From: [redacted]

Sent: Tuesday, 5 February 2019 11:52 AM

To: Brian Nijman

Cc: [redacted]

Subject: Fw: Public consultation commences on New Zealand's potential accession to maritime air pollution treaty (MARPOL Annex VI)

Attachments: 2019 EIL MARPOL Annex VI National.docx; 2018 EIL MARPOL Annex VI Auckland.docx

Good Morning Brian,
Thank you for the opportunity to provide a submission on NZs potential accession to MARPOL Annex VI. Please find below some comments that are mostly relevant to the NZIER report, and as discussed yesterday the attached documents that we contracted Emission Impossible to put together for us. You should be seeing some submissions from the District Health Boards. They will be referencing Attachment A as we provided this to provide some consistent research into this subject of shipping emissions.
I trust this is self-explanatory but if you have any further questions please do not hesitate to ask.

1. The Ministry of Health has engaged independent advice on the air quality, climate change and health issues associated with acceding to Annex VI of MARPOL (EIL, 2019)[1]. This is shared in **Attachment A**.

2. The Ministry of Health supports New Zealand's accession to Annex VI. There is extensive research that shows that the benefits of greener shipping outweigh the costs. Two compelling reasons are:

(i) Reduced emissions of harmful air pollutants will result in reduced adverse public health effects (and costs), including premature deaths, in New Zealand; and

(ii) Accession to Annex VI provides New Zealand with a tangible action to combat climate change (an issue of planetary urgency). Given New Zealand's extreme supply chain-length, these reductions are potentially more significant than is usually the case in the global perspective.

3. Our independent advice suggests that shipping emissions estimates in the cost benefit analysis prepared for the Ministry of Transport appear to be significantly underestimated (NZIER, 2018)[2]. This means that potential emissions reductions, and

associated health benefits, of acceding to Annex VI may similarly be significantly underestimated.

For example, NZIER estimates that current annual sulphur oxides emissions from shipping in Auckland are around 300 tonnes per year (2017-2018)[3]. This is significantly less than the Auckland emissions inventory estimate of 1,378 tonnes per year (Peeters, 2018)[4].

4. We consider the New Zealand social damage costs of emissions per tonne utilised by Emission Impossible Ltd may be more appropriate than the European values utilised by NZIER[5]. The European values (Merck, 2014)[6] are from 2002 (Holland and Watkiss, 2002)[7] at which time much less was known about the adverse health effects of pollutants from shipping such oxides of nitrogen. Therefore, whilst not specific to shipping, social damage costs *are* specific to the adverse health effects emissions in urban areas (as well as being more current).

As an example, an estimate of the public health *costs* associated with shipping emissions in Auckland for the four "snap shot" years covered by the Auckland air emissions inventory is provided in **Attachment B** (EIL, 2018)[8]. This shows that if MARPOL Annex VI is implemented, and then the annual public health benefit in Auckland in 2026 alone will be NZ $58 million (in NZD 2015). This figure rises to NZ $77 million in 2040 (in NZD 2015).

5. We note that benefits of *greenhouse gas* emissions reductions have not been quantified in the cost benefit assessment prepared for the Ministry of Transport and consider this a potentially significant limitation. Such benefits include, but are not limited to, reduced direct risks for shipping from extreme meteorological events but also include health benefits from reduced risks from, *inter alia*, carriers of new diseases and migration of tropical species into New Zealand.
As noted above, given New Zealand's extreme supply chain-length, these reductions are potentially more significant than is usually the case in the global perspective.

6. Following reports in the media, we query the baseline assumption that international shipping will comply with Annex VI regardless of New Zealand's position.[9] New Zealand's accession, with associated compliance and enforcement oversight, provides greater assurance that this will occur. It also means that any vessels visiting from countries not acceding to Annex VI will be obliged to comply in New Zealand waters.

7. Finally, we would like to highlight the significance of domestic emissions from ferries with respect to New Zealand acceding to Annex VI. Cook Strait ferries are responsible for more port calls in Picton and Wellington than international shipping in all ports around New Zealand. This means that the health benefits, and greenhouse gas reductions, are disproportionately higher for Picton and Wellington and provides a strong case for acceding to MARPOL Annex VI. The Ministry of Health further welcomes the cost benefit analysis supporting shore-side power for domestic ferries.

The Ministry of Health does not support delaying implementation in New Zealand to manage fuel price fluctuations for domestic shipping firms.[10] Such delays come at the expense of New Zealander's health. We note that domestic shipping firms have successfully weathered much higher price rises in the past.

8. In conclusion the Ministry of Health recommends immediate accession to Annex VI of MARPOL.

Notes:

1. Emission Impossible Ltd, (2019). *MARPOL Annex VI. Air quality, climate change and health issues for New Zealand*. Prepared for the Ministry of Health. Auckland. January.

2. New Zealand Institute of Economic Research, (2018). *MARPOL IV and VI. Assessing the economic and environmental impact of international maritime measures on New Zealand.* Report to Ministry of Transport. Wellington. November.

3. Ibid. Figure 7, at page 35.

4. Peeters S, 2018. "Auckland air emissions inventory 2016 - Sea transport". Prepared for Auckland Council. July. Table 42, at page 54.

5. Noting that EIL has also utilised a (lower) UK damage cost for SOx.

6. Merck, O., (2014). *Shipping Emissions in Ports*. International Transport Forum Discussion Papers 2014/20. Paris: OECD Publishing. December. https://doi.org.10.1787/5jrw1ktc83r1-en.

7. Holland M., & Watkiss P., (2002). *Benefits Table Database: Estimates of the Marginal External Costs of Air Pollution in Europe.* Created for the European Commission. DG Environment. Brussels. Adjusted using purchasing power parity exchange rates and updated to 2018.

8. Emission Impossible Ltd, (2018). *MARPOL Annex VI. Air quality, climate change and health issues for Auckland*. Prepared for the Auckland Regional Public Health Service. Auckland. December. Table 9, at page 41.

9. Cropp, A., 2018. Cruise ships breaching SECA limits in Alaska before visiting NZ. 27 October. Stuff.co.nz [Online: Retrieved 24 Jan 2019].

10. As suggested by NZIER at page 44.

Attachment A: *MARPOL Annex VI. Air quality, climate change and health issues for New Zealand*.

Attachment B: *MARPOL Annex VI. Air quality, climate change and health issues for Auckland*.

Regards

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MARPOL Annex VI

Air quality, climate change and health issues for New Zealand

Prepared for
Ministry of Health

Air quality, climate change and health issues for New Zealand

Client: Ministry of Health

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8 January 2019

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Revision History

No.	Date	Author	Reviewer(s)	Details
1	21 Dec 2018	**Gerda Kuschel & Louise Wickham** Directors & Senior Air Quality Specialists		Draft to client for review
2	8 Jan 2019			Updated to include WHO references on health effects of pollutants

Executive Summary

On 5 November 2018, the Ministry of Transport commenced public consultation on whether New Zealand should sign up to an international treaty for the prevention of air pollution from ships. Specifically, the proposal considers accession to Annex VI of the International Convention for the Prevention of Pollution from Ships (**MARPOL**). Annex VI regulates discharges to air which can be harmful to public health and the environment, deplete the ozone layer and contribute to climate change.

The Ministry of Health engaged Emission Impossible Ltd prepare a briefing on shipping emissions and associated health effects in New Zealand. The purpose of this briefing is twofold:

(i) to provide information to support the Ministry of Health collaborating with the Ministry of Transport on the proposal to accede to Annex VI; and
(ii) to provide information to support public health units who wish to submit on the proposal.

This briefing covers:

- what is contained in the MARPOL regulations;
- the significance of shipping emissions in New Zealand;
- key public health impacts associated with air emissions from shipping; and
- key points that could be included in submissions by public health units to improve public health outcomes.

It is our view that the Ministry of Health should support New Zealand's accession to Annex VI. There is extensive research that shows the benefits of greener shipping outweigh the costs. Three compelling reasons are:

(i) Reduced emissions of harmful air pollutants will result in reduced adverse public health effects (and costs), including premature deaths;
(ii) Reduced emissions of harmful air pollutants will result in reduced adverse effects on ecosystems (e.g. acidification, deposition of toxics such as heavy metals and dioxins); and
(iii) Reduced greenhouse gas emissions are a tangible action to combat climate change (an issue of planetary urgency).

These do not preclude feedback on other matters. Public consultation closes on 11 February 2019.

Contents

List of Appendices

1 What is MARPOL and how does it relate to New Zealand?

MARPOL is short for marine pollution. The full title of the treaty is the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78).

MARPOL was developed by the International Maritime Organization (**IMO**) to minimise pollution of the oceans and seas, including dumping, oil and air pollution. MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.

This chapter covers:

- the structure of the MARPOL convention;
- details on Annex VI (the subject of the Ministry of Transport discussion document); and
- how MARPOL Annex VI relates to New Zealand.

1.1 The structure of MARPOL

MARPOL was developed by the International Maritime Organisation (**IMO**). The IMO is the United Nations agency responsible for regulating shipping. Currently, the IMO has 174 member states and three associate members (Faroe Islands, Hong Kong and Macau).[1]

The original MARPOL convention was signed on 17 February 1973 but, following a spate of tanker accidents in 1976 – 1977, was revised by the 1978 Protocol. The original convention focussed on prevention of pollution from oil and oily water (Annex I) and entered into force on 2 October 1983.[2] Over time, additional Annexes have been added to address other aspects of marine pollution. In 1997, a Protocol was adopted to amend MARPOL and add Annex VI (prevention of air pollution from ships). Annex VI entered into force on 19 May 2005.

MARPOL currently includes six technical Annexes as follows (IMO, 2018):[3]

(i) Annex I – Regulations for the prevention of pollution by oil

Annex I covers the prevention of pollution by oil from operational measures as well as from accidental discharges. Annex I was amended in 1992 to make it mandatory for new oil tankers to have double hulls and to introduce a phase-in schedule for existing tankers to fit double hulls (this was subsequently revised in 2001 and 2003).

Annex I entered into force 2 October 1983.

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[1] International Maritime Organization (IMO), undated. "Member States".[Online: Retrieved 28 November 2018]

[2] The 1978 Protocol absorbed the parent Convention as the 1973 MARPOL Convention had not yet entered into force.

[3] IMO, undated. "International Convention for the Prevention of Pollution from Ships (MARPOL)". [Online: Retrieved 28 November 2018]

(ii) Annex II – Regulations for the control of pollution by noxious liquid substances in bulk

Annex II details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. The list appended to MARPOL includes some 250 substances; the discharge of their residues is allowed only to reception facilities for certain concentrations and conditions (which vary with the category of substances). No discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.

Annex II entered into force 2 October 1983.

(iii) Annex III – Prevention of pollution by harmful substances carried by sea in packaged form

Annex III contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications. For the purpose of this Annex, "harmful substances" are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code or which meet the criteria in the Appendix of Annex III.

Annex III entered into force 1 July 1992.

(iv) Annex IV – Prevention of pollution by sewage from ships

Annex IV contains requirements to control pollution of the sea by sewage. Under Annex IV, the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted[4] and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land. Sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.

Annex IV entered into force 27 September 2003.

(v) Annex V – Prevention of pollution by garbage from ships

Annex V deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The most important feature of Annex V is the complete ban imposed on the disposal into the sea of all forms of plastics.

Annex V entered into force 31 December 1998.

(vi) Annex VI – Prevention of air pollution from ships

[4] Finely ground up

Annex VI sets limits on emissions of sulphur and nitrogen oxides from ship exhausts and prohibits deliberate emissions of ozone depleting substances. It also provides for designated emission control areas (**ECA**) to set more stringent standards for sulphur oxides, nitrogen oxides and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships.

Annex VI entered into force 19 May 2005.

1.2 Details on Annex VI

Annex VI primarily responds to two global problems related to shipping emissions:

(i) Impacts on human health and environments in port communities from maritime pollution; and

(ii) Contributions to climate change and ozone layer depletion.

Annex VI addresses these problems by:

- Regulating air pollutants that are harmful to humans, including sulphur dioxide (**SO_2**), nitrogen oxides (**NO_X**), and particulate matter (**PM**);
- Regulating greenhouse gases (**GHGs**) and ozone depleting substances; and
- Setting out requirements for reception facilities and Port State Control, and requirements for Party States to enable their ships to demonstrate compliance with energy efficiency regulations when entering the ports of other Party States.

The key regulations currently covered by Annex VI are summarised in **Appendix A.**

Since coming into force on 19 May 2005, Annex VI has been subject to numerous amendments (refer also **Appendix A** for a full list). These amendments make reading the full body of the Annex VI treaty difficult.[5]

Of the many regulations covered by Annex VI, those related to the control of SO_X emissions have met with the most scrutiny to date. The IMO readily acknowledged that the original 1997 fuel limits for sulphur in Annex VI were too lenient to improve ship emissions appreciably. Accordingly, in 2008, Annex VI was amended to reduce the sulphur limit in marine fuels from 4.5 % to 3.5 % in 2012 with a further reduction to 0.5 % set for 2020.[6]

Similarly, the sulphur limit in marine fuels for ships operating in Sulphur (or SO_X) Emission Control Areas (**SECA**) dropped from 1.0 % in 2010 to 0.1 % in 2015.

As an alternative to using low-sulphur fuels, ships may use exhaust gas cleaning systems (e.g. scrubbers) or use other methods to limit their sulphur emissions.

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[5] https://www.transport.govt.nz/assets/Uploads/OC05343-MARPOL-Annex-VI-treaty-text.pdf

[6] All sulphur limits are weight %

Figure 1 shows how these sulphur limits compare to the current limit for New Zealand automotive diesel of 0.001 % (10 ppm).

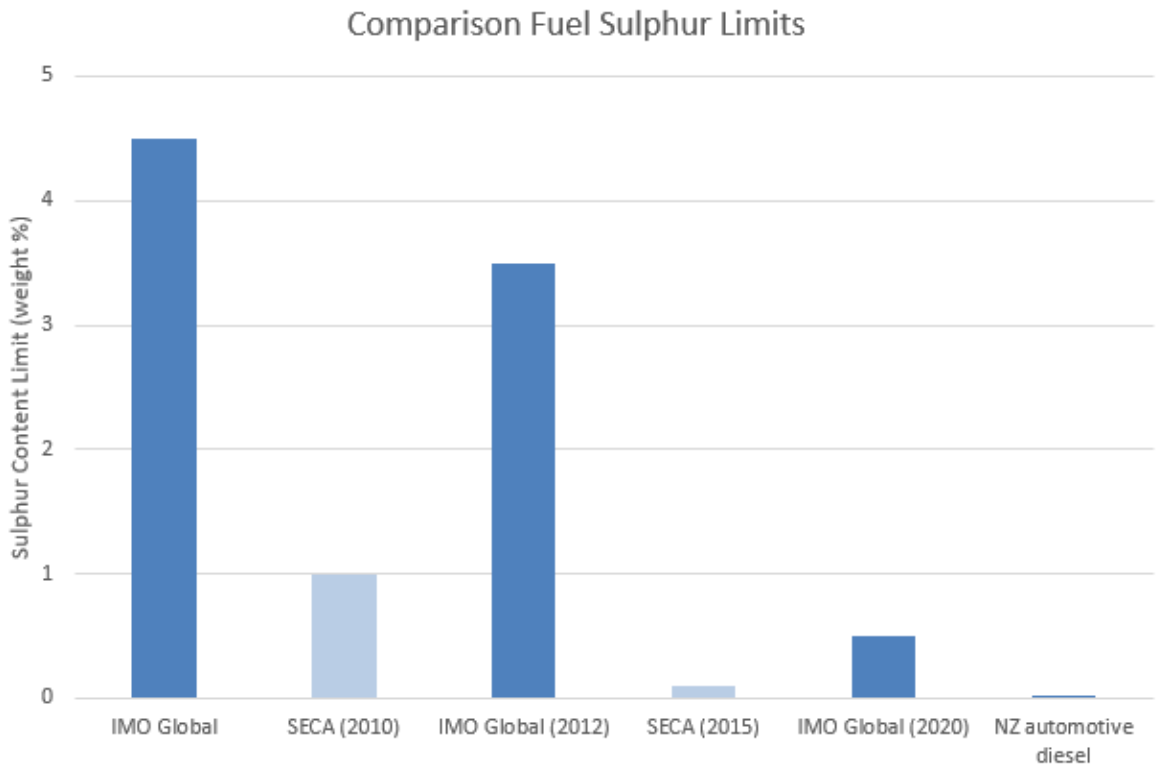

Figure 1 Comparison of the changes in sulphur limits in Annex VI marine fuel versus New Zealand automotive fuel

Note: IMO = International Maritime Organisation, SECA = Sulphur Emissions Control Area

1.3 How MARPOL Annex VI relates to New Zealand

As at 16 November 2018, 157 states are parties to the MARPOL convention.[7] This represents flag states of more than 99% of the world's shipping tonnage.

While all 157 states have acceded to Annexes I and II (mandatory), accession to the other four Annexes (voluntary) is less complete as shown in **Table 1.**

[7] IMO, undated. "Status of Treaties". [Online: Retrieved 28 November 2018]

Table 1 Status of accession to the various MARPOL Annexes by global shipping states as at 16 Nov 2018

MARPOL Annex	73/78 (I & II)	73/78 (III)	73/78 (IV)	73/78 (V)	1997 Protocol (VI)
No of states	157	147	142	152	91

New Zealand is currently a signatory to Annexes I, II, III and V. However, New Zealand has not acceded to Annex VI (prevention of air pollution from ships) - the subject of the current Ministry of Transport consultation - or Annex IV (prevention of pollution by sewage from ships).

Note: Member nations are responsible for vessels registered (flagged) on their national ship registry. This means that, regardless of where they sail, ships flagged under countries that are signatories to MARPOL are subject to its requirements.

This also means that, although New Zealand is yet to accede to Annex VI, ships from flagged states that have signed up still need to abide by its requirements in New Zealand waters. Many vessels currently operating in New Zealand waters (including international shipping, fishing vessels and ferries) are flagged to overseas states.

1.3.1 Potential impact on New Zealand ships

From 1 January 2020, all ships flagged to Annex VI Party States will have to comply with a lower sulphur fuel limit of 0.5 %. Currently the allowable limit is 3.5 %.

New Zealand's accession to Annex VI would affect some of our domestic ships, primarily by making them subject to the new limit on sulphur in fuel. The Ministry of Transport estimates the new sulphur limits would *potentially* affect around 33 ships:

- 11 ships (interisland ferries and domestic fuel tankers) that currently run on heavy fuel oil; and
- Another 22 ships for which there is no fuel information.

The Ministry of Transport also identified 36 fishing vessels which are primarily fuelled by New Zealand automotive diesel and would not be affected except for "some of the largest vessels".[8]

Affected ships have **three options to meet the new sulphur fuel limits:**

(i) Switch to low sulphur fuels (0.5 % fuel oil or New Zealand automotive diesel);[9]

(ii) Install abatement technology; and/or

[8] Office of the Associate Minister of Transport, 2018. "Approval to consult on accession to the International Maritime Organisation Treaty MARPOL Annex VI: Prevention of Air Pollution from Ships". Cabinet Environment, Energy and Climate Committee Paper. Hon James Shaw. Acting Associate Minister of Transport. November. [Online: Retrieved 12 November 2018]

[9] The Ministry of Transport is uncertain that low sulphur fuel oil (0.5% sulphur) will be available in New Zealand.

(iii) Upgrade to newer, more fuel efficient, ships.

Each of these options have costs, and benefits, for their owners as well as for New Zealand.

Note: Irrespective of New Zealand acceding to Annex VI, **from January 2020 New Zealand flagged ships visiting countries that are already party to Annex VI will still need to be compliant with Annex VI regulations.**

This includes domestic ships that are required to access dry docks in Australia or Singapore (which are already Party States to Annex VI) for out-of-water inspections, maintenance and repairs.

1.3.1 Potential impact on International ships

The Ministry of Transport states that our international trade is almost entirely carried on ships flagged to Annex VI Party States.[10] This means that there would be very little impact, if any, on international trade should New Zealand accede to Annex VI.

Unfortunately, the Ministry did not provide data on the fraction of cruise ships that are already flagged to Annex VI Party States.

There are around 300 cruise ships, and we understand these represent a small fraction of the global shipping industry. However, they are important because of the time they spend in and around New Zealand ports, where the public may be exposed to their harmful air emissions.

Currently, 78 cruise ships are scheduled to visit Wellington (alone) in 2018, with arrivals scheduled to increase to 110 in 2019.[11] However, these visits are by 24 individual ships (the same ships make multiple visits).[12]

An annual survey of 76 cruise ships in 2018, conducted by German environmental group Nabu, reports that all except one continue to burn heavy fuel oil.[13] This means that these ships will require abatement technology (scrubbers) to meet State Party Annex VI requirements when visiting State Party Annex VI countries.[14]

Recent media reports have revealed that some cruise ships that currently have abatement technology do not use it whilst in New Zealand – because current New Zealand regulations do not require it.[15] This will not be the case after 2020 **if** the ship is flagged to a country that is a party to Annex VI.

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[10] *Ibid.* at para 21.

[11] Crew Center, undated. "Wellington Cruise Ship Schedule 2018". [Online: Retrieved 13 December 2018]

[12] *Ibid.*

[13] Nature and Biodiversity Conservation Union, 2018. "NABU Cruise Ship Ranking 2018: AIDA at the top". [Online: Retrieved 20 December 2018]

[14] Or opt for lower sulphur fuel – but switching can require minor changes to the ship engines.

[15] Cropp A, 2018. "Cruise ship pollution in the spotlight after vessels busted in Alaska come to NZ". Stuff. 27 October. [Online: Retrieved 20 December 2018]

1.3.2 Compliance

Cruise ships attract public attention because they are highly visible. This visibility has underlined the importance of enforcement and compliance, with recent media revealing that it is not enough to have regulations – the regulations must be enforced.[16]

If New Zealand accedes to Annex VI, the Ministry of Transport (through Maritime New Zealand) will need to undertake compliance and enforcement actions for New Zealand and international ships operating in and around New Zealand.

[16] *Ibid.*

2 What is the significance of shipping emissions in New Zealand?

This chapter covers:

- Ship emissions to air;
- Trends in shipping movements in New Zealand;
- Trends in coastal occupation in New Zealand; and
- Relative contribution of shipping emissions to other air emissions sources in New Zealand.

2.1 Ship emissions to air

Globally air pollution from ships is a major concern - both in terms of emissions harmful to human health and greenhouse emissions. These are discussed below.

2.1.1 Harmful emissions

Harmful air pollutants emitted from fuel combustion in shipping include:

- Particulate matter smaller than 10 micrometres in diameter; 10 µm (**PM_{10}**) or smaller than 2.5 µm (**$PM_{2.5}$**);
- Nitrogen oxides (**NO_x**), in particular nitrogen dioxide (**NO_2**);
- Sulphur dioxide (**SO_2**) – primarily from combustion of heavy fuel oil as opposed to diesel;
- Carbon monoxide (**CO**);
- Volatile organic compounds (**VOC**) including polycyclic aromatic hydrocarbons (**PAHs**) and benzo(a)pyrene;
- Heavy metals including mercury and lead; and
- Dioxins.

Emissions of harmful air pollutants from shipping make a significant contribution to total emissions in Europe and worldwide. According to an analysis by Brandt et al. (2013), **shipping emissions cause about 50,000 premature deaths per year in Europe**.[17] This estimate assessed a wide variety of health impacts from typical pollutants emitted from ships, including PM_{10}, SO_2, CO lead and mercury (CEEH, 2013).[18]

Emissions of NO_x contribute to the formation of secondary particles and ozone, resulting in higher levels of respiratory and cardiovascular diseases among the population, especially in

[17] J Brandt et al, 2013. "Assessment of past present and future health cost externalities of air pollution in Europe and the contribution from international ship traffic using the EVA model system". *Atmos Chem & Physics.* 13(15):7747-7764. August.

[18] Centre for Energy, Environment and Health (CEEH), 2013. "Assessment of Health-Cost Externalities of Air Pollution at the National Level using the EVA Model System". CEEH Report Scientific Report No. 3. Roskilde. Denmark. March. [Online: Retrieved 19 December 2018]

coastal states. Sulphur dioxide is also known for its role in secondary (fine) particulate formation, which, in turn (PM) is a known carcinogen.

In contrast to the progress in reducing emissions from land-based sources, shipping emissions of SO_2 and NO_X have steadily been increasing over the last thirty years. While recently introduced marine fuel sulphur limits at global and EU levels have halted this increasing trend for SO_2 emissions (at least in the Sulphur Emission Control Areas in northern Europe and North America), NO_X emissions are expected to continue increasing. As a result, by 2022, NO_X emissions from international shipping around Europe are expected to equal or even surpass the total from all land-based sources in the 28 EU member states combined.[19]

2.1.1 Greenhouse gas emissions

Greenhouse gases emitted from ships include mainly (Styhre *et al*, 2017):[20]

- Carbon dioxide (**CO_2**);
- Methane (**CH_4**); and
- Nitrous oxide (**N_2O**).

In addition, ships emit, depending on the fuel burnt, other gases with climate impact such as black carbon (which has a warming potential) and sulphate particles (which have a cooling effect). Of these, CO_2 dominates the global warming potential and is the most significant component because of its abundance, its atmospheric lifetime and its associated warming ability that changes the amount of heat energy trapped within the atmosphere (Styhre *et al*, 2017).

The United Nations estimates that maritime transport is currently responsible for only 2.5% of global CO_2 emissions, but its emissions are projected to grow by up to 250 % by 2050.[21] To put this in context, the International Council on Clean Transportation (**ICCT**) estimates that if international shipping was treated as a country it would be the sixth largest emitter of CO_2 in the world - roughly the same as Germany.[22] Their study looking at shipping emissions between 2013 and 2015 found (ICCT, 2017):

- **Fuel consumption is increasing**. Total shipping fuel consumption increased from 291 to 298 million tonnes (+2.4%) from 2013 to 2015.

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[19] Air Pollution and Climate Secretariat, 2018. "Ship emissions". Sweden. [Online: Retrieved 13 December 2018].

The Air Pollution and Climate Secretariat is a joint venture between four Swedish environmental organisations with the chief purpose of promoting awareness of the problems associated with air pollution and climate change. The four environmental organisations are: World Wide Fund for Nature (Sweden), Friends of the Earth (Sweden), Nature and Youth Sweden and Swedish Society for Nature Conservation.

[20] Styhre, L., Winnes, H., Black, J., Lee, J., & Le-Griffin, H. (2017). "Greenhouse gas emissions from ships in ports – Case studies in four continents". Transportation Research Part D: *Transport and Environment*, 54, 212–224.

[21] United Nations, 2018. "UN Climate Change News". 10 April 2018. [Online: Retrieved 19 December 2018]

[22] International Council on Clean Transportation, 2017. Greenhouse gas emissions from global shipping, 2013-2015. Washington. USA. [Online: Retrieved 13 December 2018]

- **Shipping GHG emissions are increasing despite improvements in operational efficiency** for many ship classes. Increasing emissions are being driven by rising demand for shipping and the associated consumption of fossil fuels.

- **Black carbon is a major contributor to shipping's climate impacts**. After CO_2, black carbon contributes the most to the climate impact of shipping, representing 21% of total shipping CO_2 equivalent (**$CO_{2\text{-}e}$**) emissions on a 20-year time scale.

- **The biggest ships are speeding up and emitting more**. Unlike most ships, the largest container and oil tankers sped up between 2013 and 2015 and became less efficient, emitting more CO_2 per deadweight tonne-nautical mile in 2015 than in 2013.

- **Absolute reductions in ship emissions will require concerted action to improve the energy efficiency of shipping and to develop and deploy alternative fuel and propulsion concepts.** The only way to reduce emissions from ships without constraining demand is to substantially reduce the amount of CO_2 and $CO_{2\text{-}e}$ emitted per unit of transport supply.

Compared with vehicle emissions which have seen increasingly stringent regulation for many years, ship emissions of greenhouse gases are significant and somewhat overdue for international regulation.

2.2 Trends in NZ shipping

New Zealand has thirteen major ports as shown in **Figure 2**.

Figure 2 Locations of the major ports in New Zealand (Tenco, 2018)

Table 2 shows that of the top six ports, most have seen significant growth in port container volumes since 2010. In 2017 Tauranga, our largest port, handled an annual container volume of 774,703.[23]

Table 2 Port container volumes 2010-2017 (MoT, 2018)

Year	AKL	TRG	NAP	WGT	LYT	OTA	TOTAL
2010	541,708	347,815	111,796	70,385	188,361	154,643	1,414,708
2011	549,906	396,171	121,116	65,125	204,056	137,786	1,474,160
2012	458,567	563,033	135,819	67,722	227,844	119,400	1,572,385
2013	549,375	510,788	140,906	61,985	250,886	128,251	1,642,191
2014	610,825	529,203	144,010	71,749	262,395	118,148	1,736,330
2015	587,332	586,988	157,700	80,759	245,747	113,307	1,771,833
2016	558,510	657,690	159,950	77,403	260,760	118,586	1,832,899
2017	580,351	774,703	172,792	----	279,818	129,544	1,937,208
Growth since 2010	**7%**	**123%**	**55%**	**n/a**	**49%**	**-16%**	**37%**

Note: AKL = Auckland, TRG = Tauranga, NAP = Napier, WGT = Wellington (2017 data not available because port damaged by Kaikoura earthquake), LYT = Lyttelton, OTA = Otago (Dunedin).

At the same time, New Zealand's popularity as a world-class cruise destination is continuing to grow. Cruise market growth in New Zealand has increased 13% per annum since 2010, significantly higher than growth of the global tourism market at 7% per annum.[24]

Figure 3 shows the cruise ship movements across New Zealand in 2016/17.

In 2017/18, 37 cruise ships were forecast to make 162 voyages, spending 809 days in New Zealand ports. The forecast for 2018/19 is 39 cruise ships making 191 voyages and spending 984 days in port.

[23] Ministry of Transport, 2018. "Annual port container volumes". [Online: Retrieved 13 December 2018]

[24] Tourism New Zealand, 2018. "Cruise-infographic-highlights-thriving-visitor-sector". [Online: Retrieved 13 December 2018]

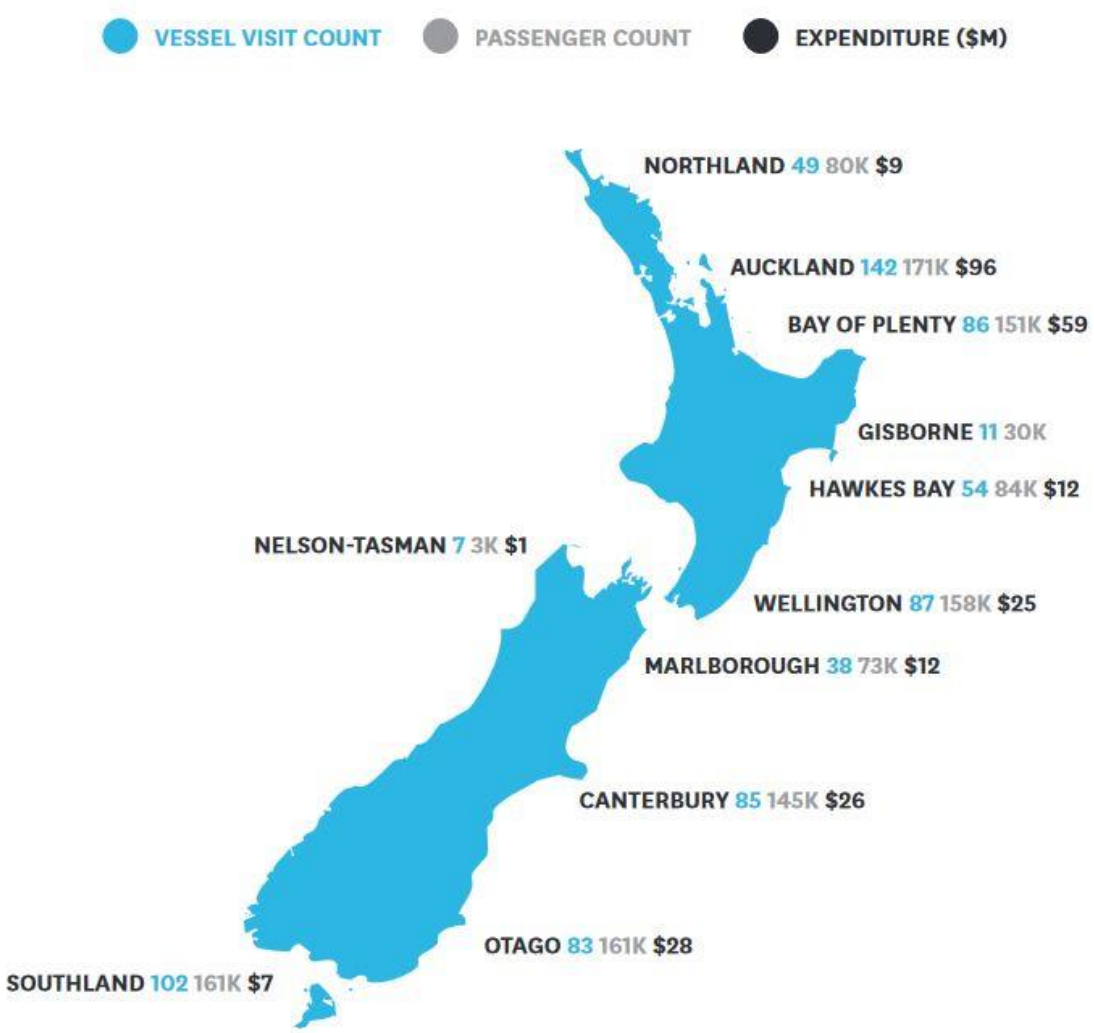

Figure 3 Cruise ships visits, passenger counts and estimated expenditure in New Zealand 2016/17 (Tourism New Zealand, 2018)

2.3 Trends in coastal occupation

Most of New Zealand's population resides near the coast, with many people living within a few kilometres from a major port.

While container volumes and cruise ship movements have grown, local populations have also increased.

Table 3 shows the population growth in cities located near to ports which have undergone expansion from 2010 to 2017. [25] Whiles these figures represent the urban areas, many of these locations have undergone residential area intensification adjacent to the ports so the likely increase in population exposure to shipping emissions is at least as much the figures shown.

Table 3 Population growth for urban areas located near major ports 2010-2017 (StatsNZ, 2018)

Urban Area	Pop'n at 30 June 2010	Pop'n at 30 June 2017	Growth
Whangarei	52300	57700	10%
Auckland	1333000	1534700	15%
Tauranga	121100	137900	14%
Gisborne	34500	36600	6%
Napier-Hastings	125700	133000	6%
New Plymouth	52900	57500	9%
Wellington	384500	412500	7%
Nelson	60700	66700	10%
Dunedin	114200	120200	5%

One way to quantify the resultant exposure would be to assume that all people living within three kilometres of a port might reasonably be affected by ship emissions. **Table 4** provides a rough estimate of resident populations within a few kilometres of New Zealand ports, based on 2013 census data (StatsNZ, 2018). This suggests that nationwide around 140,000 New Zealanders may be currently exposed to harmful ship emissions. However, the figures for Auckland are likely to be significant underestimates as the population in the inner city has surged since the 2013 census.

One drawback of this approach is that it only considers **resident** exposure and does not address people that live elsewhere but come into the central business district (**CBD**) for work each day.[26] Exposure for day commuters is likely to be significant in Auckland, Wellington and Dunedin where the CBDs are all adjacent to working ports. **Table 4** includes rough estimates of CBD working populations in Auckland and Wellington, with the numbers multiplied by 1/3 to account for city commuters only being exposed for 8 hours out of a possible 24 hours to harmful ship emissions.

This increases the total to just under 200,000 New Zealanders living and working in areas, where they could be exposed to harmful ship emissions. This is also likely to be an underestimate as it does not include people living in coastal areas near the shipping lanes (e.g. Takapuna).

Table 4 Estimated Resident Population within 3 km of New Zealand Ports (StatsNZ, 2018)

[25] Statistics New Zealand, 2018. "Subnational population estimates". [Online: Retrieved 17 December 2018]

[26] This may be offset, to some extent, by residents from the central city that work outside the CBD.

City	Census Area Unit	Residents (2013)	Workers CBD x 1/3
Whangarei	Waiotira-Springfield	2,007	
	Bream Head	1,302	
Auckland [1]	Auckland Harbourside	4,503	39,985
	St Marys	2,928	
	Freemans Bay	3,765	
	Auckland Central West	11,700	
	Auckland Central East	10,104	
	Parnell West	4,764	
	Parnell East	2,331	
	Newmarket	2,961	
	Grafton East	1,071	
	Grafton West	3,384	
	Newton	1,641	
	Stanley Bay	2,187	
	Mt Victoria	5,340	
Tauranga	Otumoetai North	3,750	
	Sulphur Pt	27	
	Tauranga City Marinas	72	
	Omanu	5,172	
Gisborne	Kaiti South	2,655	
Napier	Bluff Hill	2,697	
Wellington [2]	Thorndon-Tinakori Rd	4,125	7,667
	Lambton	5,625	
	Willis St-Cambridge Tce	7,329	
	Wellington City Marinas	36	
	Oriental Bay	1,056	
	Roseneath	1,731	
	Wadestown	3,516	
	Kaiwharawhara	144	
Marlborough	Picton	2,745	
	Waikawa	1,308	
Christchurch	Lyttelton	2,859	
Dunedin	Ravensbourne	1,230	
	Opoho	1,212	
	North Dunedin	3,465	
	Otago University	5,082	
	Roslyn North	1,881	
	Stuart St-Frederick St	3,099	
	High St-Stuart St	2,349	
	Harbourside	24	
	Fernhill	1,731	
	Roslyn South	2,256	
	Belleknowes	1,722	
	Mornington	3,267	
	Caledonian	3	
	South Dunedin	2,421	

City	Census Area Unit	Residents (2013)	Workers CBD x 1/3
	Musselburgh	2,652	
	Vauxhall	3,882	
Southland	Bluff	1,791	
Total		142,902	47,652
	National Total	**190,554**	

[1] Infometrics Auckland City Centre Economic Profile. [Online: Retrieved 20 December 2018] Available here: https://ecoprofile.infometrics.co.nz/Auckland%20City%20Centre%20(3%20CAUs)

[2] Wellington Facts and Figures. [Online: Retrieved 20 December 2018] Available here: https://www.wellingtonnz.com/life-in-wellington/facts-and-figures/

2.4 Shipping emissions relative to other air emissions sources

Little work has been undertaken to comprehensively quantify shipping emissions in New Zealand.

Table 5 presents harmful emissions arising from shipping from the recent air domain report (Our Air 2018) published by the Ministry for the Environment and Statistics New Zealand. [27] This is based on a national emissions inventory prepared by Emission Impossible Ltd for the Ministry for the Environment (EIL, 2018).[28] The national inventory estimated emissions of PM_{10}, particulate matter less than 2.5 micrometres in diameter (**$PM_{2.5}$**), CO, NO_x and SO_2 for a base year of 2015.

The national inventory only accounts for domestic vessels operating within New Zealand coastal waters and exclude emissions from international shipping in port or at sea. Nonetheless, the figures in **Table 5** show that domestic shipping (alone) is an appreciable contributor to NO_X and SO_2 emissions relative to other anthropogenic (human-generated) air emissions sources.

Table 5 Relative contribution of annual domestic shipping to total anthropogenic emissions 2015 (EIL, 2018)

Emissions (t/yr)	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2
Domestic shipping	828	748	1,089	11,564	10,114
All anthropogenic sources	46,099	34,504	531,493	121,364	49,946
Relative contribution	**2%**	**2%**	**0%**	**10%**	**20%**

Note: the shipping emissions in the above table assume an average fuel sulphur content of 3.5 %.

[27] Ministry for the Environment (MfE) and Statistics New Zealand, 2018. "Our Air 2018". Wellington. October. [Online: Retrieved 13 December 2018]

[28] Emission Impossible Ltd, 2018. "National air emissions inventory 2015". Prepared for the Ministry for the Environment. Auckland. October. [Online: Retrieved 13 December 2018]

Auckland Council published a detailed Auckland air emissions inventory that estimated emissions from international vessels (such as cargo ships and cruise ships) at port and when travelling within the Auckland Council marine boundaries.[29]

From the Auckland inventory, it is possible to estimate how many light duty vehicles (cars and vans) would be equivalent to a typical cruise ship visit - at least in terms of NO_X and PM_{10} emissions.

An "average"[30] cruise ship travelling around New Zealand typically emits 2,620 kg of NO_X and 290 kg of PM_{10} when visiting in port. These amounts are roughly equivalent to total daily emissions of:

- 210,000 cars (based on NO_X); or
- 280,000 cars (based on PM_{10}).

For perspective, in 2017 Wellington had 340,000 registered light duty vehicles (cars and vans).[31] This means that a typical cruise ship visit to Wellington results in only slightly less emissions than emissions from an entire days' worth of car and van travel in the region.

[29] Peeters S, 2018. "Auckland air emissions inventory 2016 - Sea transport". Prepared for Auckland Council. July. [Online: Retrieved 13 December 2018]

[30] Based on the total annual cruise ship emissions divided by the number of cruise ships reported in Peeters (2018).

3 Key public health impacts associated with air emissions from shipping

The key public health impacts arising from air emissions from shipping are:

(i) Effects from harmful emissions; and

(ii) Effects from climate change caused by greenhouse gas emissions

3.1 Effects associated with harmful air emissions

Harmful air pollutants are so-called because they can cause **adverse** human health effects. The effects of harmful air pollutants depend on the:

- Composition of the pollutant mixture;
- Level and duration of exposure; and
- Factors related to the sensitivity of the exposed population (such as age, ethnicity and pre-existing medical conditions).

Effects can range from minor nuisance to serious and be short-term (acute) or long-term (chronic). This document focusses primarily on pollutants that can cause serious adverse health effects.

It is well documented that exposure to air pollution may lead to adverse health effects, such as increased **morbidity** (illness) and **premature deaths** (loss of life), mainly related to respiratory and cardiovascular diseases.

Premature deaths are deaths that occur before a person reaches an expected age. This expected age is typically the life expectancy for a country stratified by sex. Premature deaths are considered preventable if their cause can be eliminated. (EEA, 2018)

3.1.1 Composition

Different air pollutants produce different health effects (see **Figure 4**):

- Carbon monoxide (CO) is a gas that is readily absorbed from the lungs into the bloodstream. It attaches more readily to haemoglobin in the blood than oxygen and can cause headaches, dizziness, weakness and aggravate heart conditions.[32]

[32] For further information on health effects, please refer WHO, 2004. "Environmental Health Criteria 213. Carbon Monoxide (Second Edition)".

- Nitrogen dioxide (NO_2) is a gas that causes increased susceptibility to infections and asthma. It reduces lung development in children and has been associated with increasingly more serious health effects, including reduced life expectancy.[33, 34]
- Sulphur dioxide (SO_2) is a gas that can aggravate respiratory and cardiovascular conditions. It can trigger bronchospasm in asthmatics and its effects are heightened by exercise. Sulphur dioxide also forms secondary (fine) particulate matter. [35]
- Volatile organic compounds (VOCs) include a wide range of chemicals, some of which are carcinogenic to humans. Of most concern are benzene,[36] formaldehyde,[37] 1-3 butadiene[38] and polycyclic aromatic hydrocarbons (**PAHs**) which include benzo(a)pyrene (**BaP**). VOCs can also react with NO_X in the presence of sunlight to form ozone (**O_3**) which is a lung irritant.[39]
- Particulate matter (PM_{10} and $PM_{2.5}$) impacts predominantly on respiratory and cardiovascular systems. Effects can range from reduced lung function to increased medication use to more hospital admissions through to reduced life expectancy and death.[40]
- Heavy metals such as lead and mercury are a threat to the development of the child in utero and early in life. Lead is a cumulative toxicant that affects multiple body systems and can cause adverse neurological and behavioural effects in children.[41] Mercury may have toxic effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes.[42]
- Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer.[43]

Particulate matter, being so ubiquitous, warrants further discussion.

Adverse health effects caused by particulate matter are dependent on its size and its ability to act as a carrier for other pollutants. Larger particles (between 2.5 and 10 µm in size) generally deposit in the upper airways but particles 2.5 µm and smaller penetrate more deeply into the lungs. Ultrafine particles ($PM_{0.1}$) with diameters less than 0.1 µm

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[33] (UK) Committee on the Medical Effects of Air Pollutants, 2015. "Statement on the evidence of effects of nitrogen dioxide on health". Public Health England. March.

[34] For further information on health effects of nitrogen dioxide, please refer WHO, 2006. "Air Quality Guideline Global Update 2005" at page 333. See also WHO, 2013. "Review of evidence on health aspects of air pollution – REVIHAAP Project" at page 117.

[35] For further information on health effects of sulphur dioxide, please refer WHO, 2006. "Air Quality Guideline Global Update 2005" at page 398. See also WHO, 2013. "Review of evidence on health aspects of air pollution – REVIHAAP Project" at page 142.

[36] For further information on health effects of benzene, please refer WHO, 2010. "Exposure to Benzene: A Major Public Health Concern." See also IARC, 2018. "IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Vol 120 Benzene."

[37] For further information on health effects of formaldehyde, please refer WHO, 2000. "WHO Guidelines for Indoor Air Quality. Selected Pollutants." At page 110. See also IARC, 2012. "IARC Monographs on the Evaluation of Carcinogenic Risks to Humans: Vol 100F-29, Formaldehyde."

[38] For further information on health effects of 1,3-butadiene, please refer WHO, 2001. "1,3-Butadiene: Human Health Aspects."

[39] For further information on health effects of ozone, please refer WHO, 2006. "Air Quality Guideline Global Update 2005" at page 314.

[40] For further information on health effects of particulate matter, please refer WHO, 2006. "Air Quality Guideline Global Update 2005" at page 247. See also WHO, 2013. "Review of evidence on health aspects of air pollution – REVIHAAP Project" pp 6-46.

[41] For further information on health effects of lead, please refer WHO, 2010b. "Exposure to lead: A major public health concern."

[42] For further information on health effects of mercury, please refer WHO, 2017. "Mercury and Health." and "Mercury: Most recent WHO evaluation and risk assessment documents".

[43] For further information on health effects of dioxins, please refer WHO, 2016. "Dioxins and their effects on human health".

can pass through pulmonary tissue, enter the bloodstream, and circulate throughout the body. In addition, toxic substances can be carried into the lungs attached to the particles. One example is arsenic, which is discharged to air when treated wood is burned in domestic fires.

Current estimates suggest that the most significant health impacts, in terms of the burden on the health system and society, arise from particulate matter (PM_{10} and $PM_{2.5}$). However, concern about exposure to NO_2 is increasing. A recent study found nearly 9,500 people die prematurely each year in London due to long-term exposure to air pollution – more than twice as many as previously thought, once both NO_2 and PM effects were accounted for.[44]

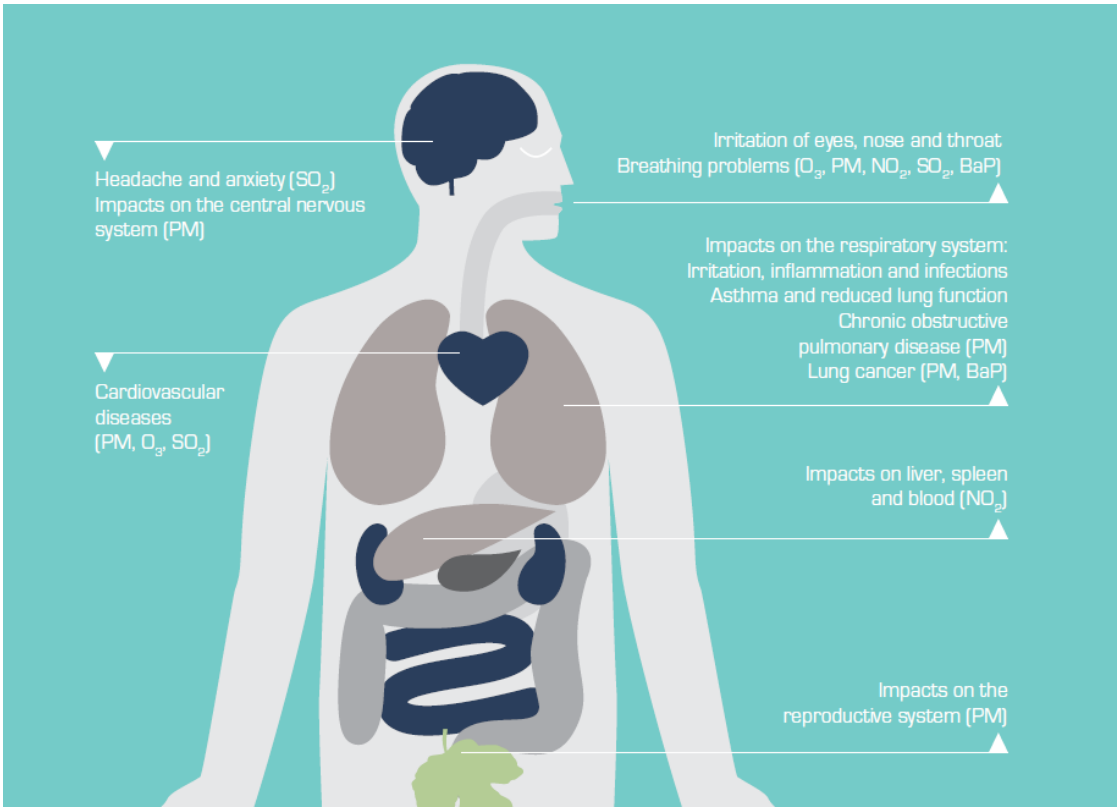

Figure 4 Examples of the health impacts associated with air pollution (EEA, 2013)

Note: BaP = benzo(a)pyrene, NO_2 = nitrogen dioxide, O_3 = ozone, PM = particulate matter, SO_2 = sulphur dioxide

[44] Kings College London, 2015. "Understanding the health impacts of air pollution in London". Prepared for Transport for London and the Greater London Authority. London. UK. July. [Online: retrieved 19 December 2018]

Note: The specialised cancer agency of the World Health Organization – the International Agency for Research on Cancer (**IARC**) – announced in 2013 that it had classified **outdoor air pollution as carcinogenic** to humans (Group 1), due to evidence linking it to lung cancer and associating it with bladder cancer.[45] In a separate evaluation, **particulate matter was also classified as carcinogenic** to humans (Group 1). IARC acknowledged that whilst the composition of air pollution and levels of exposure vary dramatically between locations, these classifications apply to all regions of the world. IARC had already classified **diesel engine exhaust as carcinogenic** to humans (Group 1) in 2012.[46]

3.1.2 Certain people are more vulnerable to poor air quality

Susceptibility to the effects of air pollution depends on factors that are unique for each individual (e.g., age, health status, genetic makeup) as well as exposure (e.g., time spent outdoors, proximity to major roads).

Based on health reviews, the groups within the population who are more affected by air pollution than others include elderly people, children (including babies, infants and unborn babies), people with pre-existing heart or lung disease, people with respiratory conditions, asthmatics, diabetics, pregnant women and Māori. [47]

3.1.3 Long-term exposure is more harmful than short-term exposure

Air pollution exposure can have two classes of effects: short-term (**acute**) or long-term (**chronic**) effects. Short–term exposures cover minutes, hours, or days. Long-term exposures are usually over months or years.

Short-term exposure to combustion related air pollution can cause respiratory irritation, even in healthy people. Clinical studies have shown a range of acute cardiovascular and respiratory effects in volunteers with or without pre-existing diseases. Some short-term effects (such as heart rhythm disturbances) are completely reversible, but others can cause chronic inflammation of the lungs and blood vessels, and eventually, following repeated exposure, lead to chronic diseases such as lung cancer and atherosclerosis (hardening of the arteries).

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[45] International Agency for Research on Cancer (IARC), 2013. "Outdoor air pollution a leading environmental cause of cancer deaths". Lyon. France. October.

[46] IARC, 2012b. "Diesel engine exhaust carcinogenic". Lyon. France. June.

[47] MfE, 2011. "Clean healthy air for all New Zealanders". Wellington. August.

Short-term effects from elevated concentrations of harmful air pollutants can include premature death in susceptible individuals. However, the major impact of air pollution exposure on life expectancy is thought to be the gradual, cumulative effects on chronic disease. Relative risk ratios indicate that **the health burden due to chronic exposure to air pollution is typically 10 times greater than that for acute exposure**.[48]

3.2 Effects associated with greenhouse gases

Greenhouse gases (also known as "climate pollutants") emitted from fuel combustion in shipping include:

- Carbon dioxide (**CO_2**);
- Nitrous oxide (**N_2O**); and
- Black carbon – which is essentially fine particulate matter ($PM_{2.5}$ and smaller).

Greenhouse gases (**GHGs**) are so-called because they contribute to global warming and climate change. GHGs are categorised as **short-lived** with an atmospheric lifetime of days to ~15 years (e.g. black carbon and CH_4) or **long-lived** with an atmospheric lifetime of more than 100 years (e.g. CO_2). For ease of comparison, GHGs are typically expressed as CO_2-equivalents (**$CO_{2\text{-}e}$**), which is the amount of *CO_2* which would have the ***equivalent*** global warming impact.

Note: Several harmful pollutants (especially black carbon) are **direct** climate pollutants. Many of the remaining harmful pollutants (e.g. SO_2 and CO) are **indirect** climate pollutants. They do not have a direct warming effect but react with other gases and increase GHG concentrations. **Therefore initiatives which address harmful air pollutants typically yield both health and climate change benefits.**

3.2.1 Impacts of climate change

Climate change affects human health in several ways.[49] Direct effects of climate change include:

- Increased extreme meteorological-caused events (e.g. flooding, fires);
- Displacement; and
- Extreme temperatures.

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[48] World Health Organization (WHO), 2006. "Air Quality Guideline Global Update 2005". WHO Regional Office for Europe. Copenhagen. Denmark.

[49] Royal Society of New Zealand, 2017. "Human Health Impacts of Climate Change in NZ". October. [Online: Retrieved 13 December 2018]

Indirect effects from climate change on human health include:

- Increased harmful algal blooms;
- Increased microbial contamination;
- Decreased food availability, quality and safety;
- Decreased mental health and well-being;
- Reduced outdoor air quality;
- Increased carriers of new diseases; and
- Increased migration of tropical species into New Zealand

These last two are particularly relevant for shipping, and increased cruise ship visits, in New Zealand.

Globally, 2017 was Earth's second-warmest year on record, just behind 2016. In New Zealand, 2017 was the fifth-warmest on record (since monitoring began in 1909) with January 2018 being the hottest New Zealand month in 150 years.[50]

While cases of malaria declined in New Zealand between 2015 and 2016, cases of dengue fever and Zika virus (also mosquito borne) increased.[51] Zika virus outbreaks in the Pacific have been increasing since 2013 and New Zealand cases are currently linked to travellers coming into New Zealand. Climate change increases the possibility of these diseases becoming established in New Zealand.

3.2.2 Vulnerable communities in New Zealand

As with effects of harmful air pollution, the effects of climate change will not be spread evenly across the population. Impacts are more likely to affect communities already subject to socioeconomic and ethnic health inequalities.

Some Māori communities are likely to be particularly vulnerable to increased flood risk due to climate change because their ancestral settlements and sacred sites are located on exposed, erosion-prone coastal lands.

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[50] National Institute of Water and Atmospheric Research (NIWA), 2018. "NZ Monthly, Seasonal and Annual Climate Summaries". Auckland. New Zealand. [Online: Retrieved 13 December 2018]

[51] Institute of Environmental Science and Research Ltd (ESR), 2018. "Notifiable Diseases Commentary 2016". New Zealand. [Online: Retrieved 17 December 2018]

3.2.3 Vulnerable communities elsewhere

New Zealand also has an obligation to support vulnerable communities in the Pacific.

Many Pacific island nations are low lying - making them considerably more vulnerable to the effects of sea level rise and extreme weather events.

As previously mentioned, Pacific island communities are already seeing increases in Zika virus infections as warmer moister conditions support increased mosquito activity.

3.3 Public health costs associated with shipping emissions

3.3.1 Global estimates

Harmful air pollution from international shipping accounts for approximately 50,000 premature deaths per year in Europe, at an annual cost to society of more than €58 billion (Brandt et al, 2013). Implementing the 0.5 % sulphur limit for marine fuels from 2020 would save 26,000 lives per year in Europe alone.

A worldwide adoption of the 0.5 % limit is expected to save 40,000 lives a year globally from lung cancer and cardiovascular diseases (not including benefits for improvements in child asthma and morbidity).[52]

The World Health Organisation (WHO) undertook a quantitative assessment of the health impacts of climate change in 2014 (WHO, 2014).[53] The assessment considered a subset of the possible health impacts and assumed continued economic growth and health progress (WHO, 2014):

> *"Even under these conditions, it concludes that climate change is expected to cause approximately 250,000 additional deaths per year between 2030 and 2050; 38,000 due to heat exposure in elderly people, 48,000 due to diarrhoea, 60,000 due to malaria, and 95,000 due to childhood undernutrition."*

3.3.2 New Zealand estimates

In New Zealand, estimates are not currently available for estimated health impacts of shipping from either harmful or greenhouse gas emissions.

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[52] European Federation for Transport and Environment, 2018. "Benefits of reducing air pollution from ships". Brussels. Belgium. [Online: Retrieved 13 December 2018]

[53] WHO, 2014. "Quantitative risk assessment of the effects of climate change on selected causes of death". Geneva. Switzerland. [Online: Retrieved 13 December 2018]

The most comprehensive study to date which quantifies health impacts from anthropogenic air emissions is the Updated Health and Air Pollution in New Zealand (HAPINZ) study. [54] **This has a base year of 2006 and is largely based on the health effects associated with PM_{10}** emitted from motor vehicles, domestic fires, open burning and industry. The annual cost of anthropogenic air pollution in New Zealand was estimated at NZD$4.28 billion (as at June 2010), as a result of 1,175 premature deaths, 607 hospitalisations for respiratory and cardiac illnesses and 1.49 million restricted activity days.[55] The Updated HAPINZ study does not specifically consider either shipping emissions or pollutants other than PM_{10}.

The HAPINZ study has been subsequently used to develop damage costs - most recently to evaluate transport emissions in Wellington.[56]

Damage costs are a way to value changes in air emissions in order to compare the benefits to society of a change in policy/operation versus the cost of implementing the change. They can also be used to compare a range of options to see which will yield the best overall outcome. Internationally, most governments publish relevant values to be used in the assessment of costs and benefits of various policy options in their jurisdictions.

Table 6 shows the damage costs developed for a Wellington transport emissions evaluation that was reviewed and approved by NZTA. In the absence of any other data, these provide a suitable basis for valuing public health benefits of emission reductions associated with New Zealand acceding to Annex VI.

Table 6 also provides a comparison with existing (2015) published damage costs for the United Kingdom.

Table 6 Estimated social (damage) costs of emissions in NZD/tonne (2015) used in Wellington compared with UK values adjusted to NZD (2015)

Pollutant	New Zealand Costs in NZD/tonne[1]	United Kingdom Costs in NZD/tonne[2]	Value Base Date
CO_2	$66	-	2015
PM_{10}	$451,123	$126,846	2015
NO_X	$16,031	$55,107	2015
CO	$4.16	-	2015
Hydrocarbons*	$1,318	-	2015
SO_2	-	$3,947	2015

[54] Kuschel et al, 2012. "Updated Health and Air Pollution in New Zealand Study". Auckland. New Zealand. March.

[55] Restricted activity days are days on which people cannot do the things they otherwise have done if air pollution was not present.

[56] Kuschel et al, 2017. "Evaluating Bus Emissions". Paper by G Kuschel, A Cooper and J Metcalfe presented at the Australasian Transport Research Forum. Auckland. 27-29 November 2017. Available at: https://atrf.info/papers/2017/index.aspx

Note:

[1] Kuschel et al, 2017

[2] DEFRA, 2015.[57] £1,956 central value converted to NZD (2015) based on GBP (3-year average 2013-2015) currency conversion 0.4955

* Essentially equivalent to volatile organic compounds (VOCs)

[57] Department Environment, Food and the Regions (DEFRA), 2015. "Air quality: economic analysis". London. September. Transport average (Central). [Online: Retrieved 20 December 2018]

4 Responding to the discussion document

The Ministry of Transport discussion document seeks feedback on New Zealand's potential accession to the International Maritime Organization treaty: MARPOL Annex VI: Prevention of Air Pollution from Ships.

This chapter outlines a preferred position to the key question on whether New Zealand should accede to MARPOL Annex VI (yes). It also provides possible responses to four questions framed as public health, one question on timeframes and a final general question posed by the Ministry of Transport.

We encourage parties to use any, or all, of the background information provided in this document to assist with drafting submissions. We further note that this document does not preclude feedback on additional matters.

For completeness, all 38 questions are repeated in full in **Appendix B**. Public consultation closes on 11 February 2019.

Q1. New Zealand's stated ambition is to be a global leader on climate change and strengthen our credibility and influence in international climate negotiations. To enable New Zealand to influence climate change policy at the IMO we need to accede to Annex VI and be at the table to influence decisions. Do you agree? Please provide a detailed response. If you don't agree please provide reasons why.

It is our view that yes, New Zealand should accede to Annex VI, but not just so that New Zealand can influence international climate negotiations.

Researchers who have extensively studied the shipping industry are clear that the benefits of greener shipping outweigh the costs (Winnebrake & Corbett, 2018).[58] The benefits include:

- Reduced emissions of harmful air pollutants will result in reduced adverse public health effects (and costs), including premature deaths;
- Reduced emissions of harmful air pollutants will result in reduced adverse effects on ecosystems (e.g. acidification, deposition of toxics such as heavy metals and dioxins);
- Reduced greenhouse gas emissions are a tangible action to combat climate change (an issue of planetary urgency).

These three benefits provide compelling reasons, on their own, for New Zealand to accede to MARPOL Annex VI.

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[58] J. Winnebrake & J. Corbett, 2018. "The urgency of curbing pollution from ships, explained". The Converation. 12 April. USA. [Online: Retrieved 20 December 2018]. Extensive shipping research available here: https://scholar.google.com/citations?user=nFDXRBkAAAAJ&hl=en&oi=ao

Q5. What are the public health benefits of acceding to Annex VI?

Little work has been undertaken to comprehensively assess shipping emissions in New Zealand. This constrains the ability of health agencies to provide robust data in support of anticipated health benefits resulting from ship emissions reductions.

This is further complicated by complexities of the counter factual position i.e. the extent to which international vessels flagged to countries which have acceded to Annex VI by 2020 would reduce their harmful air and greenhouse gas emissions anyway. Peeters (2018) notes that "*nearly all foreign vessels visiting Auckland are already subject to Annex VI regulations*".[59] Therefore, even if New Zealand does not sign up to Annex VI, a substantial drop in SO_2 emissions can be expected when the 0.5 % sulphur content limit comes into effect in 2020.

The public health benefits will not be able to be robustly quantified unless, or until, a comprehensive inventory for shipping in New Zealand is developed. (The 2015 Ministry for the Environment inventory only estimates domestic shipping emissions).[60] We query why this, and a cost benefit analysis, were not provided with the Ministry of Transport discussion document.

What is clear, and indeed well established, is that reducing emissions of harmful air pollutants from ships will have a direct reduction in adverse health effects for members of the public exposed to those emissions. A rough estimate suggests that nearly 200,000 New Zealanders may be living and working in reasonably close proximity to harmful ship emissions. Thus, it is reasonable to anticipate significant public health benefits would be accrued in and around New Zealand ports should harmful ship emissions to air be reduced. This will be especially true for harmful pollutants emitted from ship fuel combustion that are carcinogenic and/or for which there is no safe threshold such as:

- PM_{10};
- Benzene; and
- Dioxins and heavy metals including lead and mercury.

Adverse health effects from air pollution are typically disproportionately borne by sensitive parts of the population such as the elderly and the socio-economically disadvantaged. There are therefore, significant social and environmental justice benefits to be realised through regulations to reduce harmful emissions.

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[59] Peeters S., 2018. At page 5.

[60] EIL, 2018.

Q6. What are the public health costs of acceding to Annex VI?

We have not identified any public health costs of acceding to Annex VI.

Q7. Are there any cost and benefits resulting from accession to Annex VI for the marine and built environments?

This question does not relate to public health. However, the following points are relevant:

- Reduced emissions (especially greenhouse gases) will also have ecological benefits in terms of minimising ocean acidification, ocean warming and extreme weather events (which can damage habitat);
- Part of Annex VI focusses on reducing ozone depleting substances so that will also improve health and environmental outcomes;
- Reduced SO_2 emissions will reduce damage to buildings and supporting infrastructure (such as air conditioning units which, anecdotally, are already showing accelerated wear near ports such as Auckland);
- Reduced smoky stack emissions means better amenity for tourists (both domestic and international) by removing dirty plumes from ships coming into port (as well inhaling fumes while on board).

Q8. Are there any public health or other environmental issues that we should be aware of when considering accession to Annex VI?

There are significant win-win outcomes that arise from reducing ship emissions that are both harmful to people, and to global warming. It is unfortunate that the Ministry of Transport has not quantified these, and their associated costs and benefits, for their discussion document.

Climate change affects human health in several ways.[61] Direct effects of climate change include:

- Increased extreme meteorological-caused events (e.g. flooding, fires);
- Displacement; and
- Extreme temperatures.

Indirect effects from climate change on human health include:

- Increased harmful algal blooms;

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[61] Royal Society of New Zealand, 2017.

- Increased microbial contamination;
- Decreased food availability, quality and safety;
- Decreased mental health and well-being;
- Reduced outdoor air quality;
- Increased carriers of new diseases; and
- Increased migration of tropical species into New Zealand

These last two are particularly relevant for shipping, and increased cruise ship visits, in New Zealand.

While cases of malaria declined in New Zealand between 2015 and 2016, cases of dengue fever and Zika virus (also mosquito borne) increased.[62] Zika virus outbreaks in the Pacific have been increasing since 2013 and New Zealand cases are currently linked to travellers coming into New Zealand. Climate change increases the possibility of these diseases becoming established in New Zealand.

Finally, (in brief):

- New Zealand is about to implement a Zero Carbon bill that will require us to start addressing emissions wherever opportunities present themselves in order achieve real reductions in emissions by 2050;
- New Zealand is significantly lagging other countries in 'doing its bit';
- New Zealand has a moral obligation to Pacific island countries to show leadership and to support them;

We therefore strongly support international regulations that seek to reduce both harmful and greenhouse gas emissions from ships.

Q36. Are there any other issues not considered above, but which you deem important and need to be factored in when considering the costs and benefits of accession to MARPOL Annex VI?

Much like vaccinations, to be effective Annex VI requires widespread adoption. It would irresponsible for New Zealand not to accede to Annex VI.

[62] ESR, 2018.

Q38. If New Zealand is to accede to Annex VI, is 2021 a reasonable timeframe to bring the requirements into effect? Please provide your reasons for your answer.

This seems rather long given most international ships that visit New Zealand have already acceded to Annex VI.

Further, the discussion document identified fewer than 50 ships which will require regulation. This suggests compliance will not be particularly onerous (compared to say, the millions of privately-owned passenger vehicles for which the Ministry of Transport is already responsible).

January 2020, which ties in with the commencement of Annex VI regulations, is a more reasonable date.

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https://scholar.google.com/citations?user=nFDXRBkAAAAJ&hl=en&oi=ao

Appendix A MARPOL Annex VI and amendments to date

Table A1: Summary of MARPOL Annex VI Regulations

Chapter	Regulation
I. General	1. Application 2. Definitions 3. Exceptions and exemptions 4. Equivalents
II. Survey, certification and means of control	5. Surveys 6. Issue or endorsement of Certificates and Statements of Compliance related to fuel oil consumption reporting 7. Issue of a Certificate by another Party 8. Form of Certificates and Statements of Compliance related to fuel oil consumption reporting 9. Duration and validity of Certificates and Statements of Compliance related to fuel oil consumption reporting 10. Port State control on operational requirements
III. Requirements for control of emissions from ships	11. Detection of violations and enforcement 12. Ozone depleting substances (**ODN**) 13. Nitrogen oxides (**NO_X**) 14. Sulphur oxides (**SO_X**) and particulate matter 15. Volatile organic compounds (**VOC**) 16. Shipboard incineration 17. Reception facilities 18. Fuel oil quality
IV. Regulations on energy efficiency of ships (directly addresses climate change impacts)	19. Application 20. Attained Energy Efficiency Design Index (Attained **EEDI**) 21. Required EEDI 22. Ship Energy Efficiency Management Plan (**SEEMP**) 22A. Collection and reporting of ship fuel oil consumption data 23. Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships
V. Verification of compliance with the provisions of this Annex	24. Application 25. Verification of compliance
Appendices	I. Form of International Air Pollution Prevention (**IAPP**) Certificate (Regulation 8) II. Test cycles and weighting factors (Regulation 13) III. Criteria and procedures for designation of emission control areas (Regulation 13.6 and Regulation 14.3) IV. Type approval and operating limits for shipboard incinerators (Regulation 16) V. Information to be Included in the bunker delivery note (Regulation 18.5)

Chapter	Regulation	
	VI.	Fuel verification procedure for Annex VI fuel oil samples (Regulation 18.8.2)
	VII.	North American Emission Control Area (Regulation 13.6 and Regulation 14.3)
	VIII.	Form of International Energy Efficiency (**IEE**) Certificate
	IX.	Information to be submitted to the IMO Ship Fuel Oil Consumption Database
	X.	Form of Statement of Compliance – Fuel oil consumption reporting

Table A2: MARPOL Annex VI amendments to date (Australian Maritime Safety Organisation)[63]

Amendment	Date of entry into force	Comments
2017 (Annex VI) amendments MEPC.286(71) Designation of the Baltic Sea and the North Sea Emission Control Areas for NO_X Tier III control and Information to be included in the bunker delivery note	1 Jan 2019	Baltic and North Sea NO_X Emission Control Area: • The amendments to regulation 13 of MARPOL Annex VI give effect to the Baltic and North Sea NO_X Emission Control Area • The amendments also introduce a new exemption paragraph to allow ships that do not comply with the Tier III requirements to be built, converted, repaired and/or maintained at shipyards in the North Sea area. Bunker Delivery Note: • Amendments to appendix V of MARPOL Annex VI change the bunker delivery note to reflect that a ship may be using high sulphur fuel because they have in place an alternative method to manage their sulphur emissions (eg a scrubber).
2016 (Annex VI) amendments MEPC.278(70) Amendments to implement a data collection system for fuel oil consumption of ships	1 Mar 2018	Amendments to require the mandatory collection of fuel oil consumption and transport work data from international ships which are 5,000 GT and over.

[63] "Table of MARPOL Amendments". Australian Maritime Safety Authority. [Retrieved 28 November 2018]

Amendment	Date of entry into force	Comments
2016 (Annex VI) amendments MEPC.271(69) Amendments to regulation 13 – Record requirements for operational compliance with NOx Tier III Emission Control Areas	1 Sep 2017	Amendments to require certain ships to maintain records of the operational status of their marine diesel engines, together with the date, time and position of the ship when operating in NOx Emission Control Areas (NECAs). These amendments ensure authorities are able verify whether a ship's engines have been operated in compliance with NECA requirements.
2014 (Annex VI) amendments MEPC.258(67) Amendments to regulations 2 and 13 and the Supplement to the IAPP Certificate	1 Mar 2016	Amendments that extend the application of MARPOL Annex VI to gas fuelled ships, by means of amendments to the definitions of fuel oil and marine diesel engine to include gas fuel and gas fuelled engines; clarify the documentation of engines' compliance with NOx emission standards within Regulation 13.7.3 and the Supplement to the IAPP Certificate; clarify recording requirements for the length of ships used solely for recreational purposes in a footnote; recognise the updated (MEPC.244(66)) in the IAPP Certificate.
2014 (Annex VI) amendments MEPC.247(66) Amendments to make the use of the III Code mandatory	1 Jan 2016	Amendments to Annex VI to make use of the IMO Instruments Implementation Code (III Code) mandatory.
2014 (Annex VI) amendments MEPC.251(66) Amendments to regulations 2, 13, 19, 20 and the Supplement to the IAPP Certificate and certification of dual-fuel engines under the NOx Technical Code 2008	1 Mar 2015	Various amendments relating to the application of the Energy Efficiency Design Index (EEDI) to a wider range of ship types and certification of dual-fuel engines.
2012 (Annex VI) amendments MEPC.217(63) Regional Arrangements for port Reception Facilities under MARPOL Annex VI and Certification of Marine Diesel Engines fitted with selective catalytic reduction systems under the NOx Technical Code 2008	1 Aug 2013	Amendments relating to regional arrangements for port reception facilities under Annex VI and certification of marine diesel engines under the NOx Technical Code.
2011 (Annex VI) amendments MEPC.203(62) Inclusion of Regulations on Energy Efficiency for Ships	1 Jan 2013	Addition of a new Chapter 4 to Annex VI to regulate energy efficiency for ships.

Amendment	Date of entry into force	Comments
2011 (Annex VI) amendments MEPC.202(62) Designation of the Caribbean Sea Emission Control Area	1 Jan 2013	Addition of a new emission control area.
2010 (Annex VI) amendments MEPC.194(61) Revised form of Supplement to the IAPP Certificate	1 Feb 2012	Revised form of the Supplement to the IAPP Certificate.
2010 (Annex VI) amendments – MEPC.190(60) North American Emission Control Area	1 Aug 2011	Addition of a new emission control area.
2008 (Annex VI) amendments – MEPC.176(58) Revised Annex VI	1 Jul 2010	Completely revised to establish more stringent regulations to further reduce air emissions from ships. Various amendments made including, requirements for ozone depleting substances record books and VOC management plans; addition of NOx Tier II and Tier III performance standards and NOx emission control areas; provisions related to sulphur content of fuel oil to progressively reduce SOx emissions; provisions to ensure fuel oil quality and availability and reception facilities.
2005 (Annex VI) amendments MEPC.132(53) Amendments to Annex VI and to the NOx Technical Code	22 Nov 2006	Amendments related to survey and certification and addition of a new emission control area.
Protocol of 1997 Annex VI – Regulations for the Prevention of Air Pollution from Ships	19 May 2005	New Annex VI added to the convention.

Appendix B Full list of discussion document questions

Submissions can be made by email or post to:

- maritime@tranport.govt.nz with the words “MARPOL Annex VI submission” in the subject line; or:
- MARPOL Annex VI submissions, PO Box 3175, Wellington 6140.

You should indicate in your submission whether it would be acceptable, if required, for officials from the Ministry of Transport to contact you to discuss your submission. If you need more information to assist you in preparing a submission, please contact Brian Nijman at b.nijman@transport.govt.nz.

The deadline for submissions is Monday 11 February 2019.

Questions associated with accession to Annex VI

In order to provide advice to enable the Government make a decision on whether or not to accede to Annex VI, your views are sought. Submissions will inform subsequent advice to Cabinet including a National Interest Analysis (NIA) which assesses Annex VI from the perspective of its impact on New Zealand and New Zealanders. The NIA will also include economic modelling to quantify the costs and benefits of accession.

Your views on the questions below are important to enable us shape subsequent advice to Government on whether New Zealand should accede to Annex VI. Please provide as much detail as possible including references to examples and/or published material.

Improving New Zealand credibility and influence on climate policy

Annex VI is likely to be the primary international regulatory mechanism for mitigating maritime GHG emissions as well as other air pollutants.

Q1. New Zealand’s stated ambition is to be a global leader on climate change and strengthen our credibility and influence in international climate negotiations. To enable New Zealand to influence climate change policy at the IMO we need to accede to Annex VI and be at the table to influence decisions. Do you agree? Please provide a detailed response. If you don’t agree please provide reasons why.

Protecting New Zealand’s trade interests and advancing effective mitigation measures

Annex VI addresses GHG emissions (primarily CO2) from international shipping, through the following instruments:

- Ship Energy Efficiency Management Plan (**SEEMP**), an operational measure; and

- Energy Efficiency Design Index (**EEDI**), relating to the design and propulsion of new ships and those having undergone major conversion.

Slow steaming, not currently mandated by the IMO, is one way in which ships on international voyages can reduce fuel consumption and CO_2 emissions. New Zealand needs to ensure the application of slow steaming (especially if mandated through the Strategy) does not have disproportionate trade or operational impacts, given our distance from markets.

Q2. What are the costs associated with complying with SEEMP and EEDI requirements?

Q3. What are the benefits associated with the EEDI and SEEMP requirements?

Q4. What does New Zealand need to bear in mind on slow steaming when considering accession to Annex VI? Please provide as much *detail as possible.*

Improving public health

When fossil fuels are burnt, compounds harmful to human health, including nitrogen oxides, sulphur oxides and particulate matter, are released into the atmosphere.

Q5. What are the public health benefits of acceding to Annex VI?

Q6. What are the public health costs of acceding to Annex VI?

Q7. Are there any cost and benefits resulting from accession to Annex VI for the marine and built environments?

Q8. Are there any public health or other environmental issues that we should be aware of when considering accession to Annex VI?

Providing for easier movement of New Zealand flagged ships to other countries

Any New Zealand flagged vessel wishing to visit the port of a State that has acceded to Annex VI must abide by Annex VI requirements.

Q9. How would accession to Annex VI affect the limited number of domestic ships that visit overseas ports in Party States?

Q10. If we do not accede to Annex VI what are the issues that are likely to arise for the limited number of domestic ships that visit overseas ports in Party States?

Q11. Are there any other issues affecting New Zealand ships visiting the ports of Party States we should be aware of?

Q12. If we do not accede to Annex VI do you have any suggestions as to how to deal with New Zealand ships visiting overseas ports in Party States?

Low sulphur fuel

The global limit for the sulphur content of marine fuel will be strengthened to 0.5 percent from 1 January 2020, and will apply to all ships registered to Annex VI Party States. Residual fuel that meets the 0.5 percent sulphur limit will cost more to produce than 3.5 percent sulphur fuel.

Q13. What are the benefits of moving to fuel with a sulphur limit of 0.5 percent?

Q14. What are the costs associated with moving to a low sulphur fuel limit of 0.5 percent?

Q15. How easy would it be for the global shipping industry to source 0.5 percent sulphur fuel?

Q16. Would Marsden Point be able to produce low sulphur fuel?

Q17. If yes, would Marsden Point be able to produce enough quantities of low sulphur fuel at reasonable cost?

Q18. If not, where and how will international visiting ships obtain their low sulphur fuel?

Q19. How would a low sulphur fuel requirement affect our domestic shipping industry?

Q20. If low sulphur fuel is unavailable, is diesel the most likely option that will be used?

Q21. What are the benefits of switching to diesel?

Q22. What are the costs of switching to diesel?

Q23. Are ships likely to continue using 3.5 percent fuel but with abatement technology?

Q24. What are the costs associated with using abatement technology?

Q25. What are the benefits of using abatement technology?

Q26. How easy will it be to install abatement technology in ships already in service?

Q27. Are there any other considerations apart from price that is likely to be taken into account when deciding to switch fuels or use abatement technology?

Q28. Would current reception facilities at ports be able to cope with the requirements of Annex VI?

Q29. If not, what are the additional costs associated with providing additional reception facilities?

Q30. If low sulphur fuel could not be locally produced, what will happen to the 3.5 percent sulphur fuel currently produced as a by-product of the refining process?

Impact on diesel powered vessels

Annex's VI's NO_X requirements apply to new marine diesel engines greater than 130 kilowatts (kW) in power, installed on vessels constructed on or after January 1, 2000, or which undergo a major conversion after that date. Compliance with NOx emission requirements is ascertained through survey and certification, leading to the issue of an Engine International Air Pollution Prevention Certificate.

Q31. Are there any costs and/or benefits or any associated industry concerns around the NOx requirements when considering accession?

Q32. How many New Zealand vessels are likely to be affected by the NO_X requirements?

Other issues

Ships over 5,000 gross tonnes, which account for the vast majority of CO_2 emissions from international shipping, are required to submit annual fuel consumption data to their Flag State (or designated Recognised Organization) for submission to the IMO. The anonymised data will inform the IMO GHG Strategy.

Q33. Are there likely to be any problems associated with providing annual fuel consumption data?

MARPOL's provisions do not apply to ships solely engaged in domestic voyages. However, each Party should ensure that ships are constructed and act in a manner consistent with MARPOL, so far as is reasonable and practicable.

Q34. How would acceding to Annex VI affect the domestic shipping sector?

Q35. What are the benefits and costs for the domestic sector of Annex VI?

Additional questions

Q36. Are there any other issues not considered above, but which you deem important and need to be factored in when considering the costs and benefits of accession to MARPOL Annex VI?

Q37. Having taken all of the above into consideration, should New Zealand accede to Annex VI?

Indicative timeline

Following the completion of consultation, the Ministry would analyse submissions before providing advice to Government together with an NIA on whether or not to accede to Annex VI. It is anticipated that a decision will be made by Cabinet in the first half of 2019. If the Government decides that New Zealand should accede to Annex VI, the steps outlined in the table below are required before accession can take place.

Treaty making step	Indicative Timing
• A Parliamentary Select Committee considers the National Interest Analysis (NIA) and treaty text and reports back to the House of Representatives	Quarter 2, 2019
• NIA and treaty text considered by the House of Representatives	Quarter 2, 2019
• Government agencies complete work on regulatory amendments required to implement the treaty in domestic law	Quarter 3 2020
• New Zealand deposits instrument of accession with the IMO	Quarter 4, 2020
• Annex VI comes into force for New Zealand three months after depositing instrument of accession.	Quarter 1, 2021

Q38. If New Zealand is to accede to Annex VI, is 2021 a reasonable timeframe to bring the requirements into effect? Please provide your reasons for your answer.

MARPOL Annex VI

Air quality, climate change and health issues for Auckland

Prepared for
Auckland Regional Public Health Service

MARPOL Annex VI

Air quality, climate change and health issues for Auckland

Client: Auckland Regional Public Health Service

Prepared by:

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21 December 2018

Photo credit: Steve Cordory / shutterstock.com

Revision History

No.	Date	Author	Reviewer(s)	Details
1	21 Dec 2018	**Gerda Kuschel & Louise Wickham** Directors & Senior Air Quality Specialists		Draft to client for review

Executive Summary

On 5 November 2018, the Ministry of Transport commenced public consultation on whether New Zealand should sign up to an international treaty for the prevention of air pollution from ships. Specifically, the proposal considers accession to Annex VI of the International Convention for the Prevention of Pollution from Ships (**MARPOL**). Annex VI regulates discharges to air which can be harmful to public health and the environment, deplete the ozone layer and contribute to climate change.

Auckland Regional Public Health Service engaged Emission Impossible Ltd through a contract with the Ministry of Health to prepare a briefing on shipping emissions and associated health effects in Auckland. The purpose of this region-specific briefing is to provide information to support Auckland Regional Public Health Service prepare a submission on the proposal.

This briefing covers:

- what is contained in the MARPOL regulations;
- the significance of shipping emissions in New Zealand;
- key public health impacts associated with air emissions from shipping;
- key points that could be included in submissions by public health units to improve public health outcomes;
- the significance of shipping emissions in Auckland.

It is our view that the Auckland Regional Public Health Service should support New Zealand's accession to Annex VI. There is extensive research that shows the benefits of greener shipping outweigh the costs. Three compelling reasons are:

(iv) Reduced emissions of harmful air pollutants will result in reduced adverse public health effects (and costs), including premature deaths;
(v) Reduced emissions of harmful air pollutants will result in reduced adverse effects on ecosystems (e.g. acidification, deposition of toxics such as heavy metals and dioxins); and
(vi) Reduced greenhouse gas emissions are a tangible action to combat climate change (an issue of planetary urgency).

These do not preclude feedback on other matters. Public consultation closes on 11 February 2019.

Contents

List of Appendices

6 What is MARPOL and how does it relate to New Zealand?

MARPOL is short for marine pollution. The full title of the treaty is the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78).

MARPOL was developed by the International Maritime Organization (**IMO**) to minimise pollution of the oceans and seas, including dumping, oil and air pollution. MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes.

This chapter covers:

- the structure of the MARPOL convention;
- details on Annex VI (the subject of the Ministry of Transport discussion document); and
- how MARPOL Annex VI relates to New Zealand.

6.1 The structure of MARPOL

MARPOL was developed by the International Maritime Organisation (**IMO**). The IMO is the United Nations agency responsible for regulating shipping. Currently, the IMO has 174 member states and three associate members (Faroe Islands, Hong Kong and Macau).[64]

The original MARPOL convention was signed on 17 February 1973 but, following a spate of tanker accidents in 1976 – 1977, was revised by the 1978 Protocol. The original convention focussed on prevention of pollution from oil and oily water (Annex I) and entered into force on 2 October 1983.[65] Over time, additional Annexes have been added to address other aspects of marine pollution. In 1997, a Protocol was adopted to amend MARPOL and add Annex VI (prevention of air pollution from ships). Annex VI entered into force on 19 May 2005.

MARPOL currently includes six technical Annexes as follows (IMO, 2018):[66]

(vii) Annex I – Regulations for the prevention of pollution by oil

Annex I covers the prevention of pollution by oil from operational measures as well as from accidental discharges. Annex I was amended in 1992 to make it mandatory for new oil tankers to have double hulls and to introduce a phase-in schedule for existing tankers to fit double hulls (this was subsequently revised in 2001 and 2003).

Annex I entered into force 2 October 1983.

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[64] International Maritime Organization (IMO), undated. "Member States".[Online: Retrieved 28 November 2018]

[65] The 1978 Protocol absorbed the parent Convention as the 1973 MARPOL Convention had not yet entered into force.

[66] IMO, undated. "International Convention for the Prevention of Pollution from Ships (MARPOL)". [Online: Retrieved 28 November 2018]

(viii) Annex II – Regulations for the control of pollution by noxious liquid substances in bulk

Annex II details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. The list appended to MARPOL includes some 250 substances; the discharge of their residues is allowed only to reception facilities for certain concentrations and conditions (which vary with the category of substances). No discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.

Annex II entered into force 2 October 1983.

(ix) Annex III – Prevention of pollution by harmful substances carried by sea in packaged form

Annex III contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications. For the purpose of this Annex, "harmful substances" are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code or which meet the criteria in the Appendix of Annex III.

Annex III entered into force 1 July 1992.

(x) Annex IV – Prevention of pollution by sewage from ships

Annex IV contains requirements to control pollution of the sea by sewage. Under Annex IV, the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted[67] and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land. Sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.

Annex IV entered into force 27 September 2003.

(xi) Annex V – Prevention of pollution by garbage from ships

Annex V deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The most important feature of Annex V is the complete ban imposed on the disposal into the sea of all forms of plastics.

Annex V entered into force 31 December 1998.

(xii) Annex VI – Prevention of air pollution from ships

[67] Finely ground up

Annex VI sets limits on emissions of sulphur and nitrogen oxides from ship exhausts and prohibits deliberate emissions of ozone depleting substances. It also provides for designated emission control areas (**ECA**) to set more stringent standards for sulphur oxides, nitrogen oxides and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships.

Annex VI entered into force 19 May 2005.

6.2 Details on Annex VI

Annex VI primarily responds to two global problems related to shipping emissions:

(iii) Impacts on human health and environments in port communities from maritime pollution; and

(iv) Contributions to climate change and ozone layer depletion.

Annex VI addresses these problems by:

- Regulating air pollutants that are harmful to humans, including sulphur dioxide (**SO_2**), nitrogen oxides (**NO_X**), and particulate matter (**PM**);
- Regulating greenhouse gases (**GHGs**) and ozone depleting substances; and
- Setting out requirements for reception facilities and Port State Control, and requirements for Party States to enable their ships to demonstrate compliance with energy efficiency regulations when entering the ports of other Party States.

The key regulations currently covered by Annex VI are summarised in **Appendix A.**

Since coming into force on 19 May 2005, Annex VI has been subject to numerous amendments (refer also **Appendix A** for a full list). These amendments make reading the full body of the Annex VI treaty difficult.[68]

Of the many regulations covered by Annex VI, those related to the control of SO_X emissions have met with the most scrutiny to date. The IMO readily acknowledged that the original 1997 fuel limits for sulphur in Annex VI were too lenient to improve ship emissions appreciably. Accordingly, in 2008, Annex VI was amended to reduce the sulphur limit in marine fuels from 4.5 % to 3.5 % in 2012 with a further reduction to 0.5 % set for 2020.[69]

Similarly, the sulphur limit in marine fuels for ships operating in Sulphur (or SO_X) Emission Control Areas (**SECA**) dropped from 1.0 % in 2010 to 0.1 % in 2015.

As an alternative to using low-sulphur fuels, ships may use exhaust gas cleaning systems (e.g. scrubbers) or use other methods to limit their sulphur emissions.

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[68] https://www.transport.govt.nz/assets/Uploads/OC05343-MARPOL-Annex-VI-treaty-text.pdf

[69] All sulphur limits are weight %

Figure 1 shows how these sulphur limits compare to the current limit for New Zealand automotive diesel of 0.001 % (10 ppm).

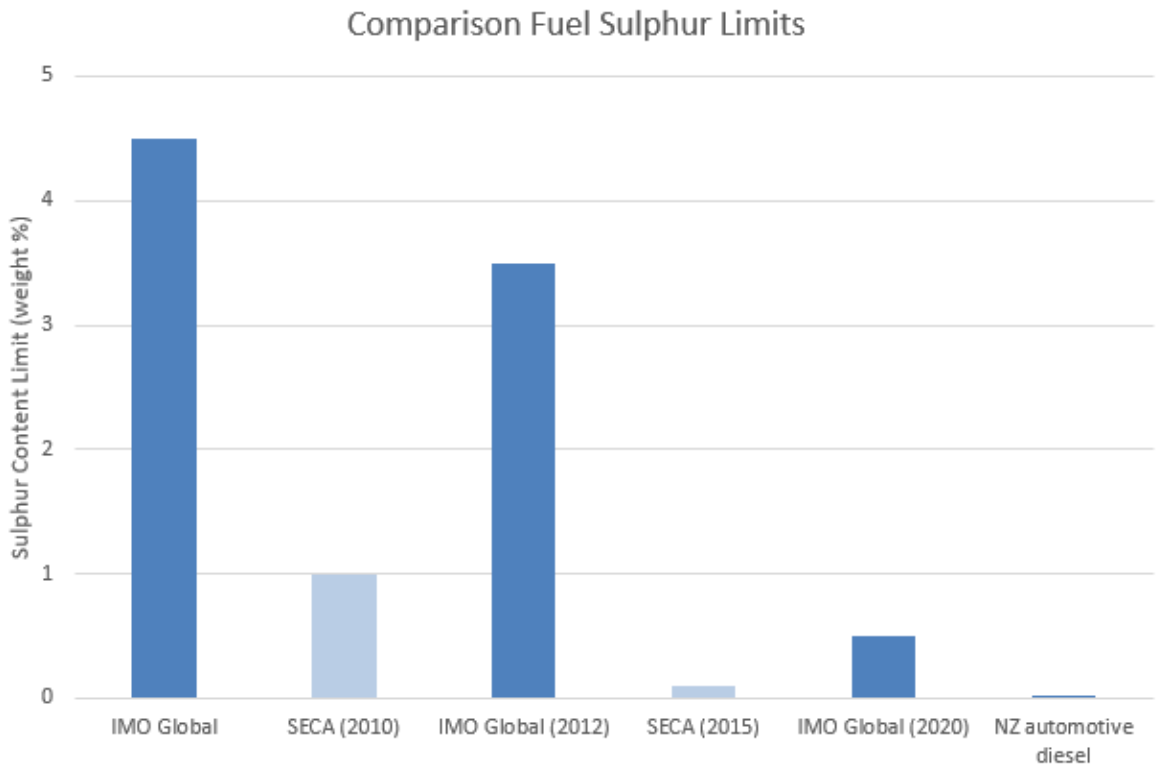

Figure 2 Comparison of the changes in sulphur limits in Annex VI marine fuel versus New Zealand automotive fuel

Note: IMO = International Maritime Organisation, SECA = Sulphur Emissions Control Area

6.3 How MARPOL Annex VI relates to New Zealand

As at 16 November 2018, 157 states are parties to the MARPOL convention.[70] This represents flag states of more than 99% of the world's shipping tonnage.

While all 157 states have acceded to Annexes I and II (mandatory), accession to the other four Annexes (voluntary) is less complete as shown in **Table 1.**

[70] IMO, undated. "Status of Treaties". [Online: Retrieved 28 November 2018]

Table 1 Status of accession to the various MARPOL Annexes by global shipping states as at 16 Nov 2018

MARPOL Annex	73/78 (I & II)	73/78 (III)	73/78 (IV)	73/78 (V)	1997 Protocol (VI)
No of states	157	147	142	152	91

New Zealand is currently a signatory to Annexes I, II, III and V. However, New Zealand has not acceded to Annex VI (prevention of air pollution from ships) - the subject of the current Ministry of Transport consultation - or Annex IV (prevention of pollution by sewage from ships).

Note: Member nations are responsible for vessels registered (flagged) on their national ship registry. This means that, regardless of where they sail, ships flagged under countries that are signatories to MARPOL are subject to its requirements.

This also means that, although New Zealand is yet to accede to Annex VI, ships from flagged states that have signed up still need to abide by its requirements in New Zealand waters. Many vessels currently operating in New Zealand waters (including international shipping, fishing vessels and ferries) are flagged to overseas states.

6.3.1 Potential impact on New Zealand ships

From 1 January 2020, all ships flagged to Annex VI Party States will have to comply with a lower sulphur fuel limit of 0.5 %. Currently the allowable limit is 3.5 %.

New Zealand's accession to Annex VI would affect some of our domestic ships, primarily by making them subject to the new limit on sulphur in fuel. The Ministry of Transport estimates the new sulphur limits would *potentially* affect around 33 ships:

- 11 ships (interisland ferries and domestic fuel tankers) that currently run on heavy fuel oil; and
- Another 22 ships for which there is no fuel information.

The Ministry of Transport also identified 36 fishing vessels which are primarily fuelled by New Zealand automotive diesel and would not be affected except for "some of the largest vessels".[71]

Affected ships have **three options to meet the new sulphur fuel limits:**

(iv) Switch to low sulphur fuels (0.5 % fuel oil or New Zealand automotive diesel);[72]

(v) Install abatement technology; and/or

[71] Office of the Associate Minister of Transport, 2018. "Approval to consult on accession to the International Maritime Organisation Treaty MARPOL Annex VI: Prevention of Air Pollution from Ships". Cabinet Environment, Energy and Climate Committee Paper. Hon James Shaw. Acting Associate Minister of Transport. November. [Online: Retrieved 12 November 2018]

[72] The Ministry of Transport is uncertain that low sulphur fuel oil (0.5% sulphur) will be available in New Zealand.

(vi) Upgrade to newer, more fuel efficient, ships.

Each of these options have costs, and benefits, for their owners as well as for New Zealand.

Note: Irrespective of New Zealand acceding to Annex VI, **from January 2020 New Zealand flagged ships visiting countries that are already party to Annex VI will still need to be compliant with Annex VI regulations.**

This includes domestic ships that are required to access dry docks in Australia or Singapore (which are already Party States to Annex VI) for out-of-water inspections, maintenance and repairs.

6.3.2 Potential impact on International ships

The Ministry of Transport states that our international trade is almost entirely carried on ships flagged to Annex VI Party States.[73] This means that there would be very little impact, if any, on international trade should New Zealand accede to Annex VI.

Unfortunately, the Ministry did not provide data on the fraction of cruise ships that are already flagged to Annex VI Party States.

There are around 300 cruise ships, and we understand these represent a small fraction of the global shipping industry. However, they are important because of the time they spend in and around New Zealand ports, where the public may be exposed to their harmful air emissions.

Currently, 78 cruise ships are scheduled to visit Wellington (alone) in 2018, with arrivals scheduled to increase to 110 in 2019.[74] However, these visits are by 24 individual ships (the same ships make multiple visits).[75]

An annual survey of 76 cruise ships in 2018, conducted by German environmental group Nabu, reports that all except one continue to burn heavy fuel oil.[76] This means that these ships will require abatement technology (scrubbers) to meet State Party Annex VI requirements when visiting State Party Annex VI countries.[77]

Recent media reports have revealed that some cruise ships that currently have abatement technology do not use it whilst in New Zealand – because current New Zealand regulations do not require it.[78] This will not be the case after 2020 **if** the ship is flagged to a country that is a party to Annex VI.

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[73] *Ibid.* at para 21.

[74] Crew Center, undated. "Wellington Cruise Ship Schedule 2018". [Online: Retrieved 13 December 2018]

[75] *Ibid.*

[76] Nature and Biodiversity Conservation Union, 2018. "NABU Cruise Ship Ranking 2018: AIDA at the top". [Online: Retrieved 20 December 2018]

[77] Or opt for lower sulphur fuel – but switching can require minor changes to the ship engines.

[78] Cropp A, 2018. "Cruise ship pollution in the spotlight after vessels busted in Alaska come to NZ". Stuff. 27 October. [Online: Retrieved 20 December 2018]

6.3.3 Compliance

Cruise ships attract public attention because they are highly visible. This visibility has underlined the importance of enforcement and compliance, with recent media revealing that it is not enough to have regulations – the regulations must be enforced.[79]

If New Zealand accedes to Annex VI, the Ministry of Transport (through Maritime New Zealand) will need to undertake compliance and enforcement actions for New Zealand and international ships operating in and around New Zealand.

[79] *Ibid.*

7 What is the significance of shipping emissions in New Zealand?

This chapter covers:

- Ship emissions to air;
- Trends in shipping movements in New Zealand;
- Trends in coastal occupation in New Zealand; and
- Relative contribution of shipping emissions to other air emissions sources in New Zealand.

7.1 Ship emissions to air

Globally air pollution from ships is a major concern - both in terms of emissions harmful to human health and greenhouse emissions. These are discussed below.

7.1.1 Harmful emissions

Harmful air pollutants emitted from fuel combustion in shipping include:

- Particulate matter smaller than 10 micrometres in diameter; 10 µm (**PM_{10}**) or smaller than 2.5 µm (**$PM_{2.5}$**);
- Nitrogen oxides (**NO_x**), in particular nitrogen dioxide (**NO_2**);
- Sulphur dioxide (**SO_2**) – primarily from combustion of heavy fuel oil as opposed to diesel;
- Carbon monoxide (**CO**);
- Volatile organic compounds (**VOC**) including polycyclic aromatic hydrocarbons (**PAHs**) and benzo(a)pyrene;
- Heavy metals including mercury and lead; and
- Dioxins.

Emissions of harmful air pollutants from shipping make a significant contribution to total emissions in Europe and worldwide. According to an analysis by Brandt et al. (2013), **shipping emissions cause about 50,000 premature deaths per year in Europe**.[80] This estimate assessed a wide variety of health impacts from typical pollutants emitted from ships, including PM_{10}, SO_2, CO lead and mercury (CEEH, 2013).[81]

Emissions of NO_x contribute to the formation of secondary particles and ozone, resulting in higher levels of respiratory and cardiovascular diseases among the population, especially in

[80] Brandt J et al, 2013. "Assessment of past present and future health cost externalities of air pollution in Europe and the contribution from international ship traffic using the EVA model system". *Atmos Chem & Physics.* 13(15):7747-7764. August.

[81] Centre for Energy, Environment and Health (CEEH), 2013. "Assessment of Health-Cost Externalities of Air Pollution at the National Level using the EVA Model System". CEEH Report Scientific Report No. 3. Roskilde. Denmark. March. [Online: Retrieved 19 December 2018]

coastal states. Sulphur dioxide is also known for its role in secondary (fine) particulate formation, which, in turn (PM) is a known carcinogen.

In contrast to the progress in reducing emissions from land-based sources, shipping emissions of SO_2 and NO_X have steadily been increasing over the last thirty years. While recently introduced marine fuel sulphur limits at global and EU levels have halted this increasing trend for SO_2 emissions (at least in the Sulphur Emission Control Areas in northern Europe and North America), NO_X emissions are expected to continue increasing. As a result, by 2022, NO_X emissions from international shipping around Europe are expected to equal or even surpass the total from all land-based sources in the 28 European member states combined.[82]

7.1.2 Greenhouse gas emissions

Greenhouse gases emitted from ships include mainly (Styhre *et al*, 2017):[83]

- Carbon dioxide (**CO_2**);
- Methane (**CH_4**); and
- Nitrous oxide (**N_2O**).

In addition, ships emit, depending on the fuel burnt, other gases with climate impact such as black carbon (which has a warming potential) and sulphate particles (which have a cooling effect). Of these, CO_2 dominates the global warming potential and is the most significant component because of its abundance, its atmospheric lifetime and its associated warming ability that changes the amount of heat energy trapped within the atmosphere (Styhre *et al*, 2017).

The United Nations estimates that maritime transport is currently responsible for only 2.5% of global CO_2 emissions, but its emissions are projected to grow by up to 250 % by 2050.[84] To put this in context, the International Council on Clean Transportation (**ICCT**) estimates that if international shipping was treated as a country it would be the sixth largest emitter of CO_2 in the world - roughly the same as Germany.[85] Their study looking at shipping emissions between 2013 and 2015 found (ICCT, 2017):

- **Fuel consumption is increasing**. Total shipping fuel consumption increased from 291 to 298 million tonnes (+2.4%) from 2013 to 2015.

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[82] Air Pollution and Climate Secretariat, 2018. "Ship emissions". Sweden. [Online: Retrieved 13 December 2018].

The Air Pollution and Climate Secretariat is a joint venture between four Swedish environmental organisations with the chief purpose of promoting awareness of the problems associated with air pollution and climate change. The four environmental organisations are: World Wide Fund for Nature (Sweden), Friends of the Earth (Sweden), Nature and Youth Sweden and Swedish Society for Nature Conservation.

[83] Styhre, L., Winnes, H., Black, J., Lee, J., & Le-Griffin, H. (2017). "Greenhouse gas emissions from ships in ports – Case studies in four continents". Transportation Research Part D: *Transport and Environment*, 54, 212–224.

[84] United Nations, 2018**. "**UN Climate Change News**".** 10 April 2018. [Online: Retrieved 19 December 2018]

[85] International Council on Clean Transportation, 2017. Greenhouse gas emissions from global shipping, 2013-2015. Washington. USA. [Online: Retrieved 13 December 2018]

- **Shipping GHG emissions are increasing despite improvements in operational efficiency** for many ship classes. Increasing emissions are being driven by rising demand for shipping and the associated consumption of fossil fuels.

- **Black carbon is a major contributor to shipping's climate impacts**. After CO_2, black carbon contributes the most to the climate impact of shipping, representing 21% of total shipping CO_2 equivalent (**$CO_{2\text{-}e}$**) emissions on a 20-year time scale.

- **The biggest ships are speeding up and emitting more**. Unlike most ships, the largest container and oil tankers sped up between 2013 and 2015 and became less efficient, emitting more CO_2 per deadweight tonne-nautical mile in 2015 than in 2013.

- **Absolute reductions in ship emissions will require concerted action to improve the energy efficiency of shipping and to develop and deploy alternative fuel and propulsion concepts.** The only way to reduce emissions from ships without constraining demand is to substantially reduce the amount of CO_2 and $CO_{2\text{-}e}$ emitted per unit of transport supply.

Compared with vehicle emissions which have seen increasingly stringent regulation for many years, ship emissions of greenhouse gases are significant and somewhat overdue for international regulation.

7.2 Trends in NZ shipping

New Zealand has thirteen major ports as shown in **Figure 2**.

Figure 2 Locations of the major ports in New Zealand (Tenco, 2018)

Table 2 shows that of the top six ports, most have seen significant growth in port container volumes since 2010. In 2017 Tauranga, our largest port, handled an annual container volume of 774,703.[86]

Table 2 Port container volumes 2010-2017 (MoT, 2018)

Year	AKL	TRG	NAP	WGT	LYT	OTA	TOTAL
2010	541,708	347,815	111,796	70,385	188,361	154,643	1,414,708
2011	549,906	396,171	121,116	65,125	204,056	137,786	1,474,160
2012	458,567	563,033	135,819	67,722	227,844	119,400	1,572,385
2013	549,375	510,788	140,906	61,985	250,886	128,251	1,642,191
2014	610,825	529,203	144,010	71,749	262,395	118,148	1,736,330
2015	587,332	586,988	157,700	80,759	245,747	113,307	1,771,833
2016	558,510	657,690	159,950	77,403	260,760	118,586	1,832,899
2017	580,351	774,703	172,792	----	279,818	129,544	1,937,208
Growth since 2010	**7%**	**123%**	**55%**	**n/a**	**49%**	**-16%**	**37%**

Note: AKL = Auckland, TRG = Tauranga, NAP = Napier, WGT = Wellington (2017 data not available because port damaged by Kaikoura earthquake), LYT = Lyttelton, OTA = Otago (Dunedin).

At the same time, New Zealand's popularity as a world-class cruise destination is continuing to grow. Cruise market growth in New Zealand has increased 13% per annum since 2010, significantly higher than growth of the global tourism market at 7% per annum.[87]

Figure 3 shows the cruise ship movements across New Zealand in 2016/17.

In 2017/18, 37 cruise ships were forecast to make 162 voyages, spending 809 days in New Zealand ports. The forecast for 2018/19 is 39 cruise ships making 191 voyages and spending 984 days in port.

[86] Ministry of Transport, 2018. "Annual port container volumes". [Online: Retrieved 13 December 2018]

[87] Tourism New Zealand, 2018. "Cruise-infographic-highlights-thriving-visitor-sector". [Online: Retrieved 13 December 2018]

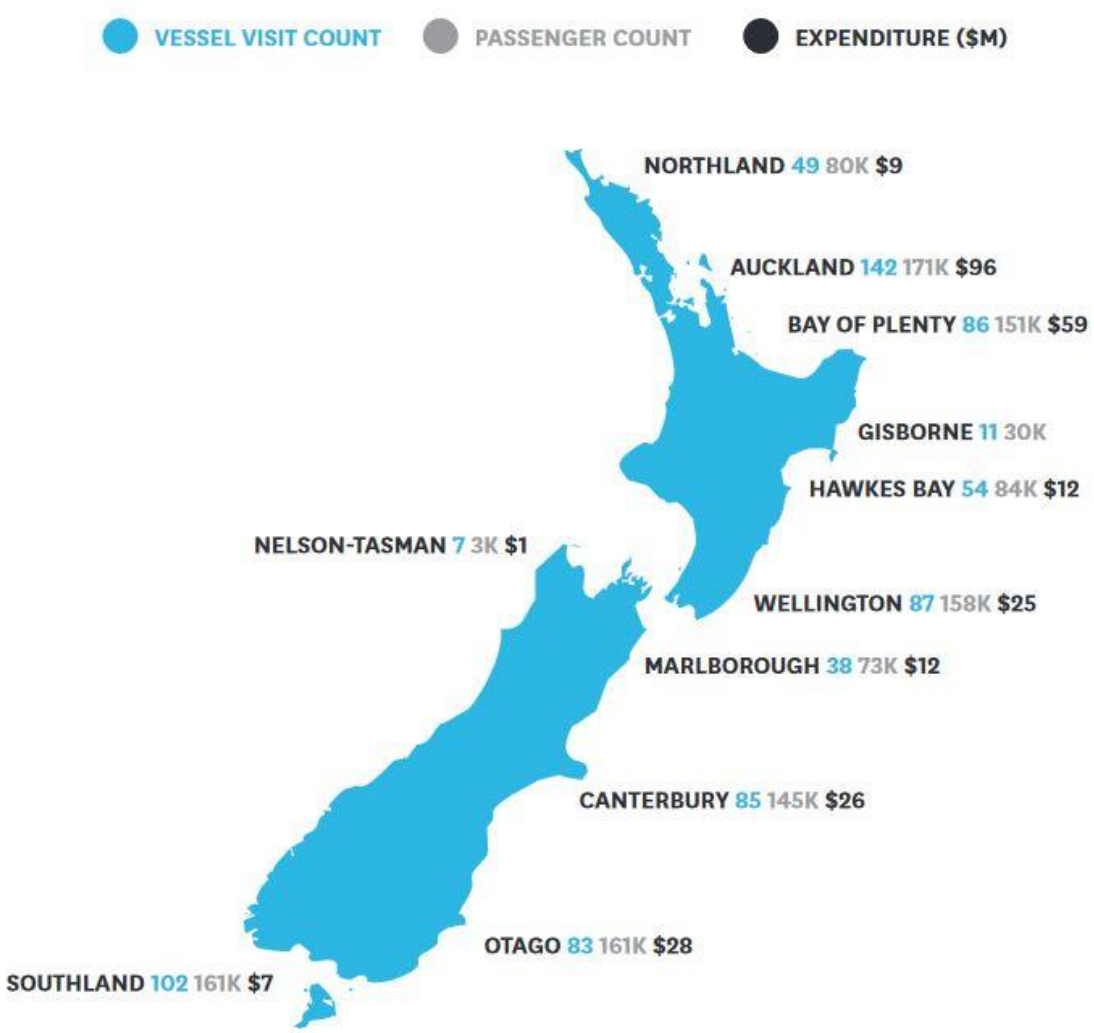

Figure 3 Cruise ships visits, passenger counts and estimated expenditure in New Zealand 2016/17 (Tourism New Zealand, 2018)

7.3 Trends in coastal occupation

Most of New Zealand's population resides near the coast, with many people living within a few kilometres from a major port.

While container volumes and cruise ship movements have grown, local populations have also increased.

Table 3 shows the population growth in cities located near to ports which have undergone expansion from 2010 to 2017. [88] Whiles these figures represent the urban areas, many of these locations have undergone residential area intensification adjacent to the ports so the likely increase in population exposure to shipping emissions is at least as much the figures shown.

Table 3 Population growth for urban areas located near major ports 2010-2017 (StatsNZ, 2018)

Urban Area	Pop'n at 30 June 2010	Pop'n at 30 June 2017	Growth
Whangarei	52300	57700	10%
Auckland	1333000	1534700	15%
Tauranga	121100	137900	14%
Gisborne	34500	36600	6%
Napier-Hastings	125700	133000	6%
New Plymouth	52900	57500	9%
Wellington	384500	412500	7%
Nelson	60700	66700	10%
Dunedin	114200	120200	5%

One way to quantify the resultant exposure would be to assume that all people living within three kilometres of a port might reasonably be affected by ship emissions. **Table 4** provides a rough estimate of resident populations within a few kilometres of New Zealand ports, based on 2013 census data (StatsNZ, 2018). This suggests that nationwide around 140,000 New Zealanders may be currently exposed to harmful ship emissions. However, the figures for Auckland are likely to be significant underestimates as the population in the inner city has surged since the 2013 census.

One drawback of this approach is that it only considers **resident** exposure and does not address people that live elsewhere but come into the central business district (**CBD**) for work each day.[89] Exposure for day commuters is likely to be significant in Auckland, Wellington and Dunedin where the CBDs are all adjacent to working ports. **Table 4** includes rough estimates of CBD working populations in Auckland and Wellington, with the numbers multiplied by 1/3 to account for city commuters only being exposed for 8 hours out of a possible 24 hours to harmful ship emissions.

This increases the total to just under 200,000 New Zealanders living and working in areas, where they could be exposed to harmful ship emissions. This is also likely to be an underestimate as it does not include people living in coastal areas near the shipping lanes (e.g. Takapuna).

Table 4 Estimated Resident Population within 3 km of New Zealand Ports (StatsNZ, 2018)

[88] Statistics New Zealand, 2018. "Subnational population estimates". [Online: Retrieved 17 December 2018]

[89] This may be offset, to some extent, by residents from the central city that work outside the CBD.

City	Census Area Unit	Residents (2013)	Workers CBD x 1/3
Whangarei	Waiotira-Springfield	2,007	
	Bream Head	1,302	
Auckland [1]	Auckland Harbourside	4,503	39,985
	St Marys	2,928	
	Freemans Bay	3,765	
	Auckland Central West	11,700	
	Auckland Central East	10,104	
	Parnell West	4,764	
	Parnell East	2,331	
	Newmarket	2,961	
	Grafton East	1,071	
	Grafton West	3,384	
	Newton	1,641	
	Stanley Bay	2,187	
	Mt Victoria	5,340	
Tauranga	Otumoetai North	3,750	
	Sulphur Pt	27	
	Tauranga City Marinas	72	
	Omanu	5,172	
Gisborne	Kaiti South	2,655	
Napier	Bluff Hill	2,697	
Wellington [2]	Thorndon-Tinakori Rd	4,125	7,667
	Lambton	5,625	
	Willis St-Cambridge Tce	7,329	
	Wellington City Marinas	36	
	Oriental Bay	1,056	
	Roseneath	1,731	
	Wadestown	3,516	
	Kaiwharawhara	144	
Marlborough	Picton	2,745	
	Waikawa	1,308	
Christchurch	Lyttelton	2,859	
Dunedin	Ravensbourne	1,230	
	Opoho	1,212	
	North Dunedin	3,465	
	Otago University	5,082	
	Roslyn North	1,881	
	Stuart St-Frederick St	3,099	
	High St-Stuart St	2,349	
	Harbourside	24	
	Fernhill	1,731	
	Roslyn South	2,256	
	Belleknowes	1,722	
	Mornington	3,267	
	Caledonian	3	
	South Dunedin	2,421	

City	Census Area Unit	Residents (2013)	Workers CBD x 1/3
	Musselburgh	2,652	
	Vauxhall	3,882	
Southland	Bluff	1,791	
Total		142,902	47,652
	National Total	**190,554**	

[1] Infometrics Auckland City Centre Economic Profile. [Online: Retrieved 20 December 2018] Available here: https://ecoprofile.infometrics.co.nz/Auckland%20City%20Centre%20(3%20CAUs)

[2] Wellington Facts and Figures. [Online: Retrieved 20 December 2018] Available here: https://www.wellingtonnz.com/life-in-wellington/facts-and-figures/

7.4 Shipping emissions relative to other air emissions sources

Little work has been undertaken to comprehensively quantify shipping emissions in New Zealand.

Table 5 presents harmful emissions arising from shipping from the recent air domain report (Our Air 2018) published by the Ministry for the Environment and Statistics New Zealand. [90] This is based on a national emissions inventory prepared by Emission Impossible Ltd for the Ministry for the Environment (EIL, 2018).[91] The national inventory estimated emissions of PM_{10}, particulate matter less than 2.5 micrometres in diameter (**$PM_{2.5}$**), CO, NO_x and SO_2 for a base year of 2015.

The national inventory only accounts for domestic vessels operating within New Zealand coastal waters and exclude emissions from international shipping in port or at sea. Nonetheless, the figures in **Table 5** show that domestic shipping (alone) is an appreciable contributor to NO_X and SO_2 emissions relative to other anthropogenic (human-generated) air emissions sources.

Table 5 Relative contribution of annual domestic shipping to total anthropogenic emissions 2015 (EIL, 2018)

Emissions (t/yr)	PM_{10}	$PM_{2.5}$	CO	NO_X	SO_2
Domestic shipping	828	748	1,089	11,564	10,114
All anthropogenic sources	46,099	34,504	531,493	121,364	49,946
Relative contribution	**2%**	**2%**	**0%**	**10%**	**20%**

Note: the shipping emissions in the above table assume an average fuel sulphur content of 3.5 %.

[90] Ministry for the Environment (MfE) and Statistics New Zealand, 2018. "Our Air 2018". Wellington. October. [Online: Retrieved 13 December 2018]

[91] Emission Impossible Ltd, 2018. "National air emissions inventory 2015". Prepared for the Ministry for the Environment. Auckland. October. [Online: Retrieved 13 December 2018]

Auckland Council published a detailed air emissions inventory that estimated emissions from international vessels (such as cargo ships and cruise ships) at port and when travelling within the Auckland Council marine boundaries.[92]

From the Auckland inventory, it is possible to estimate how many light duty vehicles (cars and vans) would be equivalent to a typical cruise ship visit - at least in terms of NO_X and PM_{10} emissions.

An "average"[93] cruise ship travelling around New Zealand typically emits 2,620 kg of NO_X and 290 kg of PM_{10} when visiting in port. These amounts are roughly equivalent to total daily emissions of:

- 210,000 cars (based on NO_X); or
- 280,000 cars (based on PM_{10}).

For perspective, in 2017 Wellington had 340,000 registered light duty vehicles (cars and vans).[94] This means that a typical cruise ship visit to Wellington results in only slightly less emissions than emissions from an entire days' worth of car and van travel in the region.

[92] Peeters S, 2018. "Auckland air emissions inventory 2016 - Sea transport". Prepared for Auckland Council. July. [Online: Retrieved 13 December 2018]

[93] Based on the total annual cruise ship emissions divided by the number of cruise ships reported in Peeters, (2018).

8 Key public health impacts associated with air emissions from shipping

The key public health impacts arising from air emissions from shipping are:

(iii) Effects from harmful emissions; and

(iv) Effects from climate change caused by greenhouse gas emissions

8.1 Effects associated with harmful air emissions

Harmful air pollutants are so-called because they can cause **adverse** human health effects. The effects of harmful air pollutants depend on the:

- Composition of the pollutant mixture;
- Level and duration of exposure; and
- Factors related to the sensitivity of the exposed population (such as age, ethnicity and pre-existing medical conditions).

Effects can range from minor nuisance to serious and be short-term (acute) or long-term (chronic). This document focusses primarily on pollutants that can cause serious adverse health effects.

It is well documented that exposure to air pollution may lead to adverse health effects, such as increased **morbidity** (illness) and **premature deaths** (loss of life), mainly related to respiratory and cardiovascular diseases.

Premature deaths are deaths that occur before a person reaches an expected age. This expected age is typically the life expectancy for a country stratified by sex. Premature deaths are considered preventable if their cause can be eliminated. (EEA, 2018)

8.1.1 Composition

Different air pollutants produce different health effects (see **Figure 4**):

- Carbon monoxide (CO) is a gas that is readily absorbed from the lungs into the bloodstream. It attaches more readily to haemoglobin in the blood than oxygen and can cause headaches, dizziness, weakness and aggravate heart conditions.
- Nitrogen dioxide (NO_2) is a gas that causes increased susceptibility to infections and asthma. It reduces lung development in children and has been associated with increasingly more serious health effects, including reduced life expectancy.[95]

[95] (UK) Committee on the Medical Effects of Air Pollutants, 2015. "Statement on the evidence of effects of nitrogen dioxide on health". Public Health England. March.

- Sulphur dioxide (SO_2) is a gas that can aggravate respiratory and cardiovascular conditions. It can trigger bronchospasm in asthmatics and its effects are heightened by exercise. Sulphur dioxide also forms secondary (fine) particulate matter.
- Volatile organic compounds (VOCs) include a wide range of chemicals, some of which are carcinogenic to humans. Of most concern are benzene, formaldehyde, 1-3 butadiene and polycyclic aromatic hydrocarbons (**PAHs**) which include benzo(a)pyrene (**BaP**). VOCs can also react with NO_X in the presence of sunlight to form ozone (**O_3**) which is a lung irritant.
- Particulate matter (PM_{10} and $PM_{2.5}$) impacts predominantly on respiratory and cardiovascular systems. Effects can range from reduced lung function to increased medication use to more hospital admissions through to reduced life expectancy and death.
- Heavy metals such as lead and mercury are a threat to the development of the child in utero and early in life. Lead is a cumulative toxicant that affects multiple body systems and can cause adverse neurological and behavioural effects in children. Mercury may have toxic effects on the nervous, digestive and immune systems, and on lungs, kidneys, skin and eyes.
- Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer.

Particulate matter, being so ubiquitous, warrants further discussion.

Adverse health effects caused by particulate matter are dependent on its size and its ability to act as a carrier for other pollutants. Larger particles (between 2.5 and 10 µm in size) generally deposit in the upper airways but particles 2.5 µm and smaller penetrate more deeply into the lungs. Ultrafine particles ($PM_{0.1}$) with diameters less than 0.1 µm can pass through pulmonary tissue, enter the bloodstream, and circulate throughout the body. In addition, toxic substances can be carried into the lungs attached to the particles. One example is arsenic, which is discharged to air when treated wood is burned in domestic fires.

Current estimates suggest that the most significant health impacts, in terms of the burden on the health system and society, arise from particulate matter (PM_{10} and $PM_{2.5}$). However, concern about exposure to NO_2 is increasing. A recent study found nearly 9,500 people die prematurely each year in London due to long-term exposure to air pollution – more than twice as many as previously thought, once both NO_2 and PM effects were accounted for.[96]

[96] Kings College London, 2015. "Understanding the health impacts of air pollution in London". Prepared for Transport for London and the Greater London Authority. London. UK. July. [Online: retrieved 19 December 2018]

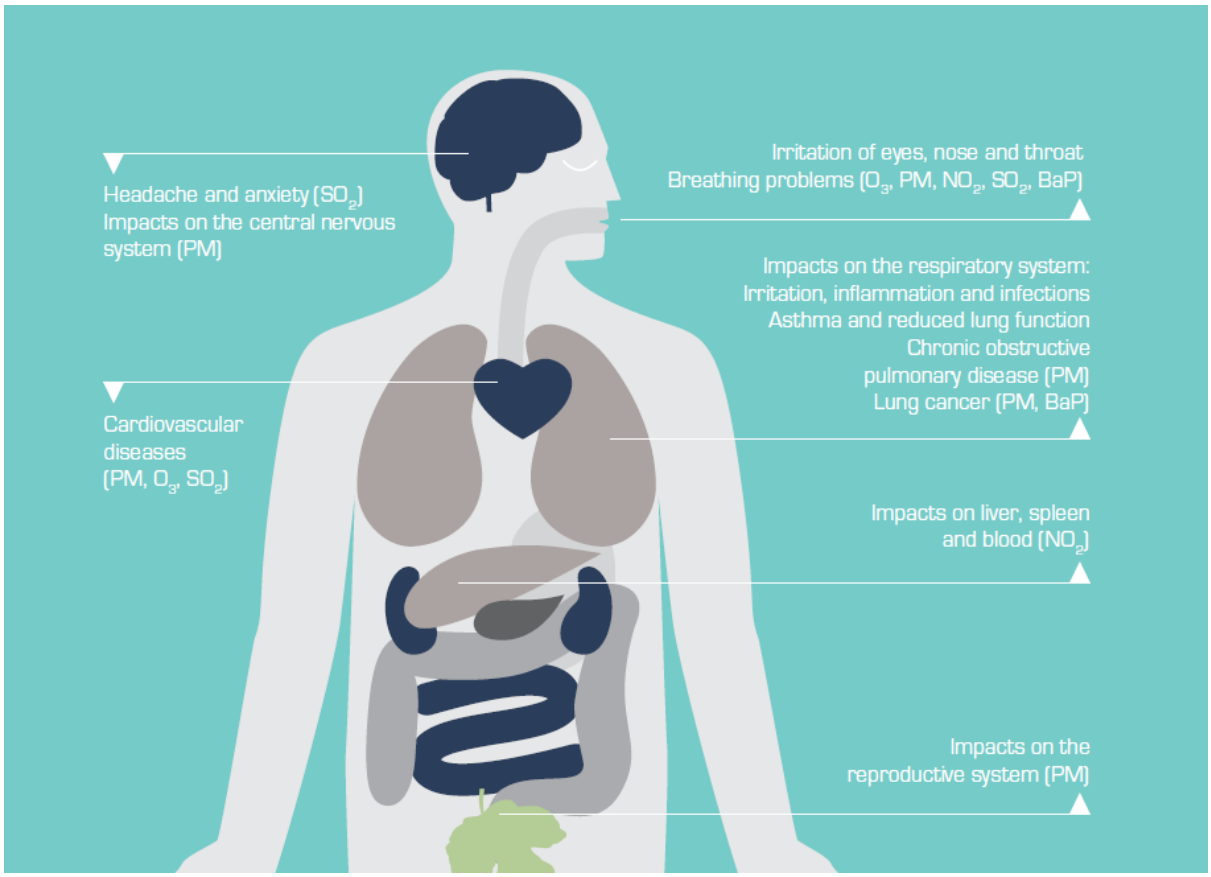

Figure 4 Examples of the health impacts associated with air pollution (EEA, 2013)

Note: BaP = benzo(a)pyrene, NO_2 = nitrogen dioxide, O_3 = ozone, PM = particulate matter, SO_2 = sulphur dioxide

Note: The specialised cancer agency of the World Health Organization – the International Agency for Research on Cancer (**IARC**) – announced in 2013 that it had classified **outdoor air pollution as carcinogenic** to humans (Group 1), due to evidence linking it to lung cancer and associating it with bladder cancer.[97] In a separate evaluation, **particulate matter was also classified as carcinogenic** to humans (Group 1). IARC acknowledged that whilst the composition of air pollution and levels of exposure vary dramatically between locations, these classifications apply to all regions of the world. IARC had already classified **diesel engine exhaust as carcinogenic** to humans (Group 1) in 2012.[98]

[97] International Agency for Research on Cancer (IARC), 2013. "Outdoor air pollution a leading environmental cause of cancer deaths". Lyon. France. October.

[98] IARC, 2012. "Diesel engine exhaust carcinogenic". Lyon. France. June.

8.1.2 Certain people are more vulnerable to poor air quality

Susceptibility to the effects of air pollution depends on factors that are unique for each individual (e.g., age, health status, genetic makeup) as well as exposure (e.g., time spent outdoors, proximity to major roads).

Based on health reviews, the groups within the population who are more affected by air pollution than others include elderly people, children (including babies, infants and unborn babies), people with pre-existing heart or lung disease, people with respiratory conditions, asthmatics, diabetics, pregnant women and Māori. [99]

8.1.3 Long-term exposure is more harmful than short-term exposure

Air pollution exposure can have two classes of effects: short-term (**acute**) or long-term (**chronic**) effects. Short–term exposures cover minutes, hours, or days. Long-term exposures are usually over months or years.

Short-term exposure to combustion related air pollution can cause respiratory irritation, even in healthy people. Clinical studies have shown a range of acute cardiovascular and respiratory effects in volunteers with or without pre-existing diseases. Some short-term effects (such as heart rhythm disturbances) are completely reversible, but others can cause chronic inflammation of the lungs and blood vessels, and eventually, following repeated exposure, lead to chronic diseases such as lung cancer and atherosclerosis (hardening of the arteries).

Short-term effects from elevated concentrations of harmful air pollutants can include premature death in susceptible individuals. However, the major impact of air pollution exposure on life expectancy is thought to be the gradual, cumulative effects on chronic disease. Relative risk ratios indicate that **the health burden due to chronic exposure to air pollution is typically 10 times greater than that for acute exposure**. [100]

8.2 Effects associated with greenhouse gases

Greenhouse gases (also known as “climate pollutants”) emitted from fuel combustion in shipping include:

- Carbon dioxide (**CO_2**);
- Nitrous oxide (**N_2O**); and

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[99] MfE, 2011. "Clean healthy air for all New Zealanders". Wellington. August.

[100] World Health Organization (WHO), 2006. "Air Quality Guideline Global Update 2005". WHO Regional Office for Europe. Copenhagen. Denmark.

- Black carbon – which is essentially fine particulate matter ($PM_{2.5}$ and smaller).

Greenhouse gases (**GHGs**) are so-called because they contribute to global warming and climate change. GHGs are categorised as **short-lived** with an atmospheric lifetime of days to ~15 years (e.g. black carbon and CH_4) or **long-lived** with an atmospheric lifetime of more than 100 years (e.g. CO_2). For ease of comparison, GHGs are typically expressed as CO_2-equivalents (**$CO_{2\text{-}e}$**), which is the amount of CO_2 which would have the ***equivalent*** global warming impact.

Note: Several harmful pollutants (especially black carbon) are **direct** climate pollutants. Many of the remaining harmful pollutants (e.g. SO_2 and CO) are **indirect** climate pollutants. They do not have a direct warming effect but react with other gases and increase GHG concentrations. **Therefore initiatives which address harmful air pollutants typically yield both health and climate change benefits.**

8.2.1 Impacts of climate change

Climate change affects human health in several ways.[101] Direct effects of climate change include:

- Increased extreme meteorological-caused events (e.g. flooding, fires);
- Displacement; and
- Extreme temperatures.

Indirect effects from climate change on human health include:

- Increased harmful algal blooms;
- Increased microbial contamination;
- Decreased food availability, quality and safety;
- Decreased mental health and well-being;
- Reduced outdoor air quality;
- Increased carriers of new diseases; and
- Increased migration of tropical species into New Zealand

These last two are particularly relevant for shipping, and increased cruise ship visits, in New Zealand.

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[101] Royal Society of New Zealand, 2017. "Human Health Impacts of Climate Change in NZ". October. [Online: Retrieved 13 December 2018]

Globally, 2017 was Earth's second-warmest year on record, just behind 2016. In New Zealand, 2017 was the fifth-warmest on record (since monitoring began in 1909) with January 2018 being the hottest New Zealand month in 150 years.[102]

While cases of malaria declined in New Zealand between 2015 and 2016, cases of dengue fever and Zika virus (also mosquito borne) increased.[103] Zika virus outbreaks in the Pacific have been increasing since 2013 and New Zealand cases are currently linked to travellers coming into New Zealand. Climate change increases the possibility of these diseases becoming established in New Zealand.

8.2.2 Vulnerable communities in New Zealand

As with effects of harmful air pollution, the effects of climate change will not be spread evenly across the population. Impacts are more likely to affect communities already subject to socioeconomic and ethnic health inequalities.

Some Māori communities are likely to be particularly vulnerable to increased flood risk due to climate change because their ancestral settlements and sacred sites are located on exposed, erosion-prone coastal lands.

8.2.3 Vulnerable communities elsewhere

New Zealand also has an obligation to support vulnerable communities in the Pacific.

Many Pacific island nations are low lying - making them considerably more vulnerable to the effects of sea level rise and extreme weather events.

As previously mentioned, Pacific island communities are already seeing increases in Zika virus infections as warmer moister conditions support increased mosquito activity.

8.3 Public health costs associated with shipping emissions

8.3.1 Global estimates

Harmful air pollution from international shipping accounts for approximately 50,000 premature deaths per year in Europe, at an annual cost to society of more than €58 billion (Brandt et al, 2013). Implementing the 0.5 % sulphur limit for marine fuels from 2020 would save 26,000 lives per year in Europe alone.

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[102] National Institute of Water and Atmospheric Research (NIWA), 2018. "NZ Monthly, Seasonal and Annual Climate Summaries". Auckland. New Zealand. [Online: Retrieved 13 December 2018]

[103] Institute of Environmental Science and Research Ltd (ESR), 2018. "Notifiable Diseases Commentary 2016". New Zealand. [Online: Retrieved 17 December 2018]

A worldwide adoption of the 0.5 % limit is expected to save 40,000 lives a year globally from lung cancer and cardiovascular diseases (not including benefits for improvements in child asthma and morbidity).[104]

The World Health Organisation (WHO) undertook a quantitative assessment of the health impacts of climate change in 2014 (WHO, 2014).[105] The assessment considered a subset of the possible health impacts and assumed continued economic growth and health progress (WHO, 2014):

> *"Even under these conditions, it concludes that climate change is expected to cause approximately 250,000 additional deaths per year between 2030 and 2050; 38,000 due to heat exposure in elderly people, 48,000 due to diarrhoea, 60,000 due to malaria, and 95,000 due to childhood undernutrition."*

8.3.2 New Zealand estimates

In New Zealand, estimates are not currently available for estimated health impacts of shipping from either harmful or greenhouse gas emissions.

The most comprehensive study to date which quantifies health impacts from anthropogenic air emissions is the Updated Health and Air Pollution in New Zealand (HAPINZ) study. [106] **This has a base year of 2006 and is largely based on the health effects associated with PM_{10}** emitted from motor vehicles, domestic fires, open burning and industry. The annual cost of anthropogenic air pollution in New Zealand was estimated at NZD$4.28 billion (as at June 2010), as a result of 1,175 premature deaths, 607 hospitalisations for respiratory and cardiac illnesses and 1.49 million restricted activity days.[107] The Updated HAPINZ study does not specifically consider either shipping emissions or pollutants other than PM_{10}.

The HAPINZ study has been subsequently used to develop damage costs - most recently to evaluate transport emissions in Wellington.[108]

Damage costs are a way to value changes in air emissions in order to compare the benefits to society of a change in policy/operation versus the cost of implementing the change. They can also be used to compare a range of options to see which will yield the best overall outcome. Internationally, most governments publish relevant values to be

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[104] European Federation for Transport and Environment, 2018. "Benefits of reducing air pollution from ships". Brussels. Belgium. [Online: Retrieved 13 December 2018]

[105] WHO, 2014. "Quantitative risk assessment of the effects of climate change on selected causes of death". Geneva. Switzerland. [Online: Retrieved 13 December 2018]

[106] Kuschel et al, 2012. "Updated Health and Air Pollution in New Zealand Study". Auckland. New Zealand. March.

[107] Restricted activity days are days on which people cannot do the things they otherwise have done if air pollution was not present.

[108] Kuschel et al, 2017. "Evaluating Bus Emissions". Paper by G Kuschel, A Cooper and J Metcalfe presented at the Australasian Transport Research Forum. Auckland. 27-29 November 2017. Available at: https://atrf.info/papers/2017/index.aspx

used in the assessment of costs and benefits of various policy options in their jurisdictions.

Table 6 shows the damage costs developed for a Wellington transport emissions evaluation that was reviewed and approved by NZTA. In the absence of any other data, these provide a suitable basis for valuing public health benefits of emission reductions associated with New Zealand acceding to Annex VI.

Table 6 also provides a comparison with existing (2015) published damage costs for the United Kingdom.

Table 6 Estimated social (damage) costs of emissions in NZD/tonne (2015) used in Wellington compared with UK values adjusted to NZD (2015)

Pollutant	New Zealand Costs in NZD/tonne[1]	United Kingdom Costs in NZD/tonne[2]	Value Base Date
CO_2	$66	-	2015
PM_{10}	$451,123	$126,846	2015
NO_X	$16,031	$55,107	2015
CO	$4.16	-	2015
Hydrocarbons*	$1,318	-	2015
SO_2	-	$3,947	2015

Note:

[1] Kuschel et al, 2017.

[2] DEFRA, 2015.[109] £1,956 central value converted to NZD (2015) based on GBP (3-year average 2013-2015) currency conversion 0.4955.

* Essentially equivalent to volatile organic compounds (VOCs)

[109] Department Environment, Food and the Regions (DEFRA), 2015. "Air quality: economic analysis". London. September. Transport average (Central). [Online: Retrieved 20 December 2018]

9 Responding to the discussion document

The Ministry of Transport discussion document seeks feedback on New Zealand's potential accession to the International Maritime Organization treaty: MARPOL Annex VI: Prevention of Air Pollution from Ships.

This chapter outlines a preferred position to the key question on whether New Zealand should accede to MARPOL Annex VI (yes). It also provides possible responses to four questions framed as public health, one question on timeframes and a final general question posed by the Ministry of Transport.

We encourage parties to use any, or all, of the background information provided in this document to assist with drafting submissions. We further note that this document does not preclude feedback on additional matters.

For completeness, all 38 questions are repeated in full in **Appendix B**. Public consultation closes on 11 February 2019.

Q1. New Zealand's stated ambition is to be a global leader on climate change and strengthen our credibility and influence in international climate negotiations. To enable New Zealand to influence climate change policy at the IMO we need to accede to Annex VI and be at the table to influence decisions. Do you agree? Please provide a detailed response. If you don't agree please provide reasons why.

It is our view that yes, New Zealand should accede to Annex VI, but not just so that New Zealand can influence international climate negotiations.

Researchers who have extensively studied the shipping industry are clear that the benefits of greener shipping outweigh the costs (Winnebrake & Corbett, 2018).[110] The benefits include:

- Reduced emissions of harmful air pollutants will result in reduced adverse public health effects (and costs), including premature deaths;
- Reduced emissions of harmful air pollutants will result in reduced adverse effects on ecosystems (e.g. acidification, deposition of toxics such as heavy metals and dioxins);
- Reduced greenhouse gas emissions are a tangible action to combat climate change (an issue of planetary urgency).

These three benefits provide compelling reasons, on their own, for New Zealand to accede to MARPOL Annex VI.

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[110] Winnebrake L and Corbett J, 2018. "The urgency of curbing pollution from ships, explained". The Converation. 12 April. USA. [Online: Retrieved 20 December 2018]. Extensive shipping research available here: https://scholar.google.com/citations?user=nFDXRBkAAAAJ&hl=en&oi=ao

Q5. What are the public health benefits of acceding to Annex VI?

Little work has been undertaken to comprehensively assess shipping emissions in New Zealand. This constrains the ability of health agencies to provide robust data in support of anticipated health benefits resulting from ship emissions reductions.

This is further complicated by complexities of the counter factual position i.e. the extent to which international vessels flagged to countries which have acceded to Annex VI by 2020 would reduce their harmful air and greenhouse gas emissions anyway. Peeters (2018) notes that "*nearly all foreign vessels visiting Auckland are already subject to Annex VI regulations*".[111] Therefore, even if New Zealand does not sign up to Annex VI, a substantial drop in SO_2 emissions can be expected when the 0.5 % sulphur content limit comes into effect in 2020.

The public health benefits will not be able to be robustly quantified unless, or until, a comprehensive inventory for shipping in New Zealand is developed. (The 2015 Ministry for the Environment inventory only estimates domestic shipping emissions).[112] We query why this, and a cost benefit analysis, were not provided with the Ministry of Transport discussion document.

What is clear, and indeed well established, is that reducing emissions of harmful air pollutants from ships will have a direct reduction in adverse health effects for members of the public exposed to those emissions. A rough estimate suggests that nearly 200,000 New Zealanders may be living and working in reasonably close proximity to harmful ship emissions. Thus, it is reasonable to anticipate significant public health benefits would be accrued in and around New Zealand ports should harmful ship emissions to air be reduced. This will be especially true for harmful pollutants emitted from ship fuel combustion that are carcinogenic and/or for which there is no safe threshold such as:

- PM_{10};
- Benzene; and
- Dioxins and heavy metals including lead and mercury.

Adverse health effects from air pollution are typically disproportionately borne by sensitive parts of the population such as the elderly and the socio-economically disadvantaged. There are therefore, significant social and environmental justice benefits to be realised through regulations to reduce harmful emissions.

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[111] Peeters S., 2018. At page 5.

[112] EIL, 2018.

Q6. What are the public health costs of acceding to Annex VI?

We have not identified any public health costs of acceding to Annex VI.

Q7. Are there any cost and benefits resulting from accession to Annex VI for the marine and built environments?

This question does not relate to public health. However, the following points are relevant:

- Reduced emissions (especially greenhouse gases) will also have ecological benefits in terms of minimising ocean acidification, ocean warming and extreme weather events (which can damage habitat);
- Part of Annex VI focusses on reducing ozone depleting substances so that will also improve health and environmental outcomes;
- Reduced SO_2 emissions will reduce damage to buildings and supporting infrastructure (such as air conditioning units which, anecdotally, are already showing accelerated wear near ports such as Auckland);
- Reduced smoky stack emissions means better amenity for tourists (both domestic and international) by removing dirty plumes from ships coming into port (as well inhaling fumes while on board).

Q8. Are there any public health or other environmental issues that we should be aware of when considering accession to Annex VI?

There are significant win-win outcomes that arise from reducing ship emissions that are both harmful to people, and to global warming. It is unfortunate that the Ministry of Transport has not quantified these, and their associated costs and benefits, for their discussion document.

Climate change affects human health in several ways.[113] Direct effects of climate change include:

- Increased extreme meteorological-caused events (e.g. flooding, fires);
- Displacement; and
- Extreme temperatures.

Indirect effects from climate change on human health include:

- Increased harmful algal blooms;

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[113] Royal Society of New Zealand, 2017.

- Increased microbial contamination;
- Decreased food availability, quality and safety;
- Decreased mental health and well-being;
- Reduced outdoor air quality;
- Increased carriers of new diseases; and
- Increased migration of tropical species into New Zealand

These last two are particularly relevant for shipping, and increased cruise ship visits, in New Zealand.

While cases of malaria declined in New Zealand between 2015 and 2016, cases of dengue fever and Zika virus (also mosquito borne) increased.[114] Zika virus outbreaks in the Pacific have been increasing since 2013 and New Zealand cases are currently linked to travellers coming into New Zealand. Climate change increases the possibility of these diseases becoming established in New Zealand.

Finally, (in brief):

- New Zealand is about to implement a Zero Carbon bill that will require us to start addressing emissions wherever opportunities present themselves in order achieve real reductions in emissions by 2050;
- New Zealand is significantly lagging other countries in 'doing its bit';
- New Zealand has a moral obligation to Pacific island countries to show leadership and to support them;

We therefore strongly support international regulations that seek to reduce both harmful and greenhouse gas emissions from ships.

Q36. Are there any other issues not considered above, but which you deem important and need to be factored in when considering the costs and benefits of accession to MARPOL Annex VI?

Much like vaccinations, to be effective Annex VI requires widespread adoption. It would be irresponsible for New Zealand not to accede to Annex VI.

[114] ESR, 2018.

Q38. If New Zealand is to accede to Annex VI, is 2021 a reasonable timeframe to bring the requirements into effect? Please provide your reasons for your answer.

This seems rather long given most international ships that visit New Zealand have already acceded to Annex VI.

Further, the discussion document identified fewer than 50 ships which will require regulation. This suggests compliance will not be particularly onerous (compared to say, the millions of privately-owned passenger vehicles for which the Ministry of Transport is already responsible).

January 2020, which ties in with the commencement of Annex VI regulations, is a more reasonable date.

10 Impact of shipping emissions in Auckland

Studies worldwide have shown that shipping emissions impact on the air quality of coastal areas adjacent to shipping routes, to the detriment of human health and the local environment.[115] Shipping emissions impact not only the levels and composition of particulate and gaseous pollutants but may also enhance new particle formation processes in urban areas.

One of the iconic features of Auckland is its waterfront. The waterfront is at the heart of the central business district and includes a series of wharves servicing local ferries, tourist operators and cruise ships as well as the port itself.

Auckland is the second largest container port and the most popular cruise destination in New Zealand. Ports of Auckland Limited (**POAL**) handled 580,351 containers in 2017 (up 3.9% on 2016 and 7.1% on 2010).[116] In addition, Auckland hosted cruise ships on 142 days during the 2016/17 cruise season, with port days projected to increase to 179 in 2017/18 (up 26% on 2016/17) then 185 in 2018/19.[117]

At the same time that container volumes and cruise ship movements have increased in Auckland, local populations have also increased. The resident population of the Auckland urban area has increased from 1.33 million as at June 2010 to 1.54 million as at June 2017 (up 15 %).[118]

A conservative (i.e. likely underestimate) is that around 100,000 people live and work within a few kilometres of the Port of Auckland.

10.1 Effects on Auckland's air quality

Auckland Council reviewed research and monitoring on the effects of shipping on air quality in Auckland in 2017. [119] The report encompassed studies undertaken between 2006 and 2016 and found:

- Concentrations of SO_2 are higher in locations close to the Auckland waterfront, particularly when the wind is coming from a north-east direction, with concentrations up to four times higher than at other sites across Auckland.
- The elevated levels of SO_2 are most likely as a result of emissions from vessels docked at the container port or the cruise ship berthing wharves.

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[115] Viana M. *et al*, 2014. "Impact of maritime transport emissions on coastal air quality in Europe". June. [Online: Retrieved 19 December 2018]

[116] Ministry of Transport, 2018.

[117] M.E Consulting, 2017. "Cruise Tourism Contribution to NZ's Economy". August. [Online: Retrieved 19 December 2018]

[118] Statistics New Zealand, 2018.

[119] Talbot N, Reid N, 2017. "Effects of shipping on Auckland's air quality 2006-2016". Prepared for Auckland Council. Auckland. March. [Online: Retrieved 19 December 2018]

- Source apportionment investigations have confirmed elevated levels of vanadium and nickel (recognised internationally as being associated with shipping emissions and therefore used as elemental "ship sulphate" signature) at waterfront and Queen Street locations.

- Shipping emissions interact with and contribute to Auckland's air pollution while the ships are under propulsion in shipping lanes approaching and leaving the port.

The report concludes that shipping emissions from near-port and docked vessels do impact and degrade the air quality of Auckland.

10.2 Trends in shipping emissions

Shipping emissions have been quantified in an inventory commissioned by Auckland Council (Peeters, 2018).[120] The inventory includes emissions from ships for a base year of 2016, with predictions for 2026, 2036 and 2040.[121]

Table 7 summarises the annual emissions estimates for different shipping sources in the Auckland region.

Table 7 Annual combined emissions from shipping in the Auckland region 2016 to 2040 (Peeters, 2018)

Year	Source	NO_X	PM_{10}	$PM_{2.5}$	VOC	CO	SO_2	CO_2
		(tonnes/year)						
2016	OGV at-sea	1,300	125	116	62	133	906	57,474
	OGV at-berth	488	53	48	15	40	472	34,231
	Harbour vessels	46	1	1	5	157	0	3,999
	Ferries	461	9	8	15	116	0	32,668
	Fishing boats	72	5	5	72	284	0	6,118
	Total for 2016	**2,368**	**192**	**178**	**169**	**730**	**1,378**	**134,489**
2026	OGV at-sea	1,462	83	77	82	173	225	74,860
	OGV at-berth	416	25	23	17	45	110	39,377
	Harbour vessels	61	1	1	7	210	0	5,428
	Ferries	536	11	11	19	173	0	41,815
	Fishing boats	57	3	3	38	203	0	6,118
	Total for 2026	**2,532**	**124**	**115**	**162**	**804**	**335**	**167,598**
2036	OGV at-sea	1,767	103	95	101	214	279	92,352
	OGV at-berth	372	17	16	15	40	19	34,336
	Harbour vessels	75	2	2	9	261	0	6,881
	Ferries	549	13	13	24	369	0	50,962
	Fishing boats	59	1	1	15	188	0	6,118
	Total for 2036	**2,822**	**137**	**126**	**163**	**1,072**	**298**	**190,649**
2040	OGV at-sea	1,878	111	102	109	229	299	99,044

[120] S Peeters, 2018.

[121] *Ibid.*

Year	Source	NO_X	PM_{10}	$PM_{2.5}$	VOC	CO	SO_2	CO_2
		(tonnes/year)						
	OGV at-berth	309	15	14	12	33	16	28,546
	Harbour vessels	82	2	2	9	279	0	7,439
	Ferries	588	14	14	25	395	0	54,555
	Fishing boats	59	1	1	15	188	0	6,118
	Total for 2040	**2,916**	**143**	**133**	**171**	**1,126**	**316**	**195,703**

Note: OGV = ocean going vessel

The emissions estimates (in **Table 7**) show the likely improvement in shipping emissions in Auckland due to the implementation of MARPOL Annex VI (as well as the implementation of shore power, also known as "cold ironing").[122] It is important to note these emissions improvements are based on a number of key assumptions (from Peeters, 2018), which follow:

For ocean going vessels (**OGV**s) in 2016:

- an average sulphur content of 2.7% in heavy fuel oil

For OGVs for 2026, 2036 and 2040:

- Cruise ship visits will increase from 99 in 2016 to 150 in 2030, with the number of visits for 2036 and 2040 linearly extrapolated.
- POAL terminal capacity will grow to two million TEU[123] by 2044 from 926,151 in 2016.
- Vehicle imports will grow from 269,939 in 2016 to 341,000 in 2041.
- Bulk carrier, general cargo and tanker activity will experience a similar growth as vehicle carriers.
- Hotelling – shore power[124] infrastructure as follows:
    - 50% of cruise ships will use shore power in 2026.
    - 50% of cruise, container and reefer vessels will use shore power in 2036.
    - 50% of all OGVs will use shore power in 2040.
- OGVs visiting Auckland will be progressively compliant with MARPOL Annex VI NOx emission standards. Compliance will be achieved through using low sulphur fuel and/or other technical implementations such as scrubbers.
- The sulphur content of marine fuels sold worldwide will be capped at 0.5 % from 2020. Sulphur emissions for 2026, 2036 and 2040 are based on a sulphur content of 0.5 %.
- By 2040, all OGVs visiting Auckland will still be powered by engines using petroleum-based fuels.

Since the development of the Auckland inventory, Ports of Auckland Ltd have set a goal to be a zero emissions port by 2040, which is a world-first. [125] This commitment, undertaken voluntarily by Ports of Auckland Ltd, will significantly reduce both harmful

[122] Cold ironing is the provision of shore side electrical power to a ship at berth while its on-board engines are shut down.

[123] 1 TEU = 20-foot-long (6.1m) shipping container

[124] Shore power is the provision of shore side electrical power to a ship at berth while its on-board engines are shut down. For OGVs, it is sometimes referred to as "cold ironing".

[125] Ports of Auckland Ltd, 2018. "Port joins coalition to fight climate change". July. [Online: Retrieved 21 December 2018]

and greenhouse gas emissions to air from cargo and cruise ships. It also provides some certainty for the reductions estimated in **Table 7**, especially for OGVs in port.

10.3 Estimated health impacts of shipping emissions

The emissions estimates (shown in **Table 7**) can be combined with damage costs (**Table 6**) to indicate the public health *costs* associated with shipping emissions in Auckland. The difference in these values, for different years, can then be used to estimate the likely *benefits* of emissions reductions – for example, from the implementation of MARPOL Annex VI.

As noted in Section 3.3.2, damage costs are a way to value changes in emissions in order to compare the benefits to society of a change in policy/operation versus the cost of implementing the change.

Damage costs are the impact to society as a result of the "emission" under consideration. Exposure to the emission increases the (public health) burden of morbidity (illness) and even mortality (death) and results in additional health costs (e.g. from increased medication or hospitalisations) as well as lost productivity. In the case of greenhouse gases, the damage costs relate to the effects of climate change on the well-being of society (and not the costs associated with complying with any carbon tax or emission trading scheme requirements which would be separate).

New Zealand does not have national published damage cost values. However, air emissions damage costs were developed for Greater Wellington Regional Council (**GW**) as part of their evaluation of transport emissions (refer **Table 6**).[126] These factors were developed from international literature and relevant local data, notably the Health and Air Pollution in New Zealand Update study.[127]

The air emissions damage cost values were reviewed and approved by the NZ Transport Agency. In the absence of any other data, these provide a suitable basis for valuing public health benefits of emission reductions associated with New Zealand acceding to Annex VI.

In addition to the damage costs developed for Wellington, we have incorporated a damage cost for SO_2 from the Department for Food and Rural Affairs (**DEFRA**) in the United Kingdom[128] as follows:

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[126] Kuschel et al, 2017.

[127] Kuschel et al, 2012.

[128] DEFRA, 2015.

- 2015 DEFRA damage costs £1,956 per tonne SO_2 (average across whole UK);
- Converted to NZD using a currency conversion factor of 0.4955 (three-year average for 2013 – 2015); and
- 2015 damage cost of NZD $3,947 per metric tonne SO_2.

The public health costs associated with shipping emissions in Auckland can then be estimated by combining the annual emissions (**Table 7**) with the damage costs (**Table 6**) then applying a discount rate of 3 % per annum[129] to the various years so all figures are adjusted to New Zealand dollars as at 2015.

Table 8 shows the estimated public health *costs* associated with shipping emissions in Auckland for the four "snap shot" years covered by the Auckland air emissions inventory:

- 2016 - before the fuel sulphur regulations in MARPOL Annex VI come into force); and
- 2026, 2036 and 2046 - after MARPOL Annex VI takes effect.[130]

The public health *benefits* of implementing MARPOL Annex VI in Auckland can then be established relative to 2016 (pre the regulations being in force) by considering the *difference* in estimated annual public health costs for each year (relative to 2016). **Table 8 Estimated annual public health costs associated with shipping emissions in Auckland**

Year	NO_X	PM_{10}	VOC	CO	SO_2	CO_2	Total
	(NZD Million 2015)						
2016	38.0	86.6	0.2	0.0	5.4	8.9	
2026	30.2	41.6	0.2	0.0	1.0	8.2	**81**
2036	25.0	34.2	0.1	0.0	0.7	7.0	**67**
2040	23.0	31.7	0.1	0.0	0.6	6.4	**62**

Table 9 Estimated annual public health benefits associated with implementing MARPOL Annex VI in Auckland relative to 2016

Year	NO_X	PM_{10}	VOC	CO	SO_2	CO_2	Total
	(NZD Million 2015)						
2016	0.0	0.0	0.0	0.0	0.0	0.0	**0**
2026	7.8	45.0	0.1	0.0	4.5	0.6	**58**
2036	12.9	52.4	0.1	0.0	4.8	1.9	**72**
2040	15.0	54.9	0.1	0.0	4.8	2.5	**77**

Table 9 shows that if MARPOL is implemented, and then the annual public health benefit in 2026 alone will be NZ $58 million (NZD 2015). This figure rises to NZ $77 million in 2040 (NZD 2015).NB: These estimates also assume that the assumptions in the Auckland inventory (refer Section 5.2) hold true.

[129] A discount rate of 3% per annum is consistent with the discount rate that typically applies year to year with the Ministry of Transport Value of a Statistical Life (VoSL) used for valuing road crash mortality.

[130] NB: The Auckland inventory also incorporates moves to shore power for OGVs while in berth from 2026.

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Appendix A MARPOL Annex VI and amendments to date

Table A1: Summary of MARPOL Annex VI Regulations

Chapter	Regulation
I. General	26. Application 27. Definitions 28. Exceptions and exemptions 29. Equivalents
II. Survey, certification and means of control	30. Surveys 31. Issue or endorsement of Certificates and Statements of Compliance related to fuel oil consumption reporting 32. Issue of a Certificate by another Party 33. Form of Certificates and Statements of Compliance related to fuel oil consumption reporting 34. Duration and validity of Certificates and Statements of Compliance related to fuel oil consumption reporting 35. Port State control on operational requirements
III. Requirements for control of emissions from ships	36. Detection of violations and enforcement 37. Ozone depleting substances (**ODN**) 38. Nitrogen oxides (**NO_X**) 39. Sulphur oxides (**SO_X**) and particulate matter 40. Volatile organic compounds (**VOC**) 41. Shipboard incineration 42. Reception facilities 43. Fuel oil quality
IV. Regulations on energy efficiency of ships (directly addresses climate change impacts)	44. Application 45. Attained Energy Efficiency Design Index (Attained **EEDI**) 46. Required EEDI 47. Ship Energy Efficiency Management Plan (**SEEMP**) 22A. Collection and reporting of ship fuel oil consumption data 48. Promotion of technical co-operation and transfer of technology relating to the improvement of energy efficiency of ships
V. Verification of compliance with the provisions of this Annex	49. Application 50. Verification of compliance
Appendices	XI. Form of International Air Pollution Prevention (**IAPP**) Certificate (Regulation 8) XII. Test cycles and weighting factors (Regulation 13) XIII. Criteria and procedures for designation of emission control areas (Regulation 13.6 and Regulation 14.3) XIV. Type approval and operating limits for shipboard incinerators (Regulation 16) XV. Information to be Included in the bunker delivery note (Regulation 18.5)

Chapter	Regulation	
	XVI.	Fuel verification procedure for Annex VI fuel oil samples (Regulation 18.8.2)
	XVII.	North American Emission Control Area (Regulation 13.6 and Regulation 14.3)
	XVIII.	Form of International Energy Efficiency (**IEE**) Certificate
	XIX.	Information to be submitted to the IMO Ship Fuel Oil Consumption Database
	XX.	Form of Statement of Compliance – Fuel oil consumption reporting

Table A2: MARPOL Annex VI amendments to date (Australian Maritime Safety Organisation)[131]

Amendment	Date of entry into force	Comments
2017 (Annex VI) amendments MEPC.286(71) Designation of the Baltic Sea and the North Sea Emission Control Areas for NO_X Tier III control and Information to be included in the bunker delivery note	1 Jan 2019	Baltic and North Sea NO_X Emission Control Area: • The amendments to regulation 13 of MARPOL Annex VI give effect to the Baltic and North Sea NO_X Emission Control Area • The amendments also introduce a new exemption paragraph to allow ships that do not comply with the Tier III requirements to be built, converted, repaired and/or maintained at shipyards in the North Sea area. Bunker Delivery Note: • Amendments to appendix V of MARPOL Annex VI change the bunker delivery note to reflect that a ship may be using high sulphur fuel because they have in place an alternative method to manage their sulphur emissions (eg a scrubber).
2016 (Annex VI) amendments MEPC.278(70) Amendments to implement a data collection system for fuel oil consumption of ships	1 Mar 2018	Amendments to require the mandatory collection of fuel oil consumption and transport work data from international ships which are 5,000 GT and over.

[131] "Table of MARPOL Amendments". Australian Maritime Safety Authority. [Retrieved 28 November 2018]

Amendment	Date of entry into force	Comments
2016 (Annex VI) amendments MEPC.271(69) Amendments to regulation 13 – Record requirements for operational compliance with NOx Tier III Emission Control Areas	1 Sep 2017	Amendments to require certain ships to maintain records of the operational status of their marine diesel engines, together with the date, time and position of the ship when operating in NOx Emission Control Areas (NECAs). These amendments ensure authorities are able verify whether a ship's engines have been operated in compliance with NECA requirements.
2014 (Annex VI) amendments MEPC.258(67) Amendments to regulations 2 and 13 and the Supplement to the IAPP Certificate	1 Mar 2016	Amendments that extend the application of MARPOL Annex VI to gas fuelled ships, by means of amendments to the definitions of fuel oil and marine diesel engine to include gas fuel and gas fuelled engines; clarify the documentation of engines' compliance with NOx emission standards within Regulation 13.7.3 and the Supplement to the IAPP Certificate; clarify recording requirements for the length of ships used solely for recreational purposes in a footnote; recognise the updated (MEPC.244(66)) in the IAPP Certificate.
2014 (Annex VI) amendments MEPC.247(66) Amendments to make the use of the III Code mandatory	1 Jan 2016	Amendments to Annex VI to make use of the IMO Instruments Implementation Code (III Code) mandatory.
2014 (Annex VI) amendments MEPC.251(66) Amendments to regulations 2, 13, 19, 20 and the Supplement to the IAPP Certificate and certification of dual-fuel engines under the NOx Technical Code 2008	1 Mar 2015	Various amendments relating to the application of the Energy Efficiency Design Index (EEDI) to a wider range of ship types and certification of dual-fuel engines.
2012 (Annex VI) amendments MEPC.217(63) Regional Arrangements for port Reception Facilities under MARPOL Annex VI and Certification of Marine Diesel Engines fitted with selective catalytic reduction systems under the NOx Technical Code 2008	1 Aug 2013	Amendments relating to regional arrangements for port reception facilities under Annex VI and certification of marine diesel engines under the NOx Technical Code.
2011 (Annex VI) amendments MEPC.203(62) Inclusion of Regulations on Energy Efficiency for Ships	1 Jan 2013	Addition of a new Chapter 4 to Annex VI to regulate energy efficiency for ships.

Amendment	Date of entry into force	Comments
2011 (Annex VI) amendments MEPC.202(62) Designation of the Caribbean Sea Emission Control Area	1 Jan 2013	Addition of a new emission control area.
2010 (Annex VI) amendments MEPC.194(61) Revised form of Supplement to the IAPP Certificate	1 Feb 2012	Revised form of the Supplement to the IAPP Certificate.
2010 (Annex VI) amendments – MEPC.190(60) North American Emission Control Area	1 Aug 2011	Addition of a new emission control area.
2008 (Annex VI) amendments – MEPC.176(58) Revised Annex VI	1 Jul 2010	Completely revised to establish more stringent regulations to further reduce air emissions from ships. Various amendments made including, requirements for ozone depleting substances record books and VOC management plans; addition of NOx Tier II and Tier III performance standards and NOx emission control areas; provisions related to sulphur content of fuel oil to progressively reduce SOx emissions; provisions to ensure fuel oil quality and availability and reception facilities.
2005 (Annex VI) amendments MEPC.132(53) Amendments to Annex VI and to the NOx Technical Code	22 Nov 2006	Amendments related to survey and certification and addition of a new emission control area.
Protocol of 1997 Annex VI – Regulations for the Prevention of Air Pollution from Ships	19 May 2005	New Annex VI added to the convention.

Appendix B Full list of discussion document questions

Submissions can be made by email or post to:

- maritime@tranport.govt.nz with the words “MARPOL Annex VI submission” in the subject line; or:
- MARPOL Annex VI submissions, PO Box 3175, Wellington 6140.

You should indicate in your submission whether it would be acceptable, if required, for officials from the Ministry of Transport to contact you to discuss your submission. If you need more information to assist you in preparing a submission, please contact Brian Nijman at b.nijman@transport.govt.nz.

The deadline for submissions is Monday 11 February 2019.

Questions associated with accession to Annex VI

In order to provide advice to enable the Government make a decision on whether or not to accede to Annex VI, your views are sought. Submissions will inform subsequent advice to Cabinet including a National Interest Analysis (NIA) which assesses Annex VI from the perspective of its impact on New Zealand and New Zealanders. The NIA will also include economic modelling to quantify the costs and benefits of accession.

Your views on the questions below are important to enable us shape subsequent advice to Government on whether New Zealand should accede to Annex VI. Please provide as much detail as possible including references to examples and/or published material.

Improving New Zealand credibility and influence on climate policy

Annex VI is likely to be the primary international regulatory mechanism for mitigating maritime GHG emissions as well as other air pollutants.

Q1. New Zealand’s stated ambition is to be a global leader on climate change and strengthen our credibility and influence in international climate negotiations. To enable New Zealand to influence climate change policy at the IMO we need to accede to Annex VI and be at the table to influence decisions. Do you agree? Please provide a detailed response. If you don’t agree please provide reasons why.

Protecting New Zealand’s trade interests and advancing effective mitigation measures

Annex VI addresses GHG emissions (primarily CO2) from international shipping, through the following instruments:

- Ship Energy Efficiency Management Plan (**SEEMP**), an operational measure; and

- Energy Efficiency Design Index (**EEDI**), relating to the design and propulsion of new ships and those having undergone major conversion.

Slow steaming, not currently mandated by the IMO, is one way in which ships on international voyages can reduce fuel consumption and CO_2 emissions. New Zealand needs to ensure the application of slow steaming (especially if mandated through the Strategy) does not have disproportionate trade or operational impacts, given our distance from markets.

Q2. What are the costs associated with complying with SEEMP and EEDI requirements?

Q3. What are the benefits associated with the EEDI and SEEMP requirements?

Q4. What does New Zealand need to bear in mind on slow steaming when considering accession to Annex VI? Please provide as much *detail as possible.*

Improving public health

When fossil fuels are burnt, compounds harmful to human health, including nitrogen oxides, sulphur oxides and particulate matter, are released into the atmosphere.

Q5. What are the public health benefits of acceding to Annex VI?

Q6. What are the public health costs of acceding to Annex VI?

Q7. Are there any cost and benefits resulting from accession to Annex VI for the marine and built environments?

Q8. Are there any public health or other environmental issues that we should be aware of when considering accession to Annex VI?

Providing for easier movement of New Zealand flagged ships to other countries

Any New Zealand flagged vessel wishing to visit the port of a State that has acceded to Annex VI must abide by Annex VI requirements.

Q9. How would accession to Annex VI affect the limited number of domestic ships that visit overseas ports in Party States?

Q10. If we do not accede to Annex VI what are the issues that are likely to arise for the limited number of domestic ships that visit overseas ports in Party States?

Q11. Are there any other issues affecting New Zealand ships visiting the ports of Party States we should be aware of?

Q12. If we do not accede to Annex VI do you have any suggestions as to how to deal with New Zealand ships visiting overseas ports in Party States?

Low sulphur fuel

The global limit for the sulphur content of marine fuel will be strengthened to 0.5 percent from 1 January 2020, and will apply to all ships registered to Annex VI Party States. Residual fuel that meets the 0.5 percent sulphur limit will cost more to produce than 3.5 percent sulphur fuel.

Q13. What are the benefits of moving to fuel with a sulphur limit of 0.5 percent?

Q14. What are the costs associated with moving to a low sulphur fuel limit of 0.5 percent?

Q15. How easy would it be for the global shipping industry to source 0.5 percent sulphur fuel?

Q16. Would Marsden Point be able to produce low sulphur fuel?

Q17. If yes, would Marsden Point be able to produce enough quantities of low sulphur fuel at reasonable cost?

Q18. If not, where and how will international visiting ships obtain their low sulphur fuel?

Q19. How would a low sulphur fuel requirement affect our domestic shipping industry?

Q20. If low sulphur fuel is unavailable, is diesel the most likely option that will be used?

Q21. What are the benefits of switching to diesel?

Q22. What are the costs of switching to diesel?

Q23. Are ships likely to continue using 3.5 percent fuel but with abatement technology?

Q24. What are the costs associated with using abatement technology?

Q25. What are the benefits of using abatement technology?

Q26. How easy will it be to install abatement technology in ships already in service?

Q27. Are there any other considerations apart from price that is likely to be taken into account when deciding to switch fuels or use abatement technology?

Q28. Would current reception facilities at ports be able to cope with the requirements of Annex VI?

Q29. If not, what are the additional costs associated with providing additional reception facilities?

Q30. If low sulphur fuel could not be locally produced, what will happen to the 3.5 percent sulphur fuel currently produced as a by-product of the refining process?

Impact on diesel powered vessels

Annex's VI's NO_X requirements apply to new marine diesel engines greater than 130 kilowatts (kW) in power, installed on vessels constructed on or after January 1, 2000, or which undergo a major conversion after that date. Compliance with NOx emission requirements is ascertained through survey and certification, leading to the issue of an Engine International Air Pollution Prevention Certificate.

Q31. Are there any costs and/or benefits or any associated industry concerns around the NOx requirements when considering accession?

Q32. How many New Zealand vessels are likely to be affected by the NO_X requirements?

Other issues

Ships over 5,000 gross tonnes, which account for the vast majority of CO_2 emissions from international shipping, are required to submit annual fuel consumption data to their Flag State (or designated Recognised Organization) for submission to the IMO. The anonymised data will inform the IMO GHG Strategy.

Q33. Are there likely to be any problems associated with providing annual fuel consumption data?

MARPOL's provisions do not apply to ships solely engaged in domestic voyages. However, each Party should ensure that ships are constructed and act in a manner consistent with MARPOL, so far as is reasonable and practicable.

Q34. How would acceding to Annex VI affect the domestic shipping sector?

Q35. What are the benefits and costs for the domestic sector of Annex VI?

Additional questions

Q36. Are there any other issues not considered above, but which you deem important and need to be factored in when considering the costs and benefits of accession to MARPOL Annex VI?

Q37. Having taken all of the above into consideration, should New Zealand accede to Annex VI?

Indicative timeline

Following the completion of consultation, the Ministry would analyse submissions before providing advice to Government together with an NIA on whether or not to accede to Annex VI. It is anticipated that a decision will be made by Cabinet in the first half of 2019. If the Government decides that New Zealand should accede to Annex VI, the steps outlined in the table below are required before accession can take place.

Treaty making step	Indicative Timing
• A Parliamentary Select Committee considers the National Interest Analysis (NIA) and treaty text and reports back to the House of Representatives	Quarter 2, 2019
• NIA and treaty text considered by the House of Representatives	Quarter 2, 2019
• Government agencies complete work on regulatory amendments required to implement the treaty in domestic law	Quarter 3 2020
• New Zealand deposits instrument of accession with the IMO	Quarter 4, 2020
• Annex VI comes into force for New Zealand three months after depositing instrument of accession.	Quarter 1, 2021

Q38. If New Zealand is to accede to Annex VI, is 2021 a reasonable timeframe to bring the requirements into effect? Please provide your reasons for your answer.