only costs identified in the initial 10-year period were costs associated with contributing to the preparation of a national plan (see Article 8(3) of the Convention). According to the Convention, a Party with relevant sources *shall* take measures to control emissions and releases and *may* prepare a national plan setting out the measures to be taken to control emissions and releases and its expected targets, goals and outcomes. Any plan shall be submitted to the Conference of the Parties within four years of the date of entry into force of the Convention for that Party.

While it is not compulsory for Australia to prepare a national plan, it is likely that the Australian Government would seek the voluntary support of the industries associated with emissions to help prepare any plan, rather than mandate participation by legislation. Therefore, costs for industry to contribute to the possible plan were not considered to be regulatory burden.

No other costs were identified through discussions with industry and government, as ratification was found to have negligible impact on existing facilities, and no new facilities are expected to be developed in the initial 10-year period.

Public lighting

The ownership, responsibilities and governance structures for street lighting assets are complex and vary depending on the type of installation and maintenance arrangements. However, the ownership can be largely separated in terms of the Australian Standards classifications for Category P (residential streets and public open spaces) and Category V (main or major road) lighting.

Street lighting using HPMV lamps on minor residential roads in Australia tends to be managed by electricity distribution networks on behalf of local councils, on the basis that the lamps are attached to the electricity networks' power poles. In most circumstances, the maintenance of the lights by the network businesses requires those assets to be 'gifted' to the distribution businesses.

Distribution businesses are responsible for only a very small proportion of main road lighting. State and territory government departments, such as main roads departments, tend to be responsible for both the management and the costs associated with main road lighting.

While ratification would bring forward capital replacement programs for HPMV lamps (under the 'most likely' scenario), there would be no regulatory burden as those costs would have occurred in the 10-year period anyway. That is because the total cost is the same and still occurs in the period for the RBM (10 years).

While there is no regulatory burden, bringing forward the conversion of the lights also brings forward the associated energy savings. However, those savings are realised by the users (that is, local councils) that pay the energy costs and therefore are *not* an offset of the regulatory burden for distribution businesses.

Other sectors

No regulatory burden costs were identified under Option 2 for the dental sector, the waste sector, oil and gas, or medical devices and pharmaceutical goods.

Regulatory burden estimate

Based on consultations with potentially affected industries, we estimate that there would be no regulatory burden imposed under Option 2 (Table A14).

Table A14: Average annual regulatory costs from business as usual ($ million)

Change in costs	Businesses	Community organisations	Individuals	Total change in costs
Total, by sector	$0	$0	$0	$0

A regulatory burden estimate of $0 indicates that ratifying the Convention would not impose any additional regulatory burden (or 'red tape') on businesses in Australia over the initial 10-year period. This is a positive outcome and indicates that the Convention could be ratified with minimal impact on industry.

Appendix B: Stakeholder consultation summary

There is broad support for ratification across government, business and industry and non-government organisations.

Industry has flagged the importance of ratification in ensuring certainty about mercury controls in Australia and for alignment with trading partners.

Impacts to industry are expected to be low due to global movements away from mercury-containing products.

Since 2010, six consultation rounds have been facilitated by the department in relation to the Minamata Convention:

1) RIS for Australia's signing of the Convention (2013): Targeted consultation with government agencies (federal, state and territory), industry stakeholders and non-government organisations.
2) Public consultation paper (2014): seeking views from stakeholders and the wider public on potential domestic impacts of Australia's ratification of the Convention.
3) Cost–benefit analysis consultation (2015): Targeted consultation process seeking quantified estimates of the potential impacts of ratification on business and industry, the community and government.
4) Exposure draft RIS (2016–17): Exposure draft of the RIS and CBA released for public comment. Twenty-nine submissions were received.
5) Cost–benefit analysis consultation (2017): Further targeted consultation with key stakeholders following submissions to the exposure draft RIS.
6) Final RIS and cost–benefit analysis (2020): Given previous extensive and thorough consultation, the Office of Best Practice Regulation advised that the update to the RIS and CBA would require only targeted consultation. Key stakeholders were identified based on:
    - international developments since the previous analysis (particularly relating to the global availability of mercury-containing products)
    - changes to the Convention since the previous analysis (guidance material relating to mercury emissions has been developed)
    - domestic changes since the previous analysis (for example, the cancellation of agricultural products containing mercury).

Table B1: Consultation summary and government response

Sector	Consultation summary	Government response/comments
Coal-fired power generation	Support the government in taking steps to address mercury emissions in Australia, to lower risks to the environment and reduce human exposure to mercury.	Noted. Changes in emissions standards are not being proposed as it is understood existing facilities operate under a range of pollution control measures that correspond to those specified in the Convention.
	Mercury emissions from Australian coal-fired power stations are relatively low as Australian coal contains comparatively low levels of mercury and facilities are fitted with emission control systems. Encourage a holistic approach to mercury emissions assessment and mitigation; where warranted, using a range of policy instruments that include current air emissions licensing protocols and related licence requirements.	
	The Government should consider potential impacts on the electricity market and price volatility for consumers if coal-fired electricity generation plants are required to use additional technologies or controls.	
Non-ferrous metals processing	Support ratification of the Minamata Convention. Existing regulatory arrangements should be considered during implementation planning to avoid unnecessary regulatory burden and duplication.	Noted. The pathway for ratification identified in the RIS recommends existing legislative frameworks for implementation.
	The only non-ferrous metal industry likely to construct new facilities in the next 20 years is gold. The Minerals Council of Australia indicated there will most likely be 10 new gold projects established during this period.	This assumption has been included in the cost-benefit analysis.
	The coverage of sources (Annex D of the Convention) should not be expanded without fully considering the global significance and the impact of any resulting obligations on Australian operations.	Being a Party to the Minamata Convention would enable the Australian Government to contribute to future decisions of the Conference of the Parties, in line with Australia's national interests.
	Any measures or responses must consider the variability in emissions caused by natural resource and technology/process variability. Mercury emission reduction efforts should focus on sources and method that maximise complementary benefits and can be delivered at least cost to industry, and that management measures should also avoid targeting operations that are due to be closed in the near term.	Noted. Changes in emissions standards are not being proposed as it is understood existing facilities operate under a range of pollution control measures that correspond to those specified in the Convention.

Sector	Consultation summary	Government response/comments
	Processes designed to reduce atmospheric emissions can lead to the production of a mercury-waste by-product that needs to be stored or disposed of.	Australia is a Party to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, facilitating the international movement of hazardous wastes when necessary. Since the exposure draft RIS (2016), two new mercury waste treatment facilities have been constructed in Australia, bolstering domestic capacity for managing mercury waste. There are further plans by private companies to establish long-term hazardous waste storage facilities in Australia.
	The definition of 'substantial' modification is unclear. Highlighted that in some sectors, equipment may be transferred between operations (existing or new).	Article 8 of the Convention defines 'substantial modification' as "modification of a relevant source that results in a significant increase in emissions, excluding any change in emissions resulting from by-product recovery." It shall be a matter for each Party to the Convention to decide whether a modification is substantial or not. The department will develop an appropriate definition for 'substantial modification' in consultation with state and territory governments, and industry.
	The Australian minerals industry does not undertake primary mining of mercury, therefore, there are no implications of the clauses prohibiting primary mercury mining.	Noted.

Sector	Consultation summary	Government response/comments
	The 2016 cost-benefit analysis assumed emission limit values were the most effective means of achieving reductions in emissions from existing Annex D facilities. Emission limit values can lead to significant costs to some industry and may not lead to commensurate reductions in mercury emissions.	The 2020 RIS has removed this assumption. For the purposes of compliance with the Convention, there is a menu of five possible measures for existing sources (Article 8(5)): 1) A quantified goal for controlling and, where feasible, reducing emissions from relevant sources; 2) Emission limit values for controlling and, where feasible, reducing emissions from relevant sources; 3) The use of best available technologies and best environmental practices to control emissions from relevant sources; 4) A multi-pollutant control strategy that would deliver co-benefits for control of mercury emissions; 5) Alternative measures to reduce emissions from relevant sources.

Sector	Consultation summary	Government response/comments
	Questioned why BAT/BEP requirements for existing operations were not considered in the 2016 cost-benefit analysis.	Article 8 recognises that measures for existing and new sources can be different. In particular, the application of best available techniques and best environmental practices (BAT/BEP) is required for new sources, but is only one of five measures that may be applied to existing sources. In selecting and implementing an approach, a Party takes into account its national circumstances, as well as the economic and technical feasibility, and affordability of the measures. Current regulatory and industry practice in Australia is to utilise best practice techniques and environmental management for new industrial facilities (of the types defined in the Convention), so the RIS has assumed the emissions requirements on any new facilities will automatically align with Convention requirements.
	Sought clarity on the threshold definition relating to mercury wastes (Article 11).	Mercury waste threshold definitions are to be considered by the Conference of the Parties in the future. Being a Party to the Minamata Convention will enable the Australian Government to contribute to future decisions of the Conference of the Parties, in line with Australia's national interests.

Sector	Consultation summary	Government response/comments
	Sought confirmation as to whether the 75% requirement under the Convention relates to aluminium refineries; and whether it relates to 75% of sources or 75% of emissions.	The Convention specifies this obligation (Article 8(2)) as relating to 75% of emissions from each source category. Annex D of the Convention lists relevant sources as: coal-fired power plants; coal-fired industrial boilers; smelting and roasting processes used in the production of non-ferrous metals (lead, zinc, copper and industrial gold); waste incineration facilities; and cement clinker production facilities.
	One industry peak body highlighted that Article 14 of the Convention (technology transfer) provides an opportunity for the promotion of minerals industry/government technical transfer/leading practice approaches to mercury management.	Noted.
Cement production	Support Australia's ratification of the Minamata Convention and the adoption of a national approach to phase-down mercury. Ratification of the Minamata Convention is important in terms of Australian Government representatives being able to participate in key decision-making processes at the Conference of the Parties.	Noted.
	No new facilities are likely to be built within the next 20 years. Ratification will have a minimal impact on existing facilities unless a change in emission standards is imposed. Australian cement clinker mercury emissions are within licence limits and below international standards.	Changes in emissions standards are not being proposed as it is understood existing facilities operate under a range of pollution control measures that correspond to those specified in the Convention.
	The use of emission limit values is the preferred measure for existing cement clinker facilities.	Noted.
	Any future regulatory framework for mercury emissions must contain an element of flexibility to allow licencing authorities to take into account such things as the technical characteristics of the installation, its geographic location, as well as the environmental conditions.	The pathway for ratification identified in the RIS recommends existing legislative frameworks for implementation.

Sector	Consultation summary	Government response/comments
	Australia needs to establish a definition for the term 'substantial modification' used in the Convention in relation to facility upgrades.	Article 8 of the Convention defines 'substantial modification' as "modification of a relevant source that results in a significant increase in emissions, excluding any change in emissions resulting from by-product recovery." It shall be a matter for each Party to the Convention to decide whether a modification is substantial or not. The department will develop an appropriate definition for 'substantial modification' in consultation with state and territory governments, and industry.
Oil and gas	Mercury is actively managed in the oil and gas industry. Existing facilities operate under a range of pollution control measures.	BAT/BEP guidance on releases from significant anthropogenic point sources is to be developed by the Conference of the Parties in the future. Being a Party to the Minamata Convention will enable the Australian Government to contribute to future decisions of the Conference of the Parties, in line with Australia's national interests.

Sector	Consultation summary	Government response/comments
Lighting	Broad industry support for Australia's ratification of the Minamata Convention. Members of Lighting Council Australia agreed to meet the mercury phase-down levels in the Minamata Convention (2017 submission). Industry reported in 2020 that lighting suppliers are already having difficulty sourcing HPMV lamps, with the remaining stocks of HPMV lamps sold recently in Australia at prices up to three times the sale prices of a couple of years ago. Across the submissions, the following comments were made in relation to Australia's ratification: • There would be environmental, health and other flow on benefits if Australia ratifies the Convention, including removing HPMV lamps from the Australian market. • Light emitting diode (LED) lamps and luminaires are the available replacement technology for HPMV lamp applications. LED technology has benefits over HPMV, including energy and greenhouse gas savings, maintenance savings, lifetime cost savings, road safety improvements and the facilitation of smart city infrastructure. • Australia does not manufacture any of the mercury-containing lamps mentioned in Part 1 of Annex A to the Convention. • There is a good commercial case to replace mercury vapour in public lighting. Lighting Council Australia recommended the government seek a three-year exemption for the import of HPMV lamps to enable time for the industry to transition.	Noted. The RIS recommends Australia register a three-year exemption (through to 31 December 2023) upon ratification for the import of High Pressure Mercury Vapour (HPMV) lamps for general lighting purposes.
	Consider Australia's ratification is important due to possible import implications for mercury containing lamps from countries that have already ratified.	Noted. Some exporting countries have obtained exemptions under the Convention to allow for additional time to adjust to these prohibitions, these exemptions will expire in 2025.
	One industry submission considered that banning the import and manufacture of mercury vapour lamps by 2020 would have a significant impact on Energy Queensland (2017 submission). It Indicated a plan to replace mercury vapour lamps from 2020-2025 with a replace at failure strategy. One industry submission advised that the proposed phase-out date of 1 January 2020 for linear fluorescent tubes and bulbs is an 'excellent target' for Australia as the current state of linear LED lighting technology is capable of being the direct replacement technology for the affected products.	The RIS recommends Australia register a three-year exemption (through to 31 December 2023) upon ratification for the import of High Pressure Mercury Vapour (HPMV) lamps for general lighting purposes. Lighting Council Australia has advised this will enable industry sufficient time to import the products necessary to facilitate 'replace at failure' strategies.
	Sought correction regarding costs to the lighting sector in responses to the exposure draft RIS (2016).	Reviewed these comments and revisited the numbers/assumptions.

Sector	Consultation summary	Government response/comments
	Sought correction regarding references made to the FluoroCycle program in the exposure draft RIS (2016).	Reviewed these comments and revisited the numbers/assumptions.
	Sought clarification as to whether high pressure sodium vapour lamps and metal halide lamps are captured under Article 4 of the Convention.	Metal halide lamps and high pressure sodium vapour lamps are not subject to Article 4 obligations under the Convention.
	Consider that although the number of mercury lamps being recycled continues to increase, the amount of waste mercury reportedly collected from lighting waste is too high for domestic capabilities. Industry raised the importance of coordinating the replacement of mercury-containing lamps with improvements in the capture and recycling of mercury containing products, and associated awareness-raising, particularly in regional and remote areas.	FluoroCycle is a voluntary product stewardship arrangement that seeks to increase the national recycling rate of waste mercury-containing lamps in Australia. Lamp recycling can help reduce the amount of mercury being sent to landfill. Established in 2010, the program targets the commercial and public space sectors where the bulk of waste lamps are generated. Since the exposure draft RIS (2016), two new mercury waste treatment facilities have been constructed in Australia, bolstering domestic capacity for processing and managing mercury waste. There are further plans by private companies to establish long-term hazardous waste storage facilities in Australia.
Medical devices and pharmaceutical goods	Medical devices and pharmaceutical goods containing mercury have largely been superseded by non-mercury containing alternatives. Industry representatives advised they are already transitioning due to shifts away from mercury-containing products in the global market.	Noted. The Convention allows the use of mercury-containing products and devices for defined essential uses, including civil protection and military uses.
Dental sector	Support Australia's ratification of the Minamata Convention to address the serious health and environmental risks posed by mercury. Ratification is in Australia's best interests to allow Australia to participate in important decision-making by the Conference of the Parties. The Australian Dental Industry Association commented that ratification of the Minamata Convention is in Australia's best interests from an environmental perspective and they are confident Australia's dental industry is able to offer the alternative products and waste collection programmes that are necessary for Australia to meet its obligations.	Noted.

Sector	Consultation summary	Government response/comments
	The Australian Government can readily commit to achieving the national obligations associated with Article 4, Annex A part II of the Convention, given that seven of the nine provisions are supported by the dental industry and / or broadly reflect current approaches to dental care. The two provisions which are not supported by the industry relate to insurance policies and programs - industry believes insurers should not influence clinical decisions on materials used in dentistry. Ratification will provide a further basis for the industry to engage with the tertiary sector on the availability and benefits of dental amalgam capture, storage and recycling technology programs.	Noted. Annex A, Part II of the Convention requires Parties to comply with a minimum of two from a possible nine measures listed. The RIS does not consider further actions to be required for the purpose of ratification.
	One submission sought federal government funding for further research and development into alternatives to mercury amalgams. The industry peak body highlighted that in terms of government support, the National Innovation and Science Agenda (NISA) has boosted research and development into dental amalgam alternatives. Further support has also been made available to Australian manufacturers through funding programs managed by Austrade and the Department of Foreign Affairs and Trade. The industry peak body advised the research and development of mercury-free materials has been a major focus for dental product manufacturers and suppliers, both in Australia and overseas, with businesses making major investments in product research, development and commercialisation. There is broad consensus that within the next 20 years, dental amalgam will have largely ceased to be used in Australia. Highlighted that current products provide a clinically effective mercury-free alternative in many circumstances and products currently in development will provide a complete substitute at a commensurate cost to dental amalgam within 20 years.	In addition to the research and development funding opportunities raised by the peak body, the Australian Government supports research and development activities in part via the research and development tax incentive.
	One industry submission raised a concern on the potential for increased compliance-related documentation. The industry peak body however highlighted that the regulatory framework under the Therapeutic Goods Administration (TGA) establishes a supply chain regulatory system where an importer or Australian manufacturer is already required to notify the TGA of their activities supplying medical devices to the Australian market. This framework will assist the Australian Government achieve its obligations under the Minamata Convention.	Noted. The RIS recommends using existing legislative frameworks, including the *Therapeutic Goods Act 1989*.
	Sought correction regarding costs for the dental industry in responses to the exposure draft RIS (2016).	Reviewed these comments and revisited the numbers/assumptions.

Sector	Consultation summary	Government response/comments
	Regarding contaminated sites, sought clarification as to whether Australia's ratification of the Minamata Convention would require a 'zero' level of mercury on site for specific future land uses, and, if so, what would be the appropriate environmentally sound strategies (and cost of such strategies) to achieve such an outcome.	Contaminated sites are already regulated through state and territory legislation under the auspices of the *National Environment Protection (Assessment of Site Contamination) Measure 1999.*
	Businesses collecting amalgam waste should be required to transfer that waste to a licensed amalgam recycling specialist. It should also be possible to determine if a business holds a current licence. Suggested that the voluntary dental amalgam waste collection scheme could be strengthened by including information about waste collection and recycling. Suggested consideration of a subsidy to encourage voluntary installation of amalgam separators and the subsequent collection of the waste.	Noted. There have historically been initiatives encouraging the installation of traps and separators in dental facilities. For example, the Victorian *Dentists for Cleaner Water* program.
	One submission was concerned about the transfer of information/technology (Article 17) in instances where such a transfer could act against its intellectual property rights.	Noted. Information will be shared on a voluntary basis and in consultation with relevant industries as appropriate.
	Consider that mercury is already becoming difficult to source, and fear Parties may ban the export of mercury for dental amalgam. Advise the government not to exceed the requirements of the Convention by banning the import of mercury for dental amalgam.	The Minamata Convention permits mercury to be imported under Article 3 for the purpose of dental amalgam manufacture, with trade in mercury for this purpose not being restricted. The department is not considering prohibiting mercury trade for the purposes of dental amalgam as part of the ratification process.
	Suggest a program to introduce filters on crematorium smokestacks would help to reduce mercury emissions.	Crematoria are excluded from Annex D of the Convention. The RIS does not consider further actions to be required for the purpose of ratification.

Sector	Consultation summary	Government response/comments
Hazardous waste treatment / storage	Support ratification and consider that effective processing and treatment of mercury contaminated waste will help the environment and human health. Note that Australia should engage in all conferences, negotiations and discussions to influence decisions that could affect industry and the community. Supports legislative and regulatory measures to reduce and where possible eliminate emissions and community exposure to mercury. Note that Australia should treat our own mercury waste.	Noted.
	Support actions to improve mercury monitoring, and the capture, safe handling and processing of mercury from all sources in the Australian environment.	Noted. Changes in standards are not being proposed as it is understood existing legislative frameworks correspond to those specified in the Convention.
	Sought clarification regarding the interstate movement of hazardous wastes.	Intestate movement of hazardous wastes are regulated through state and territory legislation under the auspices of the *National Environment Protection (Movement of Controlled Waste between States and Territories) Measure 1998.*
	Two submissions highlighted their businesses were developing treatment plants in Australia and would be in a position by 2018 to process mercury waste from sectors including the LNG and lighting sectors.	Noted.
	There should be exemptions for import and export of mercury in unprocessed and purified forms (to facilitate reclaimed mercury being used in dental amalgam).	The Minamata Convention permits mercury to be imported and exported under Article 3 for the purpose of dental amalgam manufacture, with trade in mercury for this purpose not being restricted.
	Note that Australia should cease exporting waste mercury to other countries and process in domestic facilities; and should accept imports of mercury waste from non-Parties who are still in the process of ratifying the Convention.	Noted. Trade in mercury waste is covered by the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal to which Australia is already a Party.
	Note that the government should recognise the importance of geological repositories for the management of mercury and for meeting Australia's obligations under the Convention. One submission flagged they are developing a number of geological repositories in Australia which can permanently isolate mercury and protect human health and the environment.	Noted.

Sector	Consultation summary	Government response/comments
Agricultural chemicals	Support Australia ratifying the Minamata Convention and recognise the risks mercury poses to human health and the environment, even at low concentrations. Historically encouraged the government to seek an exemption for Shirtan, a mercury-containing fungicide used on sugarcane. Canegrowers revised its position in 2017, indicating a new preference to phase-out Shirtan in 2020. The National Farmers Federation confirmed (2020) that given the recent cancelled registration of Shirtan, there will be no impacts to the sector from ratification and an exemption will no longer need to be sought.	The Australian Pesticides and Veterinary Medicines Authority has cancelled the registration of Shirtan. From June 2021, Shirtan will no longer be used in Australia. The RIS has been updated to reflect this development.
Crematoria	Support Australia's ratification of the Minamata Convention. One industry submission went further to request the Australian Government act to minimise the use and emission of mercury from all sources and apply Article 8(5) requirements to crematoria.	There are no specific measures relating to emissions from crematoria under the Convention. The department is not considering additional measures on this industry as part of the ratification process.
	Note the use of mercury-based amalgams in dentistry will reduce over time, ultimately reducing mercury emissions from cremators. One industry submission contradicted this by stating that the total contribution of the cremation industry to atmospheric pollution (not just mercury) is increasingly significant due to Australia's ageing population.	
Non-government organisations	Support Australia's ratification of the Minamata Convention and advise affected sectors have had sufficient time to prepare for any changes required by ratification, and should not require tax-payer funded incentives to reduce their pollution. Advised the exposure draft RIS (2016) was not sufficiently ambitious to address the bulk of mercury emissions and releases occurring in Australia.	Noted.
	Adequate funding from governments is required to ensure sufficient monitoring, regulation and reporting to the community.	Monitoring and reporting is conducted nationally under the auspices of the *National Environment Protection (National Pollutant Inventory) Measure 1998*. The Australian Government will continue working with states and territories to consider this comment.
	Consider the cost impact of mercury in the exposure draft RIS (2016) was underestimated.	Reviewed these comments and revisited the calculation.

Sector	Consultation summary	Government response/comments
	General consensus that dental amalgam should cease to be used in Australia immediately, particularly in public schools and dental clinics servicing people from the low-income demographic. Other concerns included: • the exposure draft RIS (2016) proposal to install traps and separators at dental clinics does not address the problem of dental amalgam use. • As mercury-free dental restorations are more expensive than dental amalgam restorations it represents a market failure in the sense that negative externalities associated with the use of dental amalgam (e.g. management of dental waste and effluents) are not factored in the market price of amalgam restorations. • The Australian public and dental workers have not been adequately informed of the associated possible health risks, neither being safely protected when being exposed to high levels of mercury during the placement and removal of mercury dental amalgam fillings. • Australian dental universities and teaching institutions need to modernize their curriculum by removing the practice of using mercury dental amalgam fillings. • The Australian Government should adopt a plan to implement the Convention's provision relating to discouraging insurance policies and programmes that favour dental amalgam use of mercury-free dental restoration.	Noted. The department is not proposing additional measures in relation to dental amalgam as part of the ratification process. Being a Party to the Minamata Convention will enable the Australian Government to contribute to future decisions of the Conference of the Parties in relation to dental amalgam. Australian Government positions on such matters will be developed in consultation with relevant stakeholders.

Sector	Consultation summary	Government response/comments
	Lighting and battery recycling should be made mandatory. Lighting and battery manufacturers/importers should be subject to a mandatory extended producer responsibility scheme.	In November 2019, Environment Ministers agreed to a new National Waste Policy Action Plan. To support the delivery of strategies within the Action Plan, Ministers also agreed to encourage major battery manufacturers to participate in a new Battery Stewardship Scheme to improve the rate of battery recycling. The *Recycling and Waste Reduction Act 2020* provides a national framework to manage waste and recycling across Australia, now and into the future. The legislation also incorporates the existing *Product Stewardship Act 2011* with improvements to encourage companies to take greater responsibility for the waste they generate, including through better product design and increased recovery and reuse of waste materials.
	Proposed a national Minamata Convention Reference Group be established with civil society representation from the public health and environment sectors, and unions.	Noted.
	Mercury pollution in Australia is approximately double the global average on a per-capita basis and raised concern of contamination being evident in waterways, estuaries, old mine sites and dumps around Australia. Sought for government to focus on remediation of legacy gold mining and chlor-alkali sites.	Noted. Contaminated sites are regulated through state and territory legislation under the auspices of the *National Environment Protection (Assessment of Site Contamination) Measure 1999.* The Conference of the Parties to the Minamata Convention has agreed to guidance on sites contaminated by mercury or mercury compounds.

Sector	Consultation summary	Government response/comments
	Mercury recovered from remediation of contaminated sites, mercury waste, oil and gas and any other source should be banned from export onto the global market for uses allowed or otherwise under the Minamata Convention. Permanent storage/disposal sites that prevent mercury from entering the environment must be established in Australia and should be the destination for all elemental mercury recovered in Australia.	Noted. Since the exposure draft RIS (2016), two new mercury waste treatment facilities have been constructed in Australia, bolstering domestic capacity for processing and managing mercury waste. There are further plans by private companies to establish long-term hazardous waste storage facilities in Australia.
	Mercury emissions from the alumina industry are significant and should be addressed as a matter of priority.	Annex D of the Convention lists relevant sources as: coal-fired power plants; coal-fired industrial boilers; smelting and roasting processes used in the production of non-ferrous metals (lead, zinc, copper and industrial gold); waste incineration facilities; and cement clinker production facilities. The combustion of coal at alumina refineries is subject to Annex D of the Convention.
	Emissions from the cement industry should be monitored.	Emissions from the cement industry are reported to the National Pollutant Inventory.
	Recommended Australia include the oil and gas industry (including the fracking industry) in its National Action Plan to reduce or eliminate mercury emissions and releases.	Noted. Australia is not required to develop a National Action Plan for the purposes of ratification.
	As alternative, comparable products are available, the use of Shirtan fungicide should have a maximum phase out date of December 2017.	The Australian Pesticides and Veterinary Medicines Authority has cancelled the registration of Shirtan. From June 2021, Shirtan will no longer be used in Australia.

Sector	Consultation summary	Government response/comments
	Australia is likely being exposed to significant mercury pollution as a result of artisanal and small-scale gold mining (ASGM) in south-east Asia. It is important for Australia to promote the use of mercury-free gold mining technologies in this region.	The Convention establishes controls on artisanal and small-scale gold mining where mercury is used.
	One submission urged the government to work with other countries such as Indonesia, PNG and the Solomon Islands.	The Convention has a financial mechanism to support developing country Parties and Parties with economies in transition in implementing their obligations under the Convention (including those relating to ASGM).

Appendix C: Current Australian measures to regulate mercury

Australian Government responsibilities

The Australian Government has responsibility for balancing specific matters in the national interest, which includes decisions on the ratification of international conventions and ensuring that Australia meets its international obligations.

Australia has existing obligations to regulate mercury under international law:

- *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal* (the Basel Convention). Technical guidelines have been adopted for the environmentally sound management of wastes consisting of, containing or contaminated with mercury or mercury compounds ('mercury wastes'). The import and export of hazardous waste is the responsibility of the Australian Government under the *Hazardous Waste Act 1989*, which derives its head of power from the Basel Convention. A waste is considered hazardous if it is listed in Annex I of the Basel Convention and includes waste with mercury concentrations exceeding 1 per cent by weight.
- *Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade* (the Rotterdam Convention). Annex III lists chemicals that are subject to prior informed consent procedures. Mercury compounds are included in that listing. As a Party to the Rotterdam Convention since 2004, Australia must ensure that the export of listed chemicals (including mercury and mercury compounds) is allowed only with written consent from a designated authority in a receiving country. Export of mercury and mercury compounds is controlled under the Customs Regulations.

Mercury and mercury compounds for some uses, and some mercury-added products, are controlled through existing customs, agricultural and veterinary chemicals, and therapeutic goods legislation.

Australian industrial chemicals legislation regulates the importation and manufacture of industrial chemicals in Australia through the assessment and registration of chemicals on the Australian Inventory of Industrial Chemicals. The inventory is administered by the federal Department of Health under the Australian Industrial Chemicals Introduction Scheme.

The use of certain mercury-containing agricultural or veterinary chemical products is regulated at the national level under the *Agricultural and Veterinary Chemicals (Administration) Act 1992*. Before an agricultural or veterinary chemical product can be legally imported, supplied, sold or used in Australia, it must be registered with the Australian Pesticides and Veterinary Medicines Authority.

The Australian Government, in cooperation with the states and territories, also has responsibility for the following mechanisms:

- The National Pollutant Inventory tracks pollution across Australia and ensures that the community has access to information about emissions and transfers of substances that may affect people locally. Mercury is one of the 93 toxic substances tracked.

  Facilities must report their mercury emissions, releases and transfers if their annual usage, emissions or releases of mercury exceed 5 kilograms per year. State and territory governments also produce emissions data for diffuse sources on a less frequent schedule. They provide that data to the Australian Government for publication on the publicly available National Pollutant Inventory website.

- National environment protection measures apply to movements of controlled waste between states and territories and assessments of site contamination.

State and territory responsibilities

The major responsibility for the management of activities potentially involving mercury lies with state and territory governments. This includes matters related to:

- mining
- manufacturing
- activities producing mercury emissions to air and releases to land and water (such as coal-fired power stations, smelting for metal production, cement clinker production and waste incineration)
- mercury storage, waste management and management of contaminated land.

The states and territories regulate those activities through a variety of legislative measures that include:

- planning and environmental assessment schemes, which assess, approve and apply conditions to proposals for new activities
- mining approvals under mining legislation
- environmental authorities (or licences), which set operating conditions under environmental protection legislation
- enforcement of compliance with licences and pollution control measures under environmental protection legislation
- hazardous goods, work health and safety, and environmental legislation to control the handling, storage, transport and disposal of mercury and mercury waste.

References

ABS (Australian Bureau of Statistics) 2019. *Births, Australia*, ABS, Canberra (accessed 27 November 2020).

ADIA (Australian Dental Industry Association) 2014. *Submission on the Minamata Convention on Mercury ratification*, 30 June.

AIHW (Australian Institute of Health and Welfare) 2012. *Australia's food and nutrition 2012*, AIHW, Canberra.

APVMA (Australian Pesticides and Veterinary Medicines Authority) 2020. *Agricultural and Veterinary Chemicals Gazette*, no. APVMA 12, 16 June (accessed 27 November 2020).

ATSDR (Agency Toxic Substances and Disease Registry) 1999. *Toxicological profile for mercury*, US Government (accessed 27 November 2020).

Australian Government (Department of Agriculture, Water and the Environment), 'The Minamata Convention: a response to a global concern', Australian Government (accessed 27 November 2020).

Australian Government (Department of Agriculture, Water and the Environment) 2020. *National Pollutant Inventory*, Australian Government.

Australian Government (Department of the Environment) 2014. 'Invitation to comment on the proposal for Australia to ratify the Minamata Convention on Mercury', Australian Government, March.

Australian Government (Department of the Environment and Energy) 2016. *National phase down of mercury: ratification of the Minamata Convention on Mercury: Final Regulation Impact Statement – exposure draft*, Australian Government (accessed 27 November 2020).

Australian Government (Department of the Environment and Energy) 2018. *Costs and benefits of Australia phasing down mercury: Report prepared for the Department of the Environment and Energy*, Marsden Jacob Associates.

Australian Government (Department of Foreign Affairs and Trade), *2017 Foreign Policy White Paper*, 2017 (accessed 27 November 2020).

Axelrad DA, Bellinger DC, Ryan LM, Woodruff TJ 2007. 'Dose–response relationship of prenatal mercury exposure and IQ: an integrative analysis of epidemiologic data', *Environmental Health Perspectives*, April, 115(4):609–615 (accessed 27 November 2020).

Bellanger M, Pichery C, Aerts D, Berglund M, Castaño A, Cejchanová M et al. 2013. 'Economic benefits of methylmercury exposure control in Europe: monetary value of neurotoxicity prevention', *Environmental Health*, January, 12(1):3 (accessed 27 November 2020).

Boston University 2020. 'Minamata disease', Boston University (accessed October, 2020).

Boucher O, Jacobson SW, Plusquellec P, Dewailly E, Ayotte P, Forget-Dubois N, Jacobson JL, Muckle G 2012. 'Prenatal methylmercury, postnatal lead exposure, and evidence of attention deficit/hyperactivity disorder among Inuit children in Arctic Québec', *Environmental Health Perspectives*, October, 120(10):1456–1461.

Das K et.al. 2003 'Heavy metals in marine mammals', in Vos JG, Bossart GD, Fournier M, O'Shea TJ (eds), *Toxicology of marine mammals*, New Perspectives: Toxicology and the Environment series, Taylor and Francis, London, pp. 135–167.

Davidson PW, Myers GJ, Cox C, Shamlaye CF, Marsh DO, Tanner MA, Berlin M, Sloane-Reeves J, Cernichiari E, Choisy O 1995. 'Longitudinal neurodevelopmental study of Seychellois children following in utero exposure to methylmercury from maternal fish ingestion: outcomes at 19 and 29 months', *Neurotoxicology* 16(4) 677-688.

Davidson PW, Myers GJ, Cox C, et al 1998. 'Effects of Prenatal and Postnatal Methylmercury Exposure from Fish Consumption on Neurodevelopment'. *Journal of the American Medical Association* 1198;280(8):701-707.

DCWP (Dentists for Cleaner Water Program) no date. *Evaluation report*, Australian Dental Association Victoria Branch and Victorian Environment Protection Authority.

FSANZ (Food Standards Australia New Zealand) 2013. *Mercury in fish: advice on fish consumption*, FSANZ, Canberra.

FSANZ (Food Standards Australia New Zealand) 2019. *25th Australian Total Diet Study*, FSANZ, Canberra.

Giang A, Selin N 2016. 'Benefits of mercury controls for the United States', *Proceedings of the National Academy of Sciences of the United States of America*, 113(2):286–291.

Grandjean P, Weihe P, White RF, Debes F, Araki S, Yokoyama, Murata, Sørensen N, Dahl R, Jørgensen PJ 1997. 'Cognitive deficit in 7-year-old children with prenatal exposure to methylmercury', *Neurotoxicology and Teratology*, 19:417–428.

Griffiths C, McGartland A, Miller M 2007. 'A comparison of the monetized impact of IQ decrements from mercury emissions', *Environmental Health Perspectives*, 115(6):841–847.

Grosse SD, Matte TD, Schwartz J, Jackson R 2002. 'Economic gains resulting from the reduction in children's exposure to lead in the United States', *Environmental Health Perspectives*, 110(6):563–569.

Health Council 2015. *Healthy mouths healthy lives: Australia's National Oral Health Plan 2015–2024*, Council of Australian Governments Health Council, Adelaide.

Hinwood AL, Callan AC, Ramalingam M, Boyce M, Heyworth J, McCafferty P, Odland JO 2013. 'Cadmium, lead and mercury exposure in non-smoking pregnant women', *Environmental Research*, October, 126:118–124.

KCGM (Kalgoorlie Consolidated Gold Mines) 2015. 'Gidji roasters replaced by UFG,' news release, KCGM, 15 June.

KCGM (Kalgoorlie Consolidated Gold Mines) no date. 'Mineral processing', KCGM (accessed 12 October 2020).

Kjellstrom T, Kennedy P, Wallis S, Mantell C 1986. *Physical and mental development of children with prenatal exposure to mercury from fish, Stage 1: Preliminary test at age 4*, report 3080, Swedish National Environmental Protection Board.

Kjellstrom T, Kennedy P, Wallis S, Stewart A, Friberg L, Lind B, Wutherspoon T, Mantell C 19898. *Physical and mental development of children with prenatal exposure to mercury from fish, Stage 2: Interviews and psychological tests at age 6*, report 3642, Swedish National Environmental Protection Board.

Monk A , Charlton-Robb K, Buddhadasa S, Thompson RM 2014. 'Comparison of mercury contamination in live and dead dolphins from a newly described species, *Tursiops australis*', *PLOS ONE*, 9(8):1.

Muir T, Zegarac M 2001. 'Societal costs of exposure to toxic substances: economic and health costs of four case studies that are candidates for environmental causation', *Environmental Health Perspectives*, 109(Suppl. 6):885–903.

Myers GJ, Cernichiari E, Toribara TY, Liang L, Marsh DO, Berlin MW, Cox C, Shamlaye CF, Choisy O, Davidson P 1995a. 'The biological monitoring of mercury in the Seychelles study', *Neurotoxicology,* 16(4), 613-628.

Myers GJ, Marsh DO, Clarkson TW, Davidson PW, Cox C, Cernichiari E, Tanner MA, Lednar W, Shamlaye C, Choisy O, Hoareau C, Berlin M 1995b. 'The Seychelles study of fetal methylmercury exposure and child development: Introduction', *Neurotoxicology,* 16(4), 583-596.

Myers GJ, Shamlaye CF, Marsh DO, Cox C, Davidson PW, Choisy O, Cernichiari E, Choi A, Tanner MA, Clarkson TW 1995c. 'The Seychelles child development study on neurodevelopmental outcomes in children following in utero exposure to methylmercury from a maternal fish diet: background and demographics', *Neurotoxicology ,*16(4), 597-612.

Myers GJ, Davidson PW, Shamlaye CF, Axtell CD, Cernichiari E, Choisy O, Choi A, Cox C, Clarkson TW 1997. 'Effects of prenatal methylmercury exposure from a high fish diet on developmental milestones in the Seychelles Child Development Study', *Neurotoxicology* 18(3): 819-829.

OBPR (Office of Best Practice Regulation) 2020. *Regulatory burden measurement framework guidance note*, Department of the Prime Minister and Cabinet, Australian Government.

OECDWP (OECD Working Party on Integrating Environmental and Economic Policies) 2017. *Economic assessments of the benefits of regulating mercury: a review*, SACAME workshop, 30–31 August, Ottawa, Canada.

Rice G, Hammitt JK 2005. *Economic valuation of human health benefits of controlling mercury emissions from US coal-fired power plants*, Northeast States for Coordinated Air Use Management (NESCAUM) (accessed 27 November 2020).

Spadaro JV, Rabl A 2008. 'Global health impacts and costs due to mercury emissions', *Risk Analysis*, 2008, 28(3):603–613 (accessed 27 November 2020).

Steven A, Mobsby D, Curtotti R 2020. *Australian fisheries and aquaculture statistics 2018*, project 2019-093, Fisheries Research and Development Corporation, Canberra.

Trasande L, Schechter C, Haynes KA, Landrigan PJ 2006. 'Applying cost analyses to drive policy that protects children: mercury as a case study', *Annals of the New York Academy of Sciences*, 1076:911–923.

Trasande L, Landrigan PJ, Schechter C 2005. 'Public health and economic consequences of methyl mercury toxicity to the developing brain', *Environmental Health Perspectives*, May, 113(5):590–596 (accessed 27 November 2020).

UNEP (UN Environment Programme) 2013a. *Global mercury assessment*, UNEP, Nairobi.

UNEP (UN Environment Programme) 2013b. *Mercury: time to act*, UNEP, Nairobi.

UNEP (UN Environment Programme) 2013c. *Costs of inaction on the sound management of chemicals*, UNEP, Nairobi.

UNEP (UN Environment Programme) 2017. 'Minamata Convention on Mercury: fact sheet.,' in *At a glance: Minamata Convention on Mercury*, UNEP, Nairobi.

UNEP (UN Environment Programme) 2019. *Global mercury assessment 2018*, UNEP, Nairobi.

UNEP (UN Environment Programme) 2020. 'Forms and guidance documents', UNEP, Nairobi.

UNEP (UN Environment Programme) 2020a. *Minamata Convention on Mercury*, UNEP, Nairobi (accessed 16 October, 2020).

UNEP (UN Environment Programme) 2020b. *Exemptions under the Minamata Convention on Mercury*, UNEP, Nairobi (accessed 12 October 2020).

USEPA (US Environmental Protection Agency) 2011. *Regulatory impact analysis for the final mercury and air toxics standards*, EPA-452/R-11-011, US Government, December, (accessed 27 November 2020).

VEPA (Victorian Environment Protection Authority) 2013. *Energy from waste*, publication 1549, Victorian Government, September (accessed 27 November 2020).

WAEPA (Western Australian Environmental Protection Authority) 2013. *Environmental and health performance of waste to energy technologies*, strategic advice, report 1468, Western Australian Government, 4 April (accessed 27 November 2020).

WHO (World Health Organization) 2013. *Mercury and health*, factsheet no. 361, WHO, Geneva.

Woodside (Woodside Energy Pty Ltd) 2014. *Browse FLNG Development draft Environmental Impact Statement*, EPBC 2013/7079, November.

Worm B, Sandow M, Oschlies A, Lotze HK, Myers RA 2005, 'Global patterns of predator diversity in the open oceans', *Science*, 309(5739):1365–1369.

Acronyms and abbreviations

BAT	best available techniques
BEP	best environmental practices
CBA	cost–benefit analysis
CO_2e	carbon dioxide equivalent
DNSP	distribution network service provider
EPA	environment/al protection agency/authority
GDP	gross domestic product
HELE	high-efficiency, low-emissions
HPMV	high-pressure mercury vapour
IQ	intelligence quotient
LED	light-emitting diode
NPV	net present value
OECD	Organisation for Economic Co-operation and Development
ppb	parts per billion
ppm	parts per million
PPP	purchasing power parity
RBM	regulatory burden measurement
RIS	Regulation Impact Statement
UN	United Nations
UNEP	United Nations Environment Programme