

This document has been prepared as part of the implementation project of Legal Pathways to Deep Decarbonization (Michael B. Gerrard and John C. Dernbach, eds. Environmental Law Institute [2019]) (LPDD). For background information on the project, see <https://lpdd.org>

Attachment 1
LEGAL MEMORANDUM
in support of Model Legislation
For Reduction of Black Carbon on Arctic Shipping Journeys
And
To Require Ships Calling at U.S. Ports to Use Low Carbon Fuels or Otherwise Reduce
Greenhouse Gas Emissions

1.0 Recommendations

Recommendation (black carbon): Congress could exercise port jurisdiction to ensure any shipping activity in the Arctic minimizes climate damage in that region by mandating measures to reduce black carbon on all Arctic journeys.

Recommendation (low climate impact fuels): The United States could require any ship that calls at their ports to verify that any Arctic trips in the past year (for example) had used low-carbon fuels or other emissions reduction measures.¹

The above recommendations appear in *Shipping*, by Aoife O’Leary, in Michael B. Gerrard and John C. Dernbach, eds., *Legal Pathways to Deep Decarbonization in the United States* (Environmental Law Institute 2019).²

2.0 Introduction

Both recommendations involve the Arctic, avoidance of climate impacts, maritime shipping, and port State jurisdiction. Both model laws incorporate the existing statutory definition of the Arctic, and both include a heavy fuel oil (HFO) ban.³ Generally, the black carbon model law requires a ship in the Arctic to use distillate fuel and a diesel particulate filter if the ship will enter or depart from a U.S. port within the year. The low climate impact fuels model law requires

¹ The term “low-carbon fuels,” is commonly used shorthand to include those fuels with a low climate impact. The memorandum refers to these as low climate impact fuels.

² Aoife O’Leary, *Shipping*, in Michael B. Gerrard and John C. Dernbach, eds., *Legal Pathways to Deep Decarbonization in the United States* (Environmental Law Institute 2019) (*Legal Pathways*) 460. The memorandum, along with notes in annotated versions of the model legislation, supplements the *Shipping* chapter. This legal memorandum is current through April 2021. See also Melissa Powers, *Black Carbon in Legal Pathways*, 846. For another avenue to address the impact of Arctic shipping, See *LPDD Model Law: Arctic Shipping Tax Act* <https://lpdd.org/resources/lpdd-model-law-arctic-shipping-tax-act/?mc_cid=486b3021c4&mc_eid=5fe7992f80> This memorandum uses certain language from the *LPDD Model Law: Amendments to Act to Prevent Pollution from Ships* <<https://lpdd.org/resources/lpdd-model-law-amendments-to-act-to-prevent-pollution-from-ships/>> Lastly, for an overview of U.S. concerns in the Arctic, see Congressional Research Service, *Changes in the Arctic: Background and Issues for Congress*, R41153 (Feb 1, 2021) (CRS, Changes in the Arctic) <<https://fas.org/sgp/crs/misc/R41153.pdf>>

³ The two model laws could work in tandem.

a ship in the Arctic to use a fuel gradually lowering lifecycle climate emissions, if the ship will enter or depart from a U.S. port within the year.

The legal memorandum first discusses the evolving conditions affecting the Arctic and the general insufficiency of other authorities, thereby providing the basis for the model laws. The memorandum then discusses elements common to both model laws, before considering elements unique to each. Lastly, the legal memorandum discusses anticipated legal issues. Both model laws are considered through Section 4. Section 5 applies solely to the black carbon model law. Section 6 applies solely to the low climate impact fuels model law. Section 7, anticipated legal issues, applies to both.

3.0 Basis for Model Laws

*If we lose the Arctic, we lose the whole world.*⁴

3.1 The Accelerating Conditions in the Arctic and Beyond

In 2015, States party to the Paris Agreement set the collective global goal of limiting global average temperature to well below 2°C above pre-industrial levels and seeking to limit global temperature increase to 1.5°C.⁵ Three years later, the Intergovernmental Panel on Climate Change (IPCC), in its 1.5°C Special Report, evidenced the urgency to limit global temperature increase to 1.5°C, and to significantly reduce emissions by 2030.⁶ Presently, the Earth’s global temperature increase is approximately 1.18°C above pre-industrial levels.⁷ At current rates of emissions, a 1.5°C increase is expected to be reached in January 2034.⁸

In 2019, the IPCC issued its report, *The Ocean and Cryosphere in a Changing Climate*.⁹ The IPCC declared that the Arctic is warming at more than twice the global average.¹⁰ The IPCC

⁴ President of the Republic of Finland, *President Niinistö in Arkhangelsk: If we lose the Arctic, we lose the whole world* (Apr 4, 2017) <<https://www.presidentti.fi/en/news/president-niinisto-in-arkhangelsk-if-we-lose-the-arctic-we-lose-the-whole-world/>>

⁵ Paris Agreement, FCCC/CP/2017/10/Add.1(adopted Dec 12, 2015, entered into force Nov 4, 2016) art 2.1(a).

⁶ Intergovernmental Panel on Climate Change, *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* (2018) (IPCC 1.5°C Report) <<https://www.ipcc.ch/sr15/>> For example, the report shows that in order to limit global temperature increase to 1.5°C, carbon dioxide emissions needed to decline by close to half of their 2010 levels by 2030. IPCC 1.5°C Report, Summary for Policymakers, 12, key finding C.1 (“In model pathways with no or limited overshoot of 1.5°C, global net anthropogenic CO₂ emissions decline by about 45% from 2010 levels by 2030 (40–60% interquartile range), reaching net zero around 2050 (2045–2055 interquartile range).”) <https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf> See IPCC 1.5°C Report, ch 3 for impacts of 1.5°C global warming on natural and human systems.

⁷ European Union, Copernicus Climate Change Service, *How close are we to reaching a global warming of 1.5°C?* (Feb 22, 2021) <<https://climate.copernicus.eu/how-close-are-we-reaching-global-warming-15degc>>

⁸ Id.

⁹ Intergovernmental Panel on Climate Change, *The Ocean and Cryosphere in a Changing Climate* (Sept 2019) (IPCC Ocean and Cryosphere Report) <<https://www.ipcc.ch/srocc/>> The cryosphere is defined as the “components of the Earth System at and below the land and ocean surface that are frozen, including snow cover, glaciers, ice sheets, ice shelves, icebergs, sea ice, lake ice, river ice, permafrost and seasonally frozen ground.” Id, *Glossary*.

¹⁰ Id, ch 3, 212, box 3.1.

reported that the “Polar Oceans are amongst the most rapidly changing oceans of the world, with consequences for global-scale storage and cycling of heat, carbon and other climatically and ecologically important properties.”¹¹

The IPCC reported that the central Arctic had “an unprecedented absence of sea ice,” and record low levels of the maximum extent of Arctic winter sea ice.¹² The mechanisms leading to the rising temperatures and absence of sea ice include:

...reduced summer albedo due to sea ice and snow cover loss, the increase of total water vapour content in the Arctic atmosphere, changes in total cloudiness in summer, additional heat generated by newly formed sea ice across more extensive open water areas in the autumn, northward transport of heat and moisture and the lower rate of heat loss to space from the Arctic relative to the subtropics.¹³

Recent evidence points to even darker consequences for the Arctic.¹⁴ The year 2020 again brought record-breaking temperatures and ice melt.¹⁵ The consequences of this acceleration

¹¹ Id, ch 3, 216, § 3.2.1.2 (references omitted).

¹² These levels are compared to 1979–2014. Id at 212, box 3.1 (references omitted).

¹³ Id at 212, box 3.1. The mechanisms are still under discussion. Id. Albedo is the reflection of sunlight. Id, Glossary. Snow and ice have high albedo. Id. See also Laura Landrum and Marika M Holland, *Extremes become routine in an emerging new Arctic*, 10 Nature Climate Change 1108, 1108 (2020) (“Arctic temperatures are rising much more rapidly than at lower latitudes—a process termed Arctic amplification. Although the relative contributions of different mechanisms to Arctic amplification is an area of active research, near-surface Arctic amplification is strongly influenced by changes in both sea-ice concentrations (SICs, an albedo feedback) and sea-ice thickness (SIT, an insulating feedback).”) <https://www.nature.com/articles/s41558-020-0892-z.epdf?sharing_token=yGnfQTW88eKDCvQrcKPFc9RgN0jAjWeI9jnR3ZoTv0MqVMypMyE7pAbPE1tu481cfXA0d4GjqhJeVhIB88dZZJi1abe22TQZDvIoxlpfXD-yndBKgUoVFuPC-jto2hvBoIFE8jjwliZ62S7k2DdoXoqOS1Vpq2NwPIh2JOn443IgUz4QPzUEPSMrk-2XN17vWSCWzIJ1rf9GMD3roXQ0uhi9sUofO3q5QEPd7eL_HwxcwBXWoHIR59wvGfVxwcaGGzidROyNI1W5BYZDiDu_Y65LVRwP9KHKk-G7Fp7G5xsZ8j0NhtlRrUy012xIFysEr&tracking_referrer=www.scientificamerican.com>

¹⁴ See, e.g., Chris Mooney and Andrew Freedman, *Earth is now losing 1.2 trillion tons of ice each year. And it’s going to get worse*, Washington Post (Jan 25, 2021) <<https://www.washingtonpost.com/climate-environment/2021/01/25/ice-melt-quickens-greenland-glaciers/>>

¹⁵ See, e.g., Andrew Freedman, *Wildfires, Record Warmth and Rapidly Melting Ice: Arctic Climate Goes Further Off The Rails This Summer* (Washington Post, July 29, 2020) <https://www.washingtonpost.com/weather/2020/07/29/arctic-climate-change-hastens/?utm_campaign=wp_energy_and_environment&utm_medium=email&utm_source=newsletter&wpisrc=nl_green> See also Andrew Ciavarella, et al, *Prolonged Siberian Heat of 2020*, World Weather Attribution (July 15, 2020) 3, § 1 <<https://www.worldweatherattribution.org/wp-content/uploads/WWA-Prolonged-heat-Siberia-2020.pdf>> See Jonathan Watts, *Alarm as Arctic Sea Ice Not Yet Freezing At Latest Date On Record*, The Guardian (Oct 22, 2020) <<https://www.theguardian.com/world/2020/oct/22/alarm-as-arctic-sea-ice-not-yet-freezing-at-latest-date-on-record>>

affect many different facets of the Arctic, including Indigenous peoples' way of life,¹⁶ biodiversity,¹⁷ and national security,¹⁸ among others.¹⁹

The effects on the Arctic go beyond the Arctic; they are felt globally. The *Ocean and Cryosphere* report notes that “Enhanced warming in the Arctic and in high mountains is causing rapid surface melt of glaciers and the Greenland ice sheet.”²⁰ There is enough water in the Greenland ice sheet to cause a global sea level rise of more than 24 feet.²¹ Sea rise is far from the only effect: “Thawing of permafrost ... has the potential to release vast quantities of methane and carbon dioxide into the atmosphere that will further exacerbate climate change.”²²

¹⁶ See, e.g., Inuit Circumpolar Council Alaska, *Food Sovereignty and Self-Governance: Inuit Role in Managing Arctic Marine Resources* (Sept 2020) <<https://www.eli.org/research-report/food-sovereignty-and-self-governance-inuit-role-managing-arctic-marine-resources>>

¹⁷ See, e.g., Arctic Council, Conservation of Arctic Flora and Fauna, CAFF Assessment Series No. 10, *Life Linked to Ice: A Guide to Sea-Ice-Associated Biodiversity In This Time of Rapid Change* (2013) <<https://www.caff.is/sea-ice-associated-biodiversity>> regarding direct and indirect effects. The document also describes the Arctic's intertwining impacts. Id at 5 (“The reduction in sea ice needs to be considered in the context of cumulative effects because it is also contributing to or interacting with other stressors, including development impacts, ocean acidification, and accumulation of persistent organic pollutants and mercury in food webs.”). Microplastics is also an added stressor. See, e.g., Peter S. Ross, *They're everywhere: New study finds polyester fibres throughout the Arctic Ocean*, *The Conversation* (Jan 12, 2021) <<https://theconversation.com/theyre-everywhere-new-study-finds-polyester-fibres-throughout-the-arctic-ocean-152881>>

¹⁸ See, e.g., CRS, Changes in the Arctic, Renewed Great Power Competition, 14–20 (cited in note 1).

¹⁹ See, e.g., National Oceanic and Atmospheric Administration, *Arctic Report Card 2020* (Dec 2020) (NOAA Arctic Report Card)

<https://www.arctic.noaa.gov/Portals/7/ArcticReportCard/Documents/ArcticReportCard_full_report2020.pdf> See also Basile Poujol, Andreas F. Prein and Andrew J. Newman, *Kilometer-scale modeling projects a tripling of Alaskan convective storms in future climate*, 55 *Climate Dynamics* 3543 (2020) <<https://link.springer.com/article/10.1007/s00382-020-05466-1>>

²⁰ IPCC Ocean and Cryosphere Report, ch 1, 112, FAQ 1.1 (cited in note 9). See also Thomas Slater, et al, *Earth's ice imbalance*, 15 *The Cryosphere* 233 (Jan 25, 2021) (“We combine satellite observations and numerical models to show that Earth lost 28 trillion tonnes of ice between 1994 and 2017. Arctic sea ice (7.6 trillion tonnes), Antarctic ice shelves (6.5 trillion tonnes), mountain glaciers (6.1 trillion tonnes), the Greenland ice sheet (3.8 trillion tonnes), the Antarctic ice sheet (2.5 trillion tonnes), and Southern Ocean sea ice (0.9 trillion tonnes) have all decreased in mass. Just over half (58 %) of the ice loss was from the Northern Hemisphere, and the remainder (42 %) was from the Southern Hemisphere. The rate of ice loss has risen by 57 % since the 1990s...”)

<<https://tc.copernicus.org/articles/15/233/2021/>>

²¹ NOAA Arctic Report Card at 5 (cited in note 19).

²² IPCC Ocean and Cryosphere Report, ch 1, 112, FAQ 1.1 (cited in note 9). In addition, the melting of the Greenland ice sheet leads to the “cold blob” in the Atlantic, which is detrimentally altering the Gulf Stream. See, e.g., Moises Velasquez-Manoff and Jeremy White, *In the Atlantic Ocean, Subtle Shifts Hint at Dramatic Dangers*, *New York Times* (Mar 2, 2021) <<https://www.nytimes.com/interactive/2021/03/02/climate/atlantic-ocean-climate-change.html>> Studies have also found connections between the melting Arctic and California's 2015 extreme drought. See, e.g., Ivana Cvijanovic, et al, *Future loss of Arctic sea-ice cover could drive a substantial decrease in California's rainfall*, 8 *Nature Communications* 1947 (Dec 5, 2017) <<https://www.nature.com/articles/s41467-017-01907-4>>?source=post_page-----> See also Dana Nuccitelli, *Warmer climate and Arctic sea ice in a veritable suicide pact*, *Yale Climate Connections* (Oct 28, 2020)

<<https://yaleclimateconnections.org/2020/10/warmer-climate-and-arctic-sea-ice-in-a-veritable-suicide-pact/>>

Studies have shown connection to the 2011 heat wave and drought in Texas and Oklahoma, as well as further effects globally. See, e.g., Michael E. Mann, et al, *Projected changes in persistent extreme summer weather events: The role of quasi-resonant amplification*, 4 *Science Advances* 1, 1 and 7 (Oct 31, 2018)

<<https://advances.sciencemag.org/content/4/10/eaat3272>>

Yet, there seems a potential consensus that zero emissions could lead to a stability of global temperature,²³ including stability in the Arctic.²⁴ If not, mitigating options grow dimmer.²⁵

3.2 The Increase of Shipping in the Arctic

For centuries, at the same time that European explorers were traversing oceans to discover the New World, explorers sailed far north in an attempt to be the first to sail through the Arctic straits that purportedly joined the Atlantic and Pacific.²⁶ As professed a captain in 1588:

Having well considered the route which has hitherto been taken to the Philippines, China, Japan, and other parts of the sea, it appears from correct charts that almost half the length of the voyage will be saved by sailing through this strait.²⁷

These Arctic explorers were several centuries too early. In 2019, there were approximately 1,628 individual ships entering the Arctic area above approximately 60° North, a 25% increase over 2013.²⁸ More than 40% were fishing vessels,²⁹ with other ship types including cargo ships, bulk

²³ Bob Berwyn, *Many Scientists Now Say Global Warming Could Stop Relatively Quickly After Emissions Go to Zero: Making It Stop*, Inside Climate News (Jan 3, 2021), quoting Michael Mann (“It’s definitely the scientific consensus now that warming stabilizes quickly, within 10 years, of emissions going to zero.”) <<https://insideclimatenews-org.cdn.ampproject.org/c/s/insideclimatenews.org/news/03012021/five-aspects-climate-change-2020/?amp>>

²⁴ Laura Landrum and Marika M Holland, *Extremes at 1117* (cited in note 13) (“Notably, reductions in GHGs can change this trajectory and may postpone or even avoid the emergence of a new Arctic in many climate properties...”).

²⁵ Katarina Zimmer, *The daring plan to save the Arctic ice with glass*, British Broadcasting Corporation (Sept 23, 2020) <<https://www.bbc.com/future/article/20200923-could-geoengineering-save-the-arctic-sea-ice>> See also Union of Concerned Scientists, *What is Solar Geoengineering?* (Dec 4, 2020) <<https://www.ucsusa.org/resources/what-solar-geoengineering>> See also National Academies of Sciences, Engineering and Medicine, *Reflecting Sunlight Recommendations for Solar Geoengineering Research and Research Governance* (2021) <<https://www.nap.edu/catalog/25762/reflecting-sunlight-recommendations-for-solar-geoengineering-research-and-research-governance>> <<https://www.nap.edu/read/25762/chapter/1>>

²⁶ W. Michael Mathes, *The Province of Anian and its Strait, 1542–1792: Fabulous Voyages of Juan de Fuca, Lorenzo Ferrer Maldonado, and Bartolome Fonte, Geographic Hoaxes and their Perpetuation*, in Juan De Fuca and Bartolome Defonte, *Fakes, Frauds, and Fabricators: Ferrer Maldonado, De Fuca, and De Fonte: the Strait of Anian, 1542-1792* (Ye Galleon Press 1999) i.

²⁷ *A Relation of the Discovery of the Strait of Anian; made by me, Capt. Lorenzo Ferrer Maldonado, in the Year 1588; in which is given the Course of the Voyage, the Situation of the Strait, the manner in which it ought to be fortified, and also, the Advantages of this Navigation, and the Loss which will arise from not prosecuting it*, in John Barrow, F.R.S., *A Chronological History of Voyages into the Arctic Regions* (John Murray 1818) (John Barrow, trans) in De Fuca and Defonte, *Fakes, Frauds, and Fabricators* at 29 (cited in note 26).

²⁸ Arctic Council, Protection of the Arctic Marine Environment Working Group, *Arctic Shipping Status Report #1: The Increase in Arctic Shipping 2013–2019* (Mar 31, 2020) (Arctic Council Shipping Increase Report) 8 <<https://pame.is/projects/arctic-marine-shipping/arctic-shipping-status-reports>> <<https://pame.is/document-library/shipping-documents/arctic-ship-traffic-data-documents/reports/arctic-shipping-status-reports-jpg-version/arctic-shipping-report-1-the-increase-in-arctic-shipping-2013-2019-jpgs>> See subsection 4.2.1 for the Arctic boundary under the Polar Code.

²⁹ Id at 10. The majority of fishing vessels use distillate fuel. International Council on Clean Transportation, Bryan Comer, et al, *White Paper: The International Maritime Organization’s Proposed Arctic Heavy Fuel Oil Ban: Likely Impacts and Opportunities for Improvement* (Sept 2020) (ICCT HFO White Paper) 11 <<https://theicct.org/publications/analysis-HFO-ban-IMO-2020>>

carriers, cruise ships, chemical tankers, crude oil tankers, and container ships.³⁰ Distance sailed increased by 75%.³¹ Though conditions in the Arctic are severe year-round, there is clear anticipation of continual growth in shipping. In 2020, the U.S. Department of the Navy referred to the area as a new “Blue Arctic.”³² China is moving forward with development of its maritime “Polar Silk Road,” to connect China and Europe.³³ Russia clearly sees a path along the Northern Sea Route.³⁴ The IPCC predicts an ice-free summer at least once a century, for a global temperature increase of 1.5°C above pre-industrial levels.³⁵ The occurrences greatly multiply with a 2°C increase: to once a decade.³⁶

It could be argued that a shorter distance between ports via the Arctic would equate to less climate change impacts being attributable to shipping emissions,³⁷ but that is not the case. Especially in the next several decades, and especially in the Arctic. This is due in part to a corresponding increase in emissions of short-lived climate pollutants (SLCPs), which have a devastating effect in the Arctic.³⁸

³⁰ Arctic Council Shipping Increase Report at 8 (cited in note 28). Also noteworthy is the effect of increased shipping traffic on wildlife in the Bering Strait. See, e.g., Audubon Alaska, *Bering Sea* <<https://ak.audubon.org/conservation/bering-sea>> The IMO established two-way voluntary shipping routes through the Bering Strait, proposed by the United States and Russia. Russian Federation and United States, *Routeing Measures and Mandatory Ship Reporting Systems: Establishment of two-way routes and precautionary areas in the Bering Sea and Bering Strait*, NCSR 5/3/7 (Nov 17, 2017) <https://www.navcen.uscg.gov/pdf/IMO/NCSR_5_3_7.pdf> International Maritime Organization, Meeting Summaries, *Sub-Committee on Navigation, Communications and Search and Rescue (NCSR), 5th session, 19-23 February 2018, New shipping routes in Bering Sea and Bering Strait to be established* <<https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/NCSR5.aspx>> Limiting the amount of international maritime transport through the Bering Strait would be beneficial.

³¹ Arctic Council Shipping Increase Report at 14 (cited in note 28).

³² The devised term indicates the development of an ice-free Arctic. U.S. Department of the Navy, *A Blue Arctic: A Strategic Blueprint for the Arctic* (Jan 5, 2020) <<https://news.usni.org/2021/01/05/new-navy-marine-corps-strategic-blueprint-for-the-arctic>>

³³ *China to develop Arctic shipping routes opened by global warming*, British Broadcasting Corporation (Jan 26, 2018) <<https://www.bbc.com/news/world-asia-china-42833178>>

³⁴ Marc Champion and Natasha Doff, *Russia's Getting Left Behind in Global Dash for Clean Energy*, Bloomberg (Mar 14, 2021) <https://www.bloomberg.com/news/articles/2021-03-15/russia-s-getting-left-behind-in-global-dash-for-clean-energy?cmpid=BBD031721_GREENDAILY&utm_medium=email&utm_source=newsletter&utm_term=210317&utm_campaign=greendaily> The Northern Sea Route is along the Russian coast. Id.

³⁵ IPCC Ocean and Cryosphere Report, ch 1, 84, § 1.4.2 (cited in note 9).

³⁶ Id. For discussion of the existence of polar ice caps on Earth and other planets, see, e.g., National Aeronautics and Space Administration, Solar System Exploration, *Frozen: Ice on Earth and Well Beyond* (Oct 22, 2018) <<https://solarsystem.nasa.gov/news/729/frozen-ice-on-earth-and-well-beyond/>>

³⁷ The Northern Sea Route from Busan, South Korea to Bremerhaven, Germany is a distance of 7,200 nautical miles. The distance between these same two ports via the Suez Canal is 10,500 nautical miles. William Booth and Amie Ferris-Rotman, *Russia's Suez Canal? Ships start plying a less-icy Arctic, thanks to climate change*, Washington Post (Sept 8, 2018) <https://www.washingtonpost.com/world/europe/russias-suez-canal-ships-start-plying-an-ice-free-arctic-thanks-to-climate-change/2018/09/08/59d50986-ac5a-11e8-9a7d-cd30504ff902_story.html> Another 5,500 miles is added around Africa if the Suez Canal is inaccessible. Michael Safi, Helena Smith, and Martin Farrer, *Suez canal: Ever Given container ship freed after a week*, The Guardian (Mar 29, 2021) <<https://www.theguardian.com/world/2021/mar/29/suez-canal-attempt-re-float-ever-given-delay-salvage-tugboats>>

³⁸ See, e.g., Yevgeny Aksenov, et al, *On the future navigability of Arctic sea routes: High-resolution projections of the Arctic Ocean and sea ice*, 75 Marine Policy, 300, 313 (2017) <<https://www.sciencedirect.com/science/article/pii/S0308597X16000038>>

3.3 Short-Lived Climate Pollutants

The SLCPs are second only to carbon dioxide in their contribution to climate change.³⁹ Their contribution is quantified at approximately 40–45% of global warming.⁴⁰ The SLCPs include black carbon, methane, hydrofluorocarbons (HFCs), and tropospheric (ground-level) ozone.⁴¹ Significant reductions of black carbon and methane could alone lead to avoidance of a 0.5°C temperature increase above pre-industrial levels.⁴² Further, these pollutants have direct impact on human health and the environment outside of climate change, and are in part regulated under both federal and international law for those effects.⁴³

In May 2019, the IPCC began the process of developing methodology for short-lived climate forcers,⁴⁴ with a completion date to occur no later than 2022.⁴⁵ The date will allow countries to include, in a consistent manner, short-lived climate forcers in their nationally determined

³⁹ Climate and Clean Air Coalition, Institute for Governance and Sustainable Development, *Primer on Short-Lived Climate Pollutants* (2013) (SLCP Primer) 5 <<https://www.ccacoalition.org/en/resources/primer-short-lived-climate-pollutants>> See also Climate and Clean Air Coalition, *Short-Lived Climate Pollutants (SLCPs): What are Short-Lived Climate Pollutants?* (CCAC SLCP) <<https://www.ccacoalition.org/en/content/short-lived-climate-pollutants-slcp>>

⁴⁰ SLCP Primer at 5 (cited in note 39).

⁴¹ CCAC SLCP (cited in note 39).

⁴² *Id.*

⁴³ See, e.g., 40 CFR 50.9–50.10 for regulation of ambient tropospheric ozone under the Clean Air Act.

Hydrofluorocarbons (HFCs) are regulated under international law pursuant to the Kigali Amendment of the Montreal Protocol, which has not been ratified by the United States. Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (adopted Oct 15, 2016, entered into force Jan 1, 2019) UNTS No. 26369 <https://treaties.un.org/doc/Treaties/2016/10/20161015%2003-23%20PM/Ch_XXVII-2.f.pdf> See, e.g., Matthew Choi, *State Department Sends Kigali Package to Biden*, Politico (Mar 29, 2021) <<https://www.politico.com/newsletters/morning-energy/2021/03/29/the-manchin-murkowski-show-794308>>

⁴⁴ The terms short-lived climate pollutants (SLCPs) and short-lived climate forcers tend to be used interchangeably, with their use dependent on the associated fora. This memorandum uses the term short-lived climate pollutants (SLCPs) unless referencing IPCC methodology work. The IPCC uses the term short-lived climate forcers (SLCFs), whereas the international coalition of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC, see subsection 3.7), the International Maritime Organization (IMO, see subsection 3.7), and the Arctic Council (see subsection 3.7) refer to short-lived climate pollutants (SLCPs). In fact, short-lived climate pollutants (SLCPs) refer to *warming* short-lived climate forcers (SLCFs). See IPCC 1.5°C Report, Glossary (cited in note 6) (“A subset of exclusively warming short-lived climate forcers is referred to as short-lived climate pollutants.”). But compare Intergovernmental Panel on Climate Change, Task Force on National Greenhouse Gas Inventories, *Report of the Expert Meeting on Short-Lived Climate Forcers* (2018) (GHG Inventories Task Force Report) 8, n 1 (“Short-lived climate forcers (SLCF) are also referred to as short-lived climate pollutants (SLCP).”) <https://www.ipcc.ch/site/assets/uploads/2019/02/1805_Expert_Meeting_on_SLCF_Report.pdf> See SLCP Primer at 5 (cited in note 39). Arctic Council, Arctic Contaminants Action Program, *Short-Lived Climate Pollutants* <<https://arctic-council.org/en/about/working-groups/acap/home/expert-groups/short-lived-climate-pollutants/>> International Maritime Organization, *Sub-Committee on Pollution Prevention and Response (PPR 8), 22-26 March 2021* (IMO PPR 8 meeting summary) <<https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/PPR-8.aspx>> See also introduced federal companion bills, the Super Pollutants Act, S 2325, 116th Cong, 1st Sess (July 30, 2019) and the Super Pollutants Act of 2019, HR 4143 116th Cong, 1st Sess (Aug 2, 2019) (which refer to short-lived climate pollutants) <<https://www.congress.gov/bill/116th-congress/senate-bill/2325>> <<https://www.congress.gov/bill/116th-congress/house-bill/4143?s=1&r=4>> See also title VII of the introduced Climate Leadership and Environmental Action for our Nation’s Future Act (CLEAN Future Act), which refers to methane and black carbon as super pollutants.

⁴⁵ Intergovernmental Panel on Climate Change, Short-lived Climate Forcers (May 2019) Decision IPCC-XLIX-7, IPCC-XLIX/Doc. 8 <https://www.ipcc.ch/site/assets/uploads/2019/05/IPCC-49_decisions_adopted.pdf> 4

contributions required by the Paris Agreement,⁴⁶ and, for example, convey reduction of SLCPs emissions along with any reduction of carbon dioxide emissions.⁴⁷

Significantly, the inclusion of SLCPs in the analysis can be directly tied to the Paris Agreement, and its goal of limiting global average temperature to well below 2°C above pre-industrial levels and seeking to limit global temperature increase to 1.5°C.⁴⁸ The Paris Agreement decision document pinpoints 2025 and 2030 as dates demonstrating that nations' present commitments to reductions will not meet the Paris Agreement goal.⁴⁹ And the IPCC 1.5°C Special Report shows an urgency to significantly reduce anthropogenic emissions by 2030, including carbon dioxide, SLCPs, and long-lived greenhouse gases (GHGs) emissions.⁵⁰ The United States recently set a 2030 target of 50–52% reduction of net GHG emissions on an economy-wide scale, and set a course for achievement of net-zero emissions no later than 2050.⁵¹ The U.S. pledge is viewed as promoting achievement of limiting the global temperature increase to 1.5°C.

3.4 Global Warming Potential

A way to facilitate needed action is through the determination of a pollutant's global warming potential (GWP). A pollutant's GWP is a conversion based on the pollutant's ability to absorb energy, and how long it stays in the atmosphere, during a certain timeframe.⁵² This allows its impact to be directly compared to the most prevalent GHG, carbon dioxide.⁵³ Carbon dioxide's GWP is the base, with a value of 1.⁵⁴ A larger value means a pollutant provides that much more

⁴⁶ Paris Agreement, art 4, ¶2 (cited in note 5).

⁴⁷ Intergovernmental Panel on Climate Change, *Methodology Report on Short-lived Climate Forcers* (Methodology Report webpage) <<https://www.ipcc.ch/report/methodology-report-on-short-lived-climate-forcers/>> Some countries (e.g., Mexico and Colombia) have included SLCPs such as black carbon in their Nationally Determined Contributions (NDCs). Government of Mexico Ministry of Environment and Natural Resources, *Nationally Determined Contributions: 2020 Update* (2020)

<<https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Mexico%20First/NDC-Eng-Dec30.pdf>> Climate and Clean Air Coalition Secretariat, *Colombia's NDC increases its 2030 climate change ambition and integrates new targets that simultaneously improve air quality and health* (Feb 24, 2021)

<<https://www.ccacoalition.org/en/news/colombia's-ndc-increases-its-2030-climate-change-ambition-and-integrates-new-targets>> Government of Colombia, *Update of the Nationally Determined Contribution of Colombia* (NDC) (2020) (trans)

<<https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Colombia%20First/NDC%20actualizada%20de%20Colombia.pdf>> It does not seem clear whether methodology for short-lived climate forcers will include *cooling* short-lived climate forcers. See Methodology Report webpage (cited in note 47). See also GHG Inventories Task Force Report, Theme 2: Assessment of climate impacts of SLCP emissions, Discussion in break-out groups under Theme 2, *What is the current scientific understanding of the local/regional climate effects of SLCPs?* at 32 (cited in note 44) (“In some cases the cooling by aerosols is believed to be the dominant driver of these [climatic] changes.”).

⁴⁸ Paris Agreement, art 2.1(a) (cited in note 5).

⁴⁹ *Id.*, Decision 1/CP.21, ¶17

⁵⁰ IPCC 1.5°C Report, Summary for Policymakers, 6, figure SPM.1 (cited in note 6).

⁵¹ United States, The United States of America Nationally Determined Contribution, Reducing Greenhouse Gases in the United States: A 2030 Emissions Target (Apr 22, 2021)

<<https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/United%20States%20of%20America%20First/United%20States%20NDC%20April%202021%20Final.pdf>> The U.S. reduction is compared to 2005 levels. *Id.*

⁵² U.S. Environmental Protection Agency, *Greenhouse Gas Emissions: Overview of Greenhouse Gases* <<https://www.epa.gov/ghgemissions/overview-greenhouse-gases>>

⁵³ *Id.*

⁵⁴ IPCC Ocean and Cryosphere Report, Glossary (cited in note 9).

warming relative to carbon dioxide in a given timeframe.⁵⁵ Methane is estimated to have a GWP over 100 years (referred to as GWP₁₀₀) of 30–36.⁵⁶ Yet over a 20-year timeframe (GWP₂₀), the GWP value increases to 85–87.⁵⁷ Given the dramatic need to reduce global warming potential on a front-end basis,⁵⁸ GWP₂₀ seems the appropriate metric.⁵⁹

3.5 Black Carbon and Shipping

The SLCP black carbon is “a relatively pure form of carbon” that is the product of incomplete combustion of fossil fuels, biomass, and biofuel.⁶⁰ It’s colloquially referred to as soot.⁶¹ Black carbon has a “strong warming effect, both in the atmosphere and when deposited on snow or

⁵⁵ U.S. Environmental Protection Agency, *Understanding Global Warming Potentials* (Understanding GWP) (“Because all GWPs are calculated relative to CO₂, GWPs based on a shorter timeframe will be larger for gases with lifetimes shorter than that of CO₂, and smaller for gases with lifetimes longer than CO₂.”)

<<https://www.epa.gov/ghgemissions/understanding-global-warming-potentials>> The GWP is multiplied by the volume to produce a CO₂ equivalent (CO₂e), which can then be combined with the carbon dioxide volume, producing, for example, 14 million metric tons CO₂ equivalent emitted (14 MMT CO₂e).

⁵⁶ See, e.g., International Council on Clean Transportation, Bryan Comer and Liudmila Osipova, *Accounting for well-to-wake carbon dioxide equivalent emissions in maritime transportation climate policies* (March 2021) (ICCT Well-to-Wake) table 1 (GWP₁₀₀ of 36) <<https://theicct.org/sites/default/files/publications/Well-to-wake-co2-mar2021-2.pdf>> See also Understanding GWP (cited in note 55). See also Intergovernmental Panel on Climate Change, *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (2014) (IPCC Fifth Assessment) 87, box 3.2, table 1 <https://ar5-syr.ipcc.ch/ipcc/resources/pdf/IPCC_SynthesisReport.pdf> The IPCC estimates GWP of 30 is for fossil methane, as opposed to biogenic methane which IPCC estimates a GWP of 28. See Intergovernmental Panel on Climate Change, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (2013) (IPCC Physical Basis) 714, table 8.7 note b and 731, table 8.A.1 <<https://www.ipcc.ch/report/ar5/wg1/>>

<<https://www.ipcc.ch/report/ar5/wg1/anthropogenic-and-natural-radiative-forcing/>>
<https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter08_FINAL.pdf>

The IPCC values are subject to revision as part of its sixth assessment cycle, October 2018 – May 2022.

Intergovernmental Panel on Climate Change, *Sixth Assessment Report* (IPCC Sixth Assessment)

<<https://www.ipcc.ch/assessment-report/ar6/>> <https://www.ipcc.ch/site/assets/uploads/2020/05/2020-AC6_en.pdf>

Note that climate-carbon feedbacks need to be considered. See ICCT Well-to-Wake, table 1.

⁵⁷ See ICCT Well-to-Wake at table 1 (cited in note 56). See IPCC Fifth Assessment at 87, box 3.2, table 1 (cited in note 56). For fossil methane value, see IPCC Physical Basis at 714, table 8.7 note b and 731, table 8.A.1 (cited in note 56). The IPCC values are subject to revision as part of its sixth assessment cycle. IPCC Sixth Assessment (cited in note 56).

See generally United Nations Climate Change, *Common metrics* <<https://unfccc.int/process-and-meetings/transparency-and-reporting/methods-for-climate-change-transparency/common-metrics>>

⁵⁸ See subsection 3.1.

⁵⁹ Or potentially the recently introduced GWP alternative, termed “GWP*,” suggested for use by the European Commission. European Commission, Commission Staff Working Document accompanying the Report from the Commission to the European Parliament and the Council: Updated analysis of the non-CO₂ climate impacts of aviation and potential policy measures pursuant to EU Emissions Trading System Directive Article 30(4) COM(2020) 747 final, 35 (“GWP* equates “an increase in the emission rate of a Short Lived Climate Forcer with a one-off ‘pulse’ emission of CO₂.”). The European Commission notes, “It could be argued that temperature-based metrics, and the GWP*, are potentially more useful for temperature-based policy objectives such as the temperature targets of the Paris Agreement. They also provide a more physical basis of actual impacts than GWPs for SLCFs.” Id at 36 <<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=SWD:2020:277:FIN>>

<<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020SC0277&from=EN>>

⁶⁰ IPCC Ocean and Cryosphere Report, Glossary (cited in note 9).

⁶¹ Id.

ice.”⁶² Its global warming potential values are estimated at 900 for GWP₁₀₀, and 3200 for GWP₂₀.⁶³

Maritime shipping’s connection to black carbon emissions is due to the dominance of HFO as the fuel used by ships.⁶⁴ The HFO is the residue from the refining of crude oil.⁶⁵ From a barrel of crude oil (42 gallons), less than a gallon remains after the refinery produces its petroleum products from the refining process.⁶⁶ The HFO, with consistency like “thick black peanut butter,”⁶⁷ also contains residual contaminants, including significant amounts of sulfur oxides, particulate matter, nitrogen oxides, volatile organic compounds (VOCs), and stratospheric ozone-depleting substances, such as hydrochlorofluorocarbons (HCFCs),⁶⁸ plus polycyclic aromatic hydrocarbons (PAHs).⁶⁹ Ships operating on HFO generate more particulate matter and black carbon per unit of fuel than other sources using fossil fuel.⁷⁰ These emissions are coupled with black carbon’s primarily local effect due to black carbon’s limited retention in the atmosphere (days or weeks).⁷¹

The International Maritime Organization (IMO), a United Nations specialized agency whose responsibilities include the prevention of pollution by ships,⁷² has stated that half the rise in Arctic temperature could be due to black carbon emissions.”⁷³ The IMO notes that black carbon

⁶² Id.

⁶³ ICCT Well-to-Wake at table 1 (cited in note 56). T.C. Bond, et al, *Bounding the role of black carbon in the climate system: A scientific assessment*, 118 J Geophysical Research: Atmospheres 5380 (Jan 2013) <<https://doi.org/10.1002/jgrd.50171>> See also International Council on Clean Transportation, Bryan Comer, et al, *Black carbon emissions and fuel use in global shipping, 2015* (Dec 2017) (ICCT Black Carbon Report) <<https://theicct.org/publications/black-carbon-emissions-global-shipping-2015>>

⁶⁴ International Maritime Organization, Marine Environment Protection Committee, *Reduction of GHG Emissions from Ships: Fourth IMO GHG Study 2020 – Final Report (Pre-session Public Release)* MEPC 75/7/15 (July 2020) Annex 2 (Fourth IMO GHG Study) 15. (Fourth IMO GHG Study begins at 33/557.) Available to public users through IMODOCS (IMODOCS) <https://webaccounts.imo.org/Common/weblogin.aspx?App=IMODOCS&ReturnUrl=https%3A%2F%2Fdocs.imo.org%2F&error_message=interaction_required> For an overview of the Fourth IMO GHG Study, see International Maritime Organization, *Fourth Greenhouse Gas Study 2020* (Fourth IMO GHG Study website) <<https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx>>

⁶⁵ ICCT HFO White Paper, iv (cited in note 29).

⁶⁶ U.S. Energy Information Administration, *Oil and petroleum products explained: Refining crude oil* (May 12, 2020) <<https://www.eia.gov/energyexplained/oil-and-petroleum-products/refining-crude-oil.php>>

⁶⁷ Nishan Degnarain, *What Is Heavy Fuel Oil, And Why Is It So Controversial? Five Killer Facts*, Forbes (Aug 14, 2020) <<https://www.forbes.com/sites/nishandegnarain/2020/08/14/what-is-heavy-fuel-oil-and-why-is-it-so-controversial-five-killer-facts/?sh=7a2ffa5f74c0>>

⁶⁸ See MARPOL Annex VI regulations 12-15. The IMO does not publish MARPOL regulations online. For Annex VI regulations, see generally, International Maritime Organization, *Prevention of Air Pollution from Ships*, sidebar *Related Information* (MARPOL Annex VI Regulations)

<<https://www.imo.org/en/OurWork/Environment/Pages/Air-Pollution.aspx>>

⁶⁹ Degnarain, *What Is Heavy Fuel Oil* (cited in note 67).

⁷⁰ International Maritime Organization, *Air Pollution and Energy Efficiency Studies: Investigation of appropriate control measures (abatement technologies) to reduce Black Carbon emissions from international shipping* (2015) (IMO Black Carbon Study) 1 §1.2 <<https://www.imo.org/en/OurWork/Environment/Pages/IMO-Publications.aspx>> <<https://www.wcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/Black%20Carbon.pdf>>

⁷¹ IPCC Ocean and Cryosphere Report, Glossary (cited in note 9).

⁷² International Maritime Organization, *Introduction to IMO* <<http://www.imo.org/en/About/Pages/Default.aspx>>

⁷³ IMO Black Carbon Study at 1, §1.3 (cited in note 70).

from maritime shipping may contribute up to half the black carbon in certain areas of the Arctic, and “localized increases in snow and ice melt do occur near the projected shipping lanes.”⁷⁴ A 2015 study found that black carbon in the Arctic warmed surface temperatures almost five times more than black carbon at lower latitudes.⁷⁵ And, whereas the IMO has noted an 11.6% increase in black carbon emissions from shipping worldwide,⁷⁶ there has been an identified 85% increase in the Arctic.⁷⁷

3.6 Greenhouse Gases and Shipping

There are over 90,000 registered ships globally. The IMO estimates international shipping GHG emissions contribute close to 3% of global emissions. This would place it as the fifth or sixth highest emitter in the world.⁷⁸ The GHG emissions from international shipping are anticipated to grow dramatically in the long term.⁷⁹

In the case where all ships globally use HFO, a climate impact analysis can be focused on quantity of emissions, since the fuel type is similar.⁸⁰ However, in the case of differing fuels, in order to appropriately reflect the climate impact, it becomes necessary to take into account each fuel stage, for both direct and indirect impacts, including feedstock production and transportation, fuel production and distribution, co-products used in other sectors, and use of the finished fuel.⁸¹

⁷⁴ Id at 2, §1.3 (citations omitted). However, the IMO attributes the majority of Arctic black carbon to being generated outside the Arctic. Id.

⁷⁵ Maria Sand, et al, *Arctic surface temperature change to emissions of black carbon within Arctic or midlatitudes*, 118 *J Geophysical Research: Atmospheres*, 7788, 7788 (2013) <<https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/jgrd.50613>> ICCT Black Carbon Report at 36 (cited in note 63).

⁷⁶ Fourth IMO GHG Study at 135 (cited in note 64).

⁷⁷ ICCT HFO White Paper at 7 (cited in note 29). Note that the time period for Arctic emissions is 2015–2019, whereas the IMO time period for global emissions is 2012–2018. The ICCT here uses the IMO Arctic boundary. See subsection 4.2 for a discussion on Arctic boundaries.

⁷⁸ Following China, the United States, India, the Russian Federation, and about equal with Japan. Fourth IMO GHG Study at 10 (cited in note 64). Fourth IMO GHG website (cited in note 64). Union of Concerned Scientists, *Each Country's Share of CO2 Emissions* (Aug 12, 2020) <<https://www.ucsusa.org/resources/each-countrys-share-co2-emissions>>

⁷⁹ Though international shipping activity decreased due to the effects of the coronavirus pandemic, the longer-term impact of the pandemic is expected to be minimal. Fourth IMO GHG Study at 12 (cited in note 64).

⁸⁰ See, e.g., Id at 23, figure 12.

⁸¹ U.S. Environmental Protection Agency, Renewable Fuel Standard Program, *Lifecycle Analysis of Greenhouse Gas Emissions under the Renewable Fuel Standard* <<https://www.epa.gov/renewable-fuel-standard-program/lifecycle-analysis-greenhouse-gas-emissions-under-renewable-fuel>> See also International Renewable Energy Agency, *Navigating to a renewable future: Solutions for decarbonising shipping: Preliminary findings* (Sept 2019) 19, figure 11 <https://irena.org/-/media/Files/IRENA/Agency/Publication/2019/Sep/IRENA_Renewable_Shipping_Sep_2019.pdf>

For example, 2019 saw the launch of the world's first liquid hydrogen carrier, from Kobe, Japan.⁸² Hydrogen is one of the fuels most touted for a net-zero future.⁸³ Yet, viewing the entire lifecycle, the vessel's intended cargo could not be characterized as having a low climate impact. Rather, the hydrogen fuel will be obtained by converting brown coal in Australia primarily into carbon monoxide and hydrogen gases.⁸⁴ The carbon monoxide is emitted to the air, where it combines with oxygen, forming carbon dioxide.⁸⁵ The hydrogen portion is converted into liquid hydrogen,⁸⁶ before being transported via the HFO-fueled liquid hydrogen carrier from the southern end of Australia to Japan.⁸⁷

A second example of a mischaracterized lower climate impact can be evidenced by a cruise ship relying on liquefied natural gas (LNG) as fuel. By use of LNG, a cruise ship's carbon dioxide emissions would be expected to be less than with HFO.⁸⁸ Yet LNG is comprised predominately of methane, which is a potent SLCP. Over a 20-year timeframe, the methane's warming effect would be 85–87 times that of carbon dioxide.⁸⁹ Due to common methane leaks and slips, LNG's use as a fuel could be expected to be more damaging than HFO.⁹⁰

⁸² Leigh Collins, *World's first liquefied hydrogen carrier launched in Japan*, Recharge (Dec 11, 2019) <<https://www.rechargenews.com/transition/worlds-first-liquefied-hydrogen-carrier-launched-in-japan/2-1-722155>>

⁸³ Alex Ivanenko, *Get Ready: The Hydrogen Economy Is On Its Way*, Forbes (Mar 11, 2021)

<<https://www.forbes.com/sites/forbestechcouncil/2021/03/11/get-ready-the-hydrogen-economy-is-on-its-way/?sh=6977484c2383>>

⁸⁴ Collins, *World's first* (cited in note 82). Victoria State Government, Earth Resources, *Alternate uses for brown coal* (Alternate Uses) <<https://earthresources.vic.gov.au/geology-exploration/coal/alternate-uses-for-brown-coal>>

⁸⁵ Collins, *World's first* (cited in note 82). Alternate Uses (cited in note 82).

⁸⁶ Collins, *World's first* (cited in note 82).

⁸⁷ Id. Baird Maritime, *Vessel Review: Suiso Frontier – Japanese LH2 Carrier Sets the Pace in Hydrogen Transport* (Mar 12, 2021) <<https://www.bairdmaritime.com/ship-world/tanker-world/gas-tanker-world/vessel-review-suiso-frontier-japanese-lh2-carrier-sets-the-pace-in-hydrogen-transport/>> See also HySTRA, *Hydrogen Supply Chain, Hydrogen Energy Supply Chain Pilot Project between Australia and Japan* <<http://www.hystra.or.jp/en/project/>>

This liquified hydrogen fuel would be deemed “gray hydrogen.” Industries use different colors to identify types of hydrogen fuel. Green hydrogen should not generate GHGs. Blue hydrogen, though sharing the color of blue carbon (carbon absorbed by the world's oceans and coastal areas) and blue economy (sustainable use of ocean resources for economic growth) is instead hydrogen produced from natural gas coupled with carbon capture and storage.

Turquoise hydrogen is made from natural gas. Gray hydrogen is produced from fossil fuels without carbon capture.

EWE Group, *The colours of hydrogen* <<https://www.ewe.com/en/ewe-group/shaping-the-future/hydrogen/the-colours-of-hydrogen>> National Oceanic and Atmospheric Administration, *What is Blue Carbon?*

<<https://oceanservice.noaa.gov/facts/bluecarbon.html>> World Bank, *What is the Blue Economy?* (June 6, 2017)

<<https://www.worldbank.org/en/news/infographic/2017/06/06/blue-economy>>

⁸⁸ International Council on Clean Transportation, Bryan Comer, *Transitioning away from heavy fuel oil in Arctic shipping*, Working Paper 2019-03 (Feb 18, 2019) 11 (ICCT, Transitioning Away)

<<https://theicct.org/publications/transitioning-away-heavy-fuel-oil-arctic-shipping>>

<https://theicct.org/sites/default/files/publications/Transitioning_from_hfo_Arctic_20190218.pdf>

⁸⁹ See text at note 57.

⁹⁰ International Council on Clean Transportation, Nikita Pavlenko, et al, *The climate implications of using LNG as a marine fuel* (Jan 2020) 19 <<https://theicct.org/publications/climate-impacts-LNG-marine-fuel-2020>> A United Nations global methane assessment, anticipated in May 2021, is expected to state that expansion of natural gas use is not compatible with limiting the global temperature increase to 1.5°C. Hiroko Tabuchi, *Halting the Vast Release of Methane Is Critical for Climate*, U.N. Says, New York Times (Apr 24, 2021)

<<https://www.nytimes.com/2021/04/24/climate/methane-leaks-united-nations.html?action=click&module=Well&pgtype=Homepage§ion=Climate%20and%20Environment>>

3.7 Gap in Laws

3.7.1 Intergovernmental Organizations with Related Expertise

Under the Paris Agreement, and its parent framework agreement, the United Nations Framework Convention on Climate Change (UNFCCC), individual States that are Parties are responsible for mitigating State-related GHG emissions.⁹¹ However, international maritime transport (as well as international aviation) is considered outside the scope of State-related GHG emissions.⁹² Therefore, for international maritime transport, climate mitigation has fallen to the IMO.

3.7.2 International Maritime Organization Measures

In 2018, the IMO adopted its Initial GHG Strategy, with its described vision: “IMO remains committed to reducing GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible in this century.”⁹³ The IMO’s listed ambitions included reducing average carbon dioxide emissions per transport work “by at least 40% by 2030” compared to 2008,⁹⁴ and “to peak” international maritime shipping GHG emissions “as soon as possible,” while “pursuing efforts towards phasing them out...as a point on a pathway of CO₂ emissions reduction consistent with the Paris Agreement temperature goals.”⁹⁵

The IMO vision and ambitions seem to echo the urgency expressed by the IPCC and the Parties to the Paris Agreement.⁹⁶ Yet, IMO decisions are made by its 174 Member States,⁹⁷ with a very strong IMO preference to operate by consensus.⁹⁸ Here, with a need to implement immediate

⁹¹ Paris Agreement (cited in note 5). United Nations Framework Convention on Climate Change (adopted May 9, 1992, entered into force Mar 21, 1994) 1771 UNTS 107 (UNFCCC).

⁹² With regards to international maritime transport, States must account for the amount of marine fuel (bunker fuel) sold by a State, though it is not considered as part of State emissions. Intergovernmental Panel on Climate Change, *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, vol 2, 3.55, §3.5.3 <<https://www.ipcc-nggip.iges.or.jp/public/2006gl/>> <https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf> Intergovernmental Panel on Climate Change, *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* (2019 IPCC Refinement) Overview, 12 §6 <<https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html>>

⁹³ International Maritime Organization, Resolution MEPC.304(72), MEPC 72/17/Add.1 Annex 11 (Apr 13, 2018) ¶2 <[https://www.wcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20MEPC.304\(72\)_E.pdf](https://www.wcdn.imo.org/localresources/en/OurWork/Environment/Documents/Resolution%20MEPC.304(72)_E.pdf)>

⁹⁴ Id at ¶3.1.2 This also includes “pursuing efforts towards 70% by 2050.” Id.

⁹⁵ Id. Also included is “to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 whilst pursuing efforts towards phasing them out as called for in the Vision ...” Id.

⁹⁶ See subsection 3.1.

⁹⁷ International Maritime Organization, *Member States, including Permanent Missions to IMO* <<https://www.imo.org/en/OurWork/ERO/Pages/Membership-and-relations.aspx>> The United States is a Member State. International Maritime Organization, *Member States* <<https://www.imo.org/en/About/Membership/Pages/MemberStates.aspx>>

⁹⁸ See, e.g., IMO efforts to reach consensus on management requirements and prospective shipping design. International Maritime Organization, *Energy Efficiency Measures, Debate on the adoption of Technical and operational measures* <<https://www.imo.org/en/OurWork/Environment/Pages/Technical-and-Operational-Measures.aspx>> IMO measures are developed through IMO committee and subcommittees (e.g., its Marine Environment Protection Committee (MEPC) and its Sub-Committee on Pollution Prevention and Response (PPR)).

definitive short-term actions to reach the goals, the IMO process has collectively failed to require the actions reflected of this urgency. As a European Parliament briefing noted,

Progress in the IMO negotiations has been slow with no agreement yet reached on the short-term measures to implement in order to achieve a GHG reduction of “at least” 40% below 2008 levels by 2030...The window of opportunity is now certainly beginning to close...⁹⁹

Nor has the IMO quickly advanced efforts to address black carbon emissions. IMO action has not proceeded beyond a 2015 analysis of black carbon reduction measures.¹⁰⁰ The IMO’s Marine Environment Protection Committee has deferred consideration of black carbon proposals until its next meeting in June 2021.¹⁰¹

The Arctic Council focuses exclusively on the Arctic, is “the leading intergovernmental forum” with respect to Arctic issues, “in particular on issues of sustainable development and environmental protection in the Arctic.”¹⁰² The Arctic Council is comprised of the eight Arctic States,¹⁰³ joined by six Permanent Participant organizations representing the Arctic’s Indigenous peoples.¹⁰⁴

International Maritime Organization, *Marine Environment Protection Committee (MEPC)*

<<https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-default.aspx>>

International Maritime Organization, *Sub-Committee on Pollution Prevention and Response (PPR)*

<<https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/PPR-default.aspx>>

⁹⁹ European Union, Directorate-General for Internal Policies, European Parliament Briefing, *Greenhouse gas emissions from shipping: waiting for concrete progress at IMO level* (Sept 2020) (EU Parliament Briefing) 11 <[https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/652754/IPOL_BRI\(2020\)652754_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2020/652754/IPOL_BRI(2020)652754_EN.pdf)> The European Union continues its plans to add maritime shipping to its Emissions Trading System beginning January 2022. See, e.g., Alessio Sbraga and Joseph Malpas, *Inclusion of shipping in the EU Emissions Trading System: current landscape, perspective and potential impact*, Lexology (Dec 14, 2020)

<<https://www.lexology.com/library/detail.aspx?g=c60523cf-2eeb-412b-9b8d-c16366d44ac4>> Indeed, Special Presidential Envoy for Climate John Kerry recently announced that “...the United States is committing to work with countries in the International Maritime Organization to adopt a goal of achieving zero emissions from international shipping by 2050, and to adopt ambitious measures that will place the sector on a pathway to achieve this goal.” Ocean Conservancy, Dan Hubbell, *Statement: Special Envoy Kerry Makes a Needed Commitment to Eliminate Shipping Emissions by 2050* (Apr 21, 2021) <<https://oceanconservancy.org/news/statement-special-envoy-kerry-makes-needed-commitment-eliminate-shipping-emissions-2050/>>

¹⁰⁰ IMO Black Carbon Study (cited in note 70). By the time of the document’s issuance, IMO had developed a definition specific to maritime black carbon emissions and measurement approaches. Id at 2, §1.4.

¹⁰¹ International Maritime Organization, Sub-Committee on Pollution Prevention and Response, Secretariat, *Decisions of Other IMO Bodies: Outcome of ALCOM/ES, MSC 102 and MEPC 75, PPR 8/2* (Jan 15, 2021) 5, §2.4. Available through IMODocs (cited in note 64).

¹⁰² Arctic Council, *About* <<https://arctic-council.org/en/about/>>

¹⁰³ The Arctic States are Canada, Denmark (for Greenland and the Faroe Islands), Finland, Iceland, Norway, Sweden, Russia, and the United States. Arctic Council, *Arctic States* <<https://arctic-council.org/en/about/states/>>

¹⁰⁴ Arctic Council, *Permanent Participants* <<https://arctic-council.org/en/about/permanent-participants/>> Observers are approved by the Arctic Council, and currently are comprised of Non-Arctic States, intergovernmental and inter-parliamentary organizations, and non-governmental organizations. Arctic Council, *Observers* <<https://arctic-council.org/en/about/observers/>>

The Arctic Council's involvement pertaining to SLCPs began in 2009.¹⁰⁵ And its engagement with Arctic maritime issues is considerable,¹⁰⁶ and recently strengthened.¹⁰⁷ Indicative of its involvement is its hosting of a conference, *Cryosphere, Climate and Water in a Warming World*, this fall.¹⁰⁸ Yet its limitation is that its function is that of a forum,¹⁰⁹ its role to implement policy.¹¹⁰ It is not devised nor equipped to mandate action.

Similarly, another intergovernmental forum, the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC), specifically focuses on SLCPs.¹¹¹ The CCAC is a coalition comprised of 70 States, along with numerous intergovernmental organizations, non-governmental organizations, and others.¹¹² The U.S. involvement has included efforts pertaining to black carbon emissions from maritime shipping.¹¹³ However, because it operates as a forum, it does not play a regulatory role.

Lastly, the Convention on Long-range Transboundary Air Pollution (CLRTAP)¹¹⁴ is a regional treaty covering Europe, North America, Eastern Europe, South-Eastern Europe, the Caucasus and Central Asia.¹¹⁵ CLRTAP has demonstrated results in air pollution reduction, beginning with its efforts pertaining to acid rain.¹¹⁶ One of CLRTAP's eight protocols, the Gothenburg Protocol, was amended in 2012,¹¹⁷ and became "the first international agreement addressing black carbon."¹¹⁸ The United States as well as a number of Arctic States are parties to the Gothenburg

¹⁰⁵ Arctic Council, Tromsø Declaration (Apr 29, 2009) <<https://oaarchive.arctic-council.org/handle/11374/91>>

¹⁰⁶ The Arctic Council relies on its working groups. The working groups involved with climate change and shipping include the Conservation of Arctic Flora and Fauna (CAFF), the Arctic Monitoring and Assessment Program (AMAP), and the Protection of the Arctic Marine Environment (PAME) working group. Arctic Council, *Working Groups* <<https://arctic-council.org/en/about/working-groups/>>

¹⁰⁷ Arctic Council, *The Road Towards Enhanced Marine Coordination in the Arctic Council* (Nov 3, 2020) <<https://arctic-council.org/en/news/the-road-towards-enhanced-marine-coordination-in-the-arctic-council/>>

¹⁰⁸ *Cryosphere, Climate and Water in a Warming World*, Reykjavík, Iceland (Sept 27 - Oct 1, 2021) <<https://arctic-council.org/en/events/cryosphere-climate-and-water-in-a-warming-world/>>

¹⁰⁹ Arctic Council, *About* (cited in note 102).

¹¹⁰ Arctic Council, *Who We Are* <<https://arctic-council.org/en/>>

¹¹¹ Climate and Clean Air Coalition, *Our Partners* <<https://ccacoalition.org/en/partners>> Climate and Clean Air Coalition, *Our Work* <<https://ccacoalition.org/en/content/what-we-do>>

¹¹² CCAC, *Our Partners* (cited in note 111).

¹¹³ See, e.g., Climate and Clean Air Coalition, CCAC Secretariat, *2nd Workshop on Marine Black Carbon Emissions* (Nov 23, 2015) <<https://www.ccacoalition.org/en/news/2nd-workshop-marine-black-carbon-emissions>>

¹¹⁴ Convention on Long-range Transboundary Air Pollution (adopted Nov 13, 1979, entered into force Mar 16, 1983) 1302 UNTS 217 (CLRTAP) <<https://www.unece.org/fileadmin/DAM/env/lrtap/full%20text/1979.CLRTAP.e.pdf>>

¹¹⁵ United Nations Economic Commission for Europe, *The Convention and its achievements* <<https://unece.org/convention-and-its-achievements>>

¹¹⁶ *Id.*

¹¹⁷ United Nations, Economic and Social Council, Economic Commission for Europe, Executive Body for the Convention on Long-range Transboundary Air Pollution, 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the Convention on Long-range Transboundary Air Pollution, as amended on 4 May 2012, ECE/EB.AIR/114 (May 6, 2013) (Gothenburg Protocol). United Nations Economic Commission for Europe, *Protocols* <<https://unece.org/protocols>> <https://unece-modl.dotsoft.gr/DAM/env/documents/2013/air/eb/ECE.EB.AIR.114_ENG.pdf>

¹¹⁸ U.S. Department of State, Office of Environmental Quality and Transboundary Issues, *Convention on Long-Range Transboundary Air Pollution* <<https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issues/convention-on-long-range-transboundary-air-pollution/>>

Protocol.¹¹⁹ However, the CLRTAP regime, like the UNFCCC regime, does not include international maritime transportation within its scope, and instead defers to the IMO.¹²⁰

4.0 Common Elements of Black Carbon and Low Climate Impact Fuels Model Laws

*We should also be considering that not only countries in the EU, but also China and many others have set sail to climate neutrality. They will hardly accept that maritime shipping keeps [lagging] behind.*¹²¹

4.1 Port State Jurisdiction

The jurisdictional framework under the United Nations Convention on the Law of the Sea (UNCLOS) delineates State maritime authorities.¹²² Though the United States is not a Party to UNCLOS, it has routinely acted in accordance with most UNCLOS provisions, including its jurisdictional framework.¹²³ The primary types of jurisdictions include flag State jurisdiction, coastal State jurisdiction, and port State jurisdiction. Primary responsibility for a ship flows to the State where the ship is registered. This is referred to as flag State jurisdiction.¹²⁴ Coastal State jurisdiction addresses maritime zones where a coastal State can exercise sovereignty or has sovereign rights.¹²⁵ Port State jurisdiction includes a port State's ability to condition entry to its

¹¹⁹ This includes the United States, Canada, Finland, Norway, and Sweden. United Nations Treaty Collection, *Amendment of the text and annexes II to IX to the Protocol to the 1979 Convention on Long-range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone and the addition of new annexes X and XI*

<https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-1-k&chapter=27&clang=_en>
<<https://treaties.un.org/doc/Treaties/2013/03/20130301%2003-53%20PM/CN.155.2013-Eng.pdf>>

¹²⁰ Gothenburg Protocol, preambular ¶10 (cited in note 117) (“Aware that emissions from shipping and aviation contribute significantly to adverse effects on human health and the environment and are important issues under consideration by the International Maritime Organization and the International Civil Aviation Organization...”).

¹²¹ International Council on Combustion Engines (CIMAC), *CIMAC misses ambition in IMO's draft regulations to reduce GHG emissions* (Nov 20, 2020) (Statement of Christoph Rofka, CIMAC Vice President Communication) <<https://www.cimac.com/news-press/news/cimac-misses-ambition-in-imos-draft-regulations-to-reduce-ghg-emissions-kopie.html>>

¹²² United Nations Convention on the Law of the Sea (adopted Dec 10, 1982, entered into force Nov 16, 1994) 1833 UNTS 3 (UNCLOS) <https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf>

¹²³ See for example, “United States Ocean Policy” of President Reagan, 19 Weekly Comp. Pres. Doc. 383–84, 383 (Mar. 10, 1983) after UNCLOS was opened for signature, wherein the President committed the United States to acting in accordance with UNCLOS with regards to “the balance of interests relating to traditional uses of the oceans,” including navigation <https://www.gc.noaa.gov/documents/031083-reagan_ocean_policy.pdf> Presidents Clinton, George W. Bush, and Obama all sought U.S. accession. President Biden supported Senate accession as a senator. Committee on Foreign Relations, Report, Convention on the Law of the Sea, 110th Cong, 1st Sess, Exec Rept 110–9 (Dec 19, 2007) <https://www.foreign.senate.gov/imo/media/doc/executive_report_110-09.pdf>

¹²⁴ UNCLOS art 91(1) (cited in note 122).

¹²⁵ A coastal State exercises sovereignty over its territorial sea (12 nautical miles from the baseline, typically the low-water line), and its internal waters (generally waters on the landward side of baseline). In addition, coastal States have sovereign rights to, inter alia, “conserving and managing the natural resources” within the exclusive economic zone (200 nautical miles from the low-water line), as well as jurisdiction for the “protection and preservation of the marine environment.” Outside coastal State jurisdiction is the High Seas. Id arts 3, 5, 8(1), 56(1), 57, and 86.

ports.¹²⁶ UNCLOS also contains provisions addressing specific situations, including authorities in ice-covered areas,¹²⁷ or transit through international straits.¹²⁸

Generally, coastal State jurisdiction does not give a coastal State the ability to establish pollution requirements for foreign vessels. Instead, these international rules and standards must be established through “the competent international organization.”¹²⁹ This competent international organization is the IMO.¹³⁰ However, with regards to a State’s ports, the roles appear reversed, with the State notifying “the competent international organization” of a State’s rules and standards for pollution upon which it conditions entry from foreign vessels to its ports.¹³¹

As long as a ship enters a port voluntarily,¹³² and has been given adequate notice,¹³³ the port State may enforce its domestic law, in addition to international law, for violations.¹³⁴ This includes a port State’s ability to condition entry on “requirements for the prevention, reduction and control of pollution of the marine environment,” for foreign-flagged ships entering their ports,¹³⁵ beyond those internationally established.¹³⁶ The most well-known U.S. example of the

¹²⁶ Id, arts 3, 11, 25(2).

¹²⁷ Id, art 234. UNCLOS article 234 allows broad latitude to coastal States for pollution protection with regards to “ice-covered areas” that are within the State’s exclusive economic zone (EEZ) (to 200 nautical miles, see note 115). The provision describes the areas in part as “where particularly severe climatic conditions and the presence of ice covering such areas for most of the year create obstructions or exceptional hazards to navigation, and pollution of the marine environment could cause major harm to or irreversible disturbance of the ecological balance.” Id. The United States could employ this provision to further extend Arctic protections within U.S. EEZ ice-covered areas. For a map of the U.S. EEZ, see National Oceanic and Atmospheric Administration, *What is the EEZ?* <<https://oceanservice.noaa.gov/facts/eez.html>>

¹²⁸ UNCLOS art 42 (cited in note 122). The Bering Strait is an international strait under UNCLOS art 37. As such, U.S. pollution prevention authorities within the strait are limited under UNCLOS to international regulations (i.e., “the prevention, reduction and control of pollution, by giving effect to applicable international regulations regarding the discharge of oil, oily wastes and other noxious substances in the strait.”) For a discussion of the intersection between ice-covered areas and international straits (e.g., the Bering Strait), see Paul Arthur Berkman, Alexander N. Vylegzhanin and Oran R. Young, *Governing the Bering Strait Region: Current Status, Emerging Issues and Future Options*, 47 *Ocean Development & International Law* 186 (2016) <<https://www.tandfonline.com/doi/full/10.1080/00908320.2016.1159091>>

¹²⁹ UNCLOS art 211(1) (cited in note 122) (“States, acting through the competent international organization or general diplomatic conference, shall establish international rules and standards to prevent, reduce and control pollution of the marine environment from vessels...”). Coastal States maintain the ability to protect their territorial seas from pollution under State authorities. Id art 211(4).

¹³⁰ International Maritime Organization, *The United Nations Convention on the Law of the Sea (UNCLOS) and the International Maritime Organization, Address by Mr. Koji Sekimizu, Secretary-General of the International Maritime Organization, to the International Tribunal for the Law of the Sea* (Mar 18, 2014) (“In such cases, the expression ‘competent international organization’, when used in the singular in UNCLOS, applies exclusively to IMO.”) <<https://www.imo.org/en/MediaCentre/SecretaryGeneral/Pages/itlos.aspx>>

¹³¹ UNCLOS art 211(3) (cited in note 122). The same principle applies to internal waters (“States which establish particular requirements for the prevention, reduction and control of pollution of the marine environment as a condition for the entry of foreign vessels into their ports or internal waters or for a call at their off-shore terminals shall give due publicity to such requirements and shall communicate them to the competent international organization.”). See also Id arts 211(5) and 212.

¹³² Different UNCLOS requirements apply if a ship is engaged in innocent passage, including, e.g., a ship in distress. See, e.g., Id arts 18, 19, 21, 25.

¹³³ Id art 211(3).

¹³⁴ Id art 220(1). Id arts 218, 220(1). Enforcement safeguards are set forth in UNCLOS Part XII, §7.

¹³⁵ Id art 211(3).

¹³⁶ Id art 211(1). UNCLOS also contemplates port States being able to coordinate the measures. Id art 211(3).

use of port State jurisdiction is the 1990 Oil Pollution Act requirement for oil tankers within U.S. waters to be double-hulled.¹³⁷ The European Union has relied extensively on port State jurisdiction for its legislation regarding GHG shipping emissions.¹³⁸ The model laws rely on port State jurisdiction.

4.2 Geographical extent of Arctic

4.2.1 Arctic Boundary Approaches

There is no universal boundary for the Arctic, or for Arctic waters.¹³⁹ In its *Ocean and Cryosphere in a Changing Climate* report, the IPCC took an ecosystem approach to define the Arctic. The report generally adopts the Protection of the Arctic Marine Environment Large Marine Ecosystem (PAME LMEs) areas, developed by an Arctic Council working group,¹⁴⁰ which expansively includes the Arctic environment.

Another approach in defining an Arctic boundary is set forth in the IMO's International Code for Ships Operating in Polar Waters (Polar Code), adopted in 2015.¹⁴¹ The Polar Code applies to

¹³⁷ 46 USC 3703a. For a discussion of port State Jurisdiction, see Robin Churchill, *Port State Jurisdiction Relating to the Safety of Shipping and Pollution From Ships—What Degree of Extra-Territoriality?*, 31 Int'l J. Marine and Coastal L. 442, 445 (2016) (“The jurisdiction of a port State over foreign ships in its ports is therefore in principle exactly the same as its territorial jurisdiction over other foreign means of transport (such as aircraft and road vehicles) and foreign nationals that are present within its territory.”)

<https://brill.com/view/journals/estu/31/3/article-p442_4.xml?language=en>

¹³⁸ See Aoife O'Leary and Fäig Abbasov, *Let's end the debate: putting international shipping into the ETS is clearly legal*, EURACTIV (Jan 28, 2021) (“History shows that regional action has been a driver of progress at the IMO. For example, the EU MRV regulation led to the adoption of the IMO Data Collection System, similar to the EU MRV but at a global level and unfortunately less transparent. Similarly, the EU sulphur regulation ensured that the IMO did not delay its 2020 0.5% global sulphur cap, reducing the amount of air pollution from shipping worldwide. Then as well, the EU banning single-hull tankers from entering its ports helped accelerate the global phase out of single-hull tankers.”)

<<https://www.euractiv.com/section/shipping/opinion/lets-end-the-debate-putting-international-shipping-into-the-ets-is-clearly-legal/>>

¹³⁹ The Arctic Council itself relies on at least three different Arctic definitions within its working groups. See, e.g., University of Lapland, Arctic Centre, *Definitions of the Arctic by the Arctic Council Working Groups* <<https://www.arcticcentre.org/EN/arcticregion/Maps/definitions>> Arctic waters are often identified with respect to their regional seas (with the Bering Sea, the Chukchi Sea, and the Beaufort Sea bordering U.S. coasts). A map showing the regional seas is attached. See memorandum attachment A, figure 1. The Arctic region could also be defined, e.g., as: (1) the area north of the Arctic Circle; (2) the area north of tree line (the northern limit of tree growth); or (3) the area where the average daily summer temperature is no greater than 10° Celsius (50° Fahrenheit). National Oceanic and Atmospheric Administration, Pacific Marine Environmental Laboratory, *Frequently Asked Questions about the Arctic*, no 17, *What is the size of the Arctic region and the Arctic Ocean?*

<<https://www.pmel.noaa.gov/arctic-zone/faq.html>>

¹⁴⁰ IPCC Ocean and Cryosphere Report, ch 3, 211, figure 3.2 (cited in note 9). The IPCC notes that it relies on “a purposefully flexible approach” to defining polar regions due to differing elements and scientific disciplines. Id. See also Arctic Council, Protection of the Arctic Marine Environment, *Large Marine Ecosystems (LMEs) of the Arctic* (PAME, LMEs) <<https://pame.is/projects/ecosystem-approach/arctic-large-marine-ecosystems-lme-s>> Maps showing the PAME LMEs boundaries are attached. See memorandum attachment A, figures 2 and 3.

¹⁴¹ International Maritime Organization, *International Code for Ships Operating in Polar Waters*, MEPC 68/21/Add.1 Annex 10, 3 (2015) (Polar Code) <<https://www.imo.org/en/MediaCentre/HotTopics/Pages/polar-default.aspx>>

<<https://www.wcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/POLAR%20CODE%20TEXT%20>

ships in defined Arctic waters (and to a defined Antarctic area).¹⁴² Its boundary for Arctic waters is more limited than that utilized by the IPCC.¹⁴³ The Polar Code is primarily implemented through two international treaties: a treaty pertaining to safety at sea (for those provisions related to safety at sea),¹⁴⁴ and for pollution from ships, the International Convention for the Prevention of Pollution from Ships (MARPOL),¹⁴⁵ an international treaty which specifically addresses pollution from ships.

4.2.2 United States Statutory Boundary

The U.S. definition of the Arctic is contained in the Arctic Research and Policy Act:

As used in this chapter, the term “Arctic” means all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, and Chukchi Seas; and the Aleutian chain.¹⁴⁶

The statutory definition is incorporated by reference elsewhere in the U.S. Code, in statutory provisions pertaining to Arctic maritime domain awareness and Arctic maritime transportation,¹⁴⁷ though a narrowed definition of the Arctic can be found pertaining to Arctic drone use, where the Arctic is limited to waters north of the Aleutian chain.¹⁴⁸

The model laws use the Arctic definition found in the Arctic Research and Policy Act, and by doing so, reflect the definition accepted by Congress, better match the IPCC boundaries in the

AS%20ADOPTED.pdf> For general information on the Polar Code, see International Maritime Organization, *International Code for Ships Operating in Polar Waters (Polar Code)* <<https://www.imo.org/en/OurWork/Safety/Pages/polar-code.aspx>>

¹⁴² Polar Code at 8 and 9, figures 1 and 2 (cited in note 141).

¹⁴³ A map showing the Polar Code boundary is attached. See memorandum attachment A, figure 4.

¹⁴⁴ International Convention for the Safety of Life at Sea (adopted Nov 1, 1974, entered into force May 25, 1980) 1184 UNTS 3.

¹⁴⁵ Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (adopted on Feb 17, 1978, entered into force Oct 2, 1983) 1340 UNTS 61 (MARPOL)

<<https://www.jus.uio.no/english/services/library/treaties/06/6-05/ships-pollution.xml>> The United States is a State Party to MARPOL. See International Maritime Organization, *Status of Conventions* (IMO Status of Conventions), under heading, Status of IMO Treaties. International Maritime Organization, *Status of IMO Treaties* (Jan 7, 2021) (Status of IMO Treaties) 111 <<https://www.imo.org/en/About/Conventions/Pages/StatusOfConventions.aspx>>

<<https://www.wcdn.imo.org/localresources/en/About/Conventions/StatusOfConventions/Status%20-%202021.pdf>>

¹⁴⁶ Arctic Research and Policy Act § 112, 15 USC § 4111. Maps showing the boundary is attached. See memorandum attachment A, figures 5 and 6. The Arctic Circle is located at approximately 66°30' N.

¹⁴⁷ Howard Coble Coast Guard and Maritime Transportation Act of 2014, Pub L No 113–281, 128 Stat 3056 (2014). See 14 USC §§ 714(e) and 716(f) See also 14 USC 716(a) (“The purpose of this section is to ensure safe and secure maritime shipping in the Arctic including the availability of aids to navigation, vessel escorts, spill response capability, and maritime search and rescue in the Arctic.”).

¹⁴⁸ Federal Aviation Administration Reauthorization Act of 2018, Pub L 115–254, 132 Stat 3284 (2018) See 49 USC § 44801(3) (“The term “Arctic” means the United States zone of the Chukchi Sea, Beaufort Sea, and Bering Sea north of the Aleutian chain.”).

northern Pacific,¹⁴⁹ and offer protection of certain areas beyond that defined by the Polar Code.¹⁵⁰

4.3 Ban on Heavy Fuel Oil as Fuel in the Arctic

*Regarding fuel quality, the fastest way to immediately cut black carbon emissions is to switch from residual fuels, such as heavy fuel oil (HFO), to distillate fuels, which reduces black carbon by 33%, on average. Using distillate fuels also enables the use of diesel particulate filters, which remove more than 90% of black carbon from the exhaust.*¹⁵¹

The model laws' prohibition of HFO as fuel in the Arctic (for ships that depart or call at U.S. ports) will lead to an immediate decrease in black carbon emissions from those ships. The lifecycle climate impact will also be reduced, both by the reduction in black carbon and in the use of distillate fuels rather than HFO. In addition, an HFO ban on ships calling at or departing from U.S. ports will lessen the risk of an HFO spill in the Arctic, as an HFO spill there would have devastating consequences.

4.3.1 IMO Black Carbon Measures

More than a decade ago, the United States, Norway, and Sweden submitted a proposal to the IMO to significantly reduce black carbon emissions from ships in the Arctic.¹⁵² The proposal suggested a number of options to address black carbon, including distillate fuels coupled with diesel particulate filters.¹⁵³ Five years later, the IMO issued an analysis of measures to address black carbon.¹⁵⁴ The analysis identified six favored measures that would address black carbon, along with other air emissions in the Arctic.¹⁵⁵

¹⁴⁹ See, e.g., the LMEs in the northern Pacific. See memorandum attachment A.

¹⁵⁰ Compared to the statutory definition, the Polar Code boundaries are less expansive in the northern Pacific as well as east of Iceland in the Atlantic, but more expansive west of Iceland. See memorandum attachment A.

¹⁵¹ Climate and Clean Air Coalition, Bryan Comer, *Black Carbon and Maritime Shipping: The Long Road to Regulating a Short-Lived Climate Pollutant* (Apr 25, 2019) <<https://ccacoalition.org/en/blog/black-carbon-and-maritime-shipping-long-road-regulating-short-lived-climate-pollutant>> Originally published by Air & Waste Management Association EM (Apr 2019) <<https://www.awma.org/content.asp?admin=Y&contentid=500>> <<https://pubs.awma.org/flip/EM-Apr-2019/comer.pdf>> See also ICCT HFO White Paper at 20, n 6 (cited in note 29) (“BC emissions from HFO fueled ships that switch to distillate would fall 44% from 225 t to 121 t, reducing total BC emissions in the Arctic from 356 t to 252 t, a decrease of 30%.”).

¹⁵² Norway, Sweden and the United States, *Prevention of Air Pollution from Ships Reduction of emissions of black carbon from shipping in the Arctic*, MEPC 60/4/24 (Jan 15, 2010) (U.S. Black Carbon Proposal) ¶16. Available through IMODocs (cited in note 64).

¹⁵³ U.S. Black Carbon Proposal at ¶11 (cited in note 152).

¹⁵⁴ See IMO Black Carbon Study (cited in note 70).

¹⁵⁵ The identified abatement technologies were LNG, water-in-fuel emulsion, scrubbers, diesel particulate filter, HFO – distillate, slow steaming – de-rating. IMO Black Carbon Study at 18, table 12. (cited in note 70). The IMO Sub-Committee on Pollution Prevention and Response met in late March 2021 (PPR 8) ahead of the MEPC’s June 2021 meeting. The sub-committee agreed in the future to develop, “...guidelines on recommendatory goal-based control measures to reduce the impact...” IMO PPR 8 meeting summary, *Reducing the impact on the Arctic of Black Carbon emissions from international shipping* (cited in note 44). A map showing black carbon emissions from shipping within the Polar Code boundary is attached. See memorandum attachment A, figure 7.

Meanwhile, the IMO was attempting to address sulfur oxides in air emissions.¹⁵⁶ The IMO was implementing a phased reduction of allowed sulfur in HFO.¹⁵⁷ The first two required reductions in HFO were from 4.5% to 3.5%.¹⁵⁸ In January 2020, the most significant reduction took effect, dropping to 0.50% (called IMO 2020).¹⁵⁹ There were two primary options for a ship to have compliant 0.50% fuel. A ship could use a modified HFO (“very low sulfur fuel oil”), commonly referred to as VLSFO,¹⁶⁰ or a ship could use marine distillate fuels.¹⁶¹ VLSFO proved overwhelmingly preferred.¹⁶²

However, shortly before the 0.50% sulfur in fuel requirement began, it was becoming evident that VLSFO was having an unintended detrimental environmental consequence. Finland and Germany submitted evidence that VLSFO led to an increase in a ship’s black carbon emissions.¹⁶³ Industry raised other concerns with VLSFO.¹⁶⁴ The result has been an IMO amendment to add further sampling and verification of VLSFO; VLSFO remains available.¹⁶⁵

¹⁵⁶ The IMO regulates the sulfur oxides through MARPOL Annex VI. See MARPOL Annex VI Regulations (cited in note 68). Annex VI addresses air pollution from ships. MARPOL includes annexes, with each annex addressing a specific source of ship pollution. The United States is a State Party to Annex VI. See Status of IMO Treaties at 115 (cited in note 145). MARPOL is implemented by the United States primarily through the Act to Prevent Pollution from Ships (APPS). The Act to Prevent Pollution from Ships, 33 USC §§ 1901-1913 (APPS). APPS implements Annexes I, II, V, and VI. Id. § 1901(a)(5). For a summary of U.S. implementation of MARPOL annexes, see United States Coast Guard, Office of Commercial Vessel Compliance, *International Convention for the Prevention of Pollution by Ships - MARPOL 73/78* <<https://www.dco.uscg.mil/Our-Organization/Assistant-Commandant-for-Prevention-Policy-CG-5P/Inspections-Compliance-CG-5PC-/Commercial-Vessel-Compliance/Domestic-Compliance-Division/MARPOL/>>

¹⁵⁷ MARPOL Annex VI regulation 14.1. See MARPOL Annex VI Regulations (cited in note 68). See generally International Maritime Organization, *Sulphur oxides (SOx) and Particulate Matter (PM) – Regulation 14* <[https://www.imo.org/en/OurWork/Environment/Pages/Sulphur-oxides-\(SOx\)—Regulation-14.aspx](https://www.imo.org/en/OurWork/Environment/Pages/Sulphur-oxides-(SOx)—Regulation-14.aspx)> A more stringent level of reduction is required in Emission Control Areas (IMO-designated areas with more stringent air emission requirements). Id. Sulfur oxides emissions are damaging to both health and the environment. International Maritime Organization, *IMO 2020 – Cutting Sulphur Oxide Emissions (2020)*(Cutting Sulfur Oxide) <<https://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx>> All North American U.S. coastal waters are included in an Emission Control Area, with the exception of the U.S. Arctic. Designation of North American Emission Control Area to Reduce Emissions from Ships (Mar 2010) 2, figure 1 <<https://www.epa.gov/regulations-emissions-vehicles-and-engines/designation-north-american-emission-control-area-marine>> <<https://nepis.epa.gov/Exe/ZyPDF.cgi/P100AU0I.PDF?Dockey=P100AU0I.PDF>>

¹⁵⁸ MARPOL Annex VI regulation 14.1. See MARPOL Annex VI Regulations (cited in note 68).

¹⁵⁹ Id.

¹⁶⁰ Andy Laven, Sahara Group, *IMO 2020: Coming up VLSFO* (June 10, 2020) <<https://www.energyvoice.com/opinion/244841/imo-2020-coming-up-vlsfo/>>

¹⁶¹ Id.

¹⁶² Id.

¹⁶³ Finland and Germany, *Reduction of the Impact on the Arctic of Black Carbon Emissions from International Shipping: Initial results of a Black Carbon measurement campaign with emphasis on the impact of the fuel oil quality on Black Carbon emissions*, PPR 7/8 (Nov 15, 2019) (Finland and Germany submission) and its Corrigendum, PPR 7/8/Corr.1 (Jan 29, 2020); Available through IMODocs (cited in note 64). The increase in black carbon emissions ranged 10-85% compared to HFO. Finland and Germany submission ¶ 22.

¹⁶⁴ Laven, *IMO 2020* (cited in note 160).

¹⁶⁵ Resolution MEPC.324(75), MEPC 75/18/Add.1 Annex 1 (Nov 20, 2020) <[https://www.wcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/MEPC.324\(75\).pdf](https://www.wcdn.imo.org/localresources/en/OurWork/Environment/Documents/Air%20pollution/MEPC.324(75).pdf)> See also IMO PPR 8 meeting summary (cited in note 44).

4.3.2 Heavy Fuel Oil Ban

In 2010, the IMO established a complete ban on ships' carriage and use of all heavy grade oils (including HFO and crude oil) in Antarctic waters.¹⁶⁶ A prohibition on the use of heavy grade oils as ballast in Antarctic waters was added in 2014.¹⁶⁷

In 2017, the IMO opened discussions for a possible Arctic ban.¹⁶⁸ However, the IMO limited the scope to “development of measures to reduce risks of use and carriage of *heavy fuel oil as fuel* by ships in Arctic waters.”¹⁶⁹ Not within the scope was banning solely carriage, such as an oil tanker transporting crude oil in the Arctic (already prohibited in Antarctic waters). The United States, along with seven other countries, proposed an Arctic HFO as fuel ban the following year.¹⁷⁰ The

¹⁶⁶ MARPOL Annex I regulation 43. International Maritime Organization, Resolution MEPC 189(60), MEPC 60/22 Annex 10 (Mar 26, 2010). Vessels engaged in securing the safety of ships or in a search and rescue operation are excepted. *Id.* The Antarctic HFO ban includes (1) crude oils having a density at 15°C higher than 900 kg/m³, (2) oils, other than crude oils, having a density at 15°C higher than 900 kg/m³ or a kinematic viscosity at 50°C higher than 180 mm²/s or (3) bitumen, tar and their emulsions. *Id.*

<[https://www.wapps.imo.org/blast/blastDataHelper.asp?data_id=28814&filename=189\(60\).pdf](https://www.wapps.imo.org/blast/blastDataHelper.asp?data_id=28814&filename=189(60).pdf)>

MARPOL Annex I addresses oil pollution. See generally, International Maritime Organization, *MARPOL Annex I – Prevention of Pollution by Oil* <<https://www.imo.org/en/OurWork/Environment/Pages/OilPollution-Default.aspx>> Annex I is compulsory for State Parties, though pursuant to a U.S. declaration, its U.S. application is limited to “seagoing ships.” See Status of IMO Treaties at 140 (cited in note 145) (“By a notification received on 16 October 1980, the Government of the United States stated ‘that the United States considers that Annex I and II of the Protocol apply only to seagoing ships.’”). See also 33 USC § 1903(a) (“In the administration and enforcement of the MARPOL Protocol and this chapter, Annexes I and II of the Convention apply only to seagoing ships.”). A seagoing ship would be a ship in voyage beyond the U.S. Boundary Line. See, e.g., 46 USC § 2101(42) and (43). Boundary Lines are set forth in 46 CFR Part 7. Boundary Lines generally follow the high tide waterline, including “across entrances to small bays, inlets and rivers.” 46 CFR 7.5(c).

¹⁶⁷ Annex I regulation 43. International Maritime Organization, Resolution MEPC.256(67), MEPC 67/20 Annex 7 (Oct 17, 2014)

<[https://www.wcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.256\(67\).pdf](https://www.wcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/MEPCDocuments/MEPC.256(67).pdf)>

¹⁶⁸ International Maritime Organization, *Report of the Marine Environment Protection Committee on its Seventy-First Session*, MEPC 71/17 (July 24, 2017) ¶14.13.1 (IMO Arctic HFO Scope). Available through IMODocs (cited in note 64). At present, the only HFO ban in the Arctic applies to the waters around Svalbard nature areas, in the northern Atlantic. Governor of Svalbard, *Heavy fuel oil ban in the protected areas*

<<https://www.sysselmannen.no/en/heavy-fuel-oil-ban-in-the-protected-areas/>> Lovdata, *Regulations on the national parks Sør-Spitsbergen, Forlandet and Nordvest-Spitsbergen, on the nature reserves Nordaust-Svalbard and Sørøst-Svalbard, and on the nature reserves for birds on Svalbard* (trans)

<<https://lovdata.no/dokument/SF/forskrift/2014-04-04-377>> The Norwegian government plans to extend this soon to all Svalbard waters. Thomas Nilsen, *Ban on heavy fuel oil coming to all of Svalbard*, Barents Observer (Nov 06, 2020) <<https://thebarentsobserver.com/en/arctic/2020/11/ban-heavy-fuel-oil-coming-all-svalbard>>

¹⁶⁹ IMO Arctic HFO Scope (cited in note 168) (emphasis added). Nor was a ban on HFO as ballast part of the scope. *Id.* The Polar Code encourages the avoidance of use and carriage of HFO in the Arctic, but does not prohibit it. Polar Code, part II-B, ¶1.1 (cited in note 141) (“Ships are encouraged to apply regulation 43 of MARPOL Annex I when operating in Arctic waters.”).

¹⁷⁰ Finland, Germany, Iceland, the Netherlands, New Zealand, Norway, Sweden and the United States, *Development of Measures to Reduce Risks of Use and Carriage of Heavy Fuel Oil as Fuel by Ships in Arctic Waters: Proposal to ban heavy fuel oil use and carriage as fuel by ships in Arctic waters*, MEPC 72/11/1 (Feb 2, 2018) (Finland et al, Proposed HFO Ban) ¶2. Available through IMODocs (cited in note 64) (“This proposal introduces a mandatory ban of HFO use and carriage for use as fuel by ships in Arctic waters. The ban would be mandatory for all ships to which the International Convention for Prevention of Pollution from Ships (MARPOL) applies, while operating in

countries' proposal made no reference to air emissions or to black carbon. Instead, the focus was on the impacts of the “devastating and lasting effects on fragile Arctic marine and coastal environments” of even a single spill.¹⁷¹ Although the proposal allowed for a five-year delay for certain ships with fuel tank protections,¹⁷² the proposal urged implementation “as soon as possible,” with any extension being “short-lived.”¹⁷³ The countries proposed to tie the ban's implementation date to the HFO sulfur reduction to 0.5% since, “by 2021 it is expected that marine distillate fuels will be increasingly available and that many ships will have switched to using them.”¹⁷⁴

However, the resultant IMO ban, expected to be adopted in June 2021, moves even further away from a comprehensive ban.¹⁷⁵ The ban does not apply to HFO or crude oil carried solely as cargo (in line with the IMO's identified scope), and focuses solely on carriage and use of ship fuel.¹⁷⁶ And significantly, the Arctic HFO ban would be delayed until July 2024, with a further delay for a large number of ships until July 2029, through application of exemptions as well as waivers granted by individual Arctic States.¹⁷⁷ Calculations by the International Council on Clean Transportation found that, applying exemptions and waivers to the previous year's data, 93% of Canadian-flagged ships, and 97% of Russian-flagged ships would not have been affected by the

Arctic waters.”). HFO that was solely cargo would not be prohibited. Id. The ban could be briefly delayed for certain ships. Id at ¶5.

¹⁷¹ Id at ¶3.

¹⁷² Id at ¶5.

¹⁷³ Id at ¶3.

¹⁷⁴ Id at ¶4. See also ICCT, *Transitioning Away* at 2 (cited in note 88) (“All ships are capable of using distillate fuels; ships commonly switch from HFO to distillates as they enter and leave Emission Control Areas ...”).

¹⁷⁵ The Arctic ban would become MARPOL Annex I regulation 43A. It is not yet law. In October 2020, the IMO's Marine Environment Protection Committee agreed to circulation of a draft amendment for an Arctic HFO ban, for subsequent adoption at its meeting in June 2021. International Maritime Organization, *Marine Environment Protection Committee (MEPC) 75, 16-20 November (virtual session), Draft amendments to prohibit the use, and carriage for use, as fuel of HFO by ships in Arctic waters approved*

<<https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MEPC-75th-session.aspx>> For a thorough

analysis of the IMO proposed ban, see ICCT HFO White Paper (cited in note 29). Annex I regulation 43A is accessible in the ICCT HFO White Paper, 26, appendix A. The IMO Sub-Committee on Pollution Prevention and Response meeting in March 2021 agreed to develop guidelines for risk reduction measures for HFO as fuel in the Arctic. IMO PPR 8 meeting summary, *Mitigation measures to reduce risks of use and carriage of heavy fuel oil as fuel by ships in Arctic waters* (cited in note 44). For a concise criticism of the Arctic ban, see Anna Barford and James Gamble, *Ban on heavy fuel oil in the Arctic is too weak*, Policy Options Politiques (Apr 13, 2021)

<<https://policyoptions.irpp.org/magazines/april-2021/ban-on-heavy-fuel-oil-in-the-arctic-is-too-weak/>>

¹⁷⁶ MARPOL Annex I regulation 43A specifically references paragraph 1.2 of regulation 43, rather than 1.1–1.3. MARPOL Annex I regulation 43A.1 (cited in note 175). See also MARPOL Annex I regulation 43 (cited in note 166). Under either definition, VLSFO would be banned due to its density. See MARPOL Annex I regulations 43.1.2 and 43A.1. See also e.g., Unni Einemo, *Unintended consequences*, International Bunker Industry Association (Apr 17, 2020) <<https://ibia.net/2020/04/17/unintended-consequences/>> The model laws match the Arctic ban HFO definition. There is the potential for a model law to expand to placement of an Arctic ban on all carriage, in line with the IMO Antarctic ban. However, such a ban is outside the scope of the model law recommendations. The Polar Code encourages avoidance of fuel carriage in the Arctic. See note 169 reference to Polar Code, part II-B, ¶1.1.

¹⁷⁷ MARPOL Annex I regulation 43A.2 and 43A.4 (cited in note 175). Exemptions and waivers can be applied for five years. Id.

ban at present.¹⁷⁸ In addition, a ship of another country whose range includes waters of an Arctic country could gain a waiver by reflagging its ship to that country.¹⁷⁹

5.0 Additional Element of Black Carbon Model Law

5.1 Diesel Particulate Filter Requirement

For a ship utilizing distillate fuel, the addition of a diesel particulate filter drastically reduces black carbon emission levels.¹⁸⁰ The model law phases in the filter requirement, after the required switch to distillate fuel. The expectation is that compliance will be shown through a survey of the ship and an authorized certificate issued by the U.S. Environmental Protection Agency, as well as ship certification.¹⁸¹

6.0 Additional Elements of Low Climate Impact Fuels Model Law

6.1 Phased Reduction in the Arctic of Lifecycle Climate Emissions in Fuels

For the low climate impact fuels model law, distillate fuels serve as a bridge fuel. The model law requires a phased reduction in the lifecycle climate emissions in fuels. The reduction of lifecycle climate emissions is consistent with the urgency set forth in the Paris Agreement and its related decision document, and consistent with the IMO Initial GHG strategy. The phased reduction is modeled in part on the renewable fuel program of the Clean Air Act, modified to circumstances

¹⁷⁸ ICCT HFO White Paper, 16 (cited in note 29).

¹⁷⁹ The proposed IMO ban allows a State with a “coastline of which borders on Arctic waters” to waive requirements until July 2029 “for ships flying the flag of the Party while operating in waters subject to the sovereignty or jurisdiction of that Party...” MARPOL Annex I regulation 43A.4 (cited in note 175). For flag jurisdiction under UNCLOS, the sole connection between a flag State and its ship can be as limited as the specific act of a State authorizing the ship to fly its flag, leading many ships to instead fly a “flag of convenience.” International Tribunal for the Law of the Sea judgment of *The M/V "Saiga" (No. 2) Case (Saint Vincent and the Grenadines v. Guinea)* ITLOS Reports, Judgment of 1 July 1999 (*The M/V "Saiga" Case*) ¶ 83 <https://www.itlos.org/fileadmin/itlos/documents/cases/case_no_2/published/C2-J-1_Jul_99.pdf> See, e.g., William Booth and Amie Ferris-Rotman, *Russia's Suez Canal?* (cited in note 37). The referenced containership which travels from South Korea to Germany could become a Russian-flagged vessel, thereby allowing the ship to avoid the MARPOL requirements whenever traveling in Russian waters until July 2029, and continue other non-Arctic journeys without effect. See also Robyn Dixon, *While the world tore its hair out over the Suez, Russia saw an opportunity*, Washington Post (Mar 29, 2021) (“Nikolai Korchunov, Russia’s envoy for international cooperation in the Arctic, said Friday that the Suez Canal blockage should press the world to look at the [Northern Sea Route] as an alternative. ‘The incident in the Suez Canal should make everyone think about diversifying strategic sea routes amid the increasing scope of sea shipping,’ he said.”) <https://www.washingtonpost.com/world/russia-suez-touts-arctic-sea-route/2021/03/29/576f6794-9097-11eb-aadc-af78701a30ca_story.html> See also subsection 4.1 regarding port State jurisdiction.

¹⁸⁰ See text at note 151. See also 73 Fed Reg 37096, 37134 (June 30, 2008) regarding diesel particulate filter decades-long use in U.S. trucks (“Broad application of catalyzed diesel particulate filter (CDPF) systems with greater than 90 percent PM control began with the successful introduction of 2007 model year heavy duty diesel trucks in the United States.”). For abatement technologies cost comparisons, including use of diesel particulate filters, see IMO Black Carbon Study at 25 § 5.6, 30 § 6.3, and 34 § 6.4.4 (cited in note 70). See also ICCT Black Carbon Report at 51, 53 (cited in note 63).

¹⁸¹ This would operate similarly to MARPOL Annex VI regulations 5 and 8.1, and Appendix I. See MARPOL Annex VI Regulations (cited in note 68).

of maritime shipping.¹⁸² The model law’s phased dates would allow technologies to develop. In addition, it seems possible to mix fuels to meet lifecycle reductions.¹⁸³ Due to the model law’s credit provisions, the percent lifecycle reduction can vary, as more lifecycle reduction than needed could establish a credit, and vice versa.¹⁸⁴

6.2 Renewable Sources

The model law could assist in the development of low-impact renewable energy sources in the United States. For instance, Alaska’s energy sources are not limited to its petroleum reserves. Governor of Alaska, Mike Dunleavy, though known for his support of Alaska’s oil industry,¹⁸⁵ has acknowledged “the reality that our state can no longer be funded solely by oil.” The Governor has cited Alaska’s “unlimited tidal, hydro and geothermal power.”¹⁸⁶ Wind power could also become a significant source of renewable energy.¹⁸⁷ With regard to wave energy,

¹⁸² The model law adapts certain definitions and parts of the framework of the RFS program. The Clean Air Act’s Renewable Fuel Standard (RFS) program specifically excludes “ocean-going vessels.” 42 U.S.C. 7545(o)(1)(L). Also, the RFS program generally focuses on compliance of fuel producers. 42 U.S.C. 7545(o)(2)(A)(iii)(I). In addition, the sole focus of the RFS program is biofuels. 42 U.S.C. 7545(o)(1)(J). The model law also reflects certain requirements from MARPOL (cited in note 145) and APPS (e.g., APPS penalties provision) (cited in note 156). California’s program, and the international aviation program also served as references. See, e.g., California Air Resources Board, *Low Carbon Fuel Standard* <<https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/resources>> For an overview of alternative fuel types, see Environmental Defense Fund, *Exploring the relevance of ICAO’s Sustainable Aviation Fuels framework for the IMO* (June 30, 2020) § 2.5 <https://www.edf.org/sites/default/files/content/Exploring_the_relevance_of_ICAO_SAF_for_the_IMO_July_2020.pdf> Note that more than 500 international climate scientists have requested President Biden and other world leaders refrain from treating the burning of biomass or reduction of forests as a path towards carbon neutrality. Woodwell Climate Research Center, *Letter Regarding Use of Forests for Bioenergy* (Feb 11, 2021) <<https://www.woodwellclimate.org/letter-regarding-use-of-forests-for-bioenergy/>> World Wide Fund for Nature, *500+ scientists tell EU to end tree burning for energy* (Feb 11, 2021) <<https://www.wwf.eu/?uNewsID=2128466>>

¹⁸³ For example, hydrogen can be mixed with conventional fuel. National Renewable Energy Laboratory, Mark Ruth, et al., *The Technical and Economic Potential of the H2@Scale Concept within the United States*, NREL/TP-6A20-77610 (Oct 2020) (*U.S. H2@Scale*) 6 <<https://www.nrel.gov/docs/fy21osti/77610.pdf>>

¹⁸⁴ Norway is establishing a zero-emission zone for ships, including cruise ships, in the waters surrounding its World Heritage fjords, to be effective no later than 2026. United Nations Educational, Scientific and Cultural Organization, *Norwegian parliament adopts zero-emission regulations in World Heritage fjords*, (May 17, 2018) <<https://whc.unesco.org/en/news/1824>> Stortinget, *Climate strategy for 2030 - Norwegian change in European cooperation* (trans), Meld. St. 41 (2016-2017), Innst. 253 S (2017-2018) <<https://www.stortinget.no/no/Saker-og-publikasjoner/Saker/Sak/?p=69170>>

¹⁸⁵ Associated Press, *Alaska Wants to Shun Banks That Don't Fund State Oil and Gas*, U.S. News & World Report (Dec 16, 2020) <<https://www.usnews.com/news/best-states/alaska/articles/2020-12-16/alaska-wants-to-shun-banks-that-dont-fund-state-oil-and-gas>>

¹⁸⁶ Mike Dunleavy, Opinion: *A path forward for Alaska's economy*, Arctic Sounder (Dec 24, 2020) <http://www.thearcticsounder.com/article/2052a_path_forward_for_alaskas_economy> For tidal power, Alaska’s Cook Inlet possesses the second-highest tidal range in North America, with a tidal range of up to 40 feet. U.S. Energy Information Administration, *Hydropower explained: Tidal power* <<https://www.eia.gov/energyexplained/hydropower/tidal-power.php>> As for Alaska’s geothermal resources, the City of Unalaska, located on Unalaska Island in the Aleutian Islands recently entered into a commercial agreement to receive all its needed power from the island’s volcano. Hope McKenney, *City of Unalaska inks purchase agreement for geothermal power*, KTOO television station (Sept 10, 2020) <<https://www.ktoo.org/2020/09/10/city-of-unalaska-inks-purchase-agreement-for-geothermal-power/>>

¹⁸⁷ The U.S. Department of Energy estimates Alaska wind power could offer “the largest gross resource capacity of any state.” U.S. Department of Energy and U.S. Department of the Interior, *National Offshore Wind Strategy* (2016)

“Alaska has one of the strongest wave resources in the world, with parts of the Aleutian Islands coast averaging more than 50 kW per meter of wave front.”¹⁸⁸ This area could become a green hydrogen refueling stop.¹⁸⁹ The Port of Dutch Harbor at Unalaska Island is the sole deep-water port in northern and western Alaska.¹⁹⁰ Decades-long efforts to make the Port of Nome a deep-water port are now closer to fruition as Congress recently authorized funding for the project.¹⁹¹ And the Biden Administration recently created a federal Climate Innovation Working Group “to foster affordable, game-changing technologies” to help achieve the 2050 net-zero goal, and provided an initial \$100 million in funding.¹⁹²

n 17 <<https://www.energy.gov/eere/wind/downloads/national-offshore-wind-strategy-facilitating-development-offshore-wind-industry>> <<https://www.energy.gov/sites/prod/files/2016/09/f33/National-Offshore-Wind-Strategy-report-09082016.pdf>>

¹⁸⁸Renewable Energy Alaska Project, *Ocean and River Hydrokinetic*

<<https://alaskarenewableenergy.org/technologies/ocean-and-river-hydrokinetic/>>

¹⁸⁹ International Council on Clean Transportation, Elise Georgeff, et al, *Liquid hydrogen refueling infrastructure to support a zero-emission U.S.–China container shipping corridor*, Working Paper 2020-24 (Oct 2020)

<<https://theicct.org/sites/default/files/publications/ZEV-port-infra-hydrogren-oct2020.pdf>>

¹⁹⁰ Alaska, Department of Transportation and Public Facilities, *Arctic Port Study*

<<http://dot.alaska.gov/stwdmno/ports/arctic.shtml>>

¹⁹¹ Consolidated Appropriations Act of 2021, Pub L No 116-260, 134 Stat 1182 (2020) §401(1)

<<https://www.congress.gov/bill/116th-congress/house-bill/133/text/enr?q=%7B%22search%22%3A%5B%22%5C%22port+of+nome%5C%22%22%5D%7D&r=1>>

<<https://www.congress.gov/bill/116th-congress/house-bill/133/text/enr?q=%7B%22search%22%3A%5B%22%5C%22port+of+nome%5C%22%22%5D%7D&r=1>> See

also U.S. Army Corps of Engineers, Alaska District, *Corps seeks federal authorization for port expansion project in Nome* <<https://www.poa.usace.army.mil/Media/News-Releases/Article/2202590/corps-seeks-federal-authorization-for-port-expansion-project-in-nome/>> <<https://www.poa.usace.army.mil/Library/Reports-and-Studies/>>

<<https://www.poa.usace.army.mil/Portals/34/docs/civilworks/publicreview/portofnome/FinalNomeIFREA29May20signed.pdf?ver=2020-06-02-192545-533>> Plug-in shore power should also be incorporated to limit emissions of ships at berth in Arctic ports. See, e.g., California Air Resources Board, *Ocean-Going Vessels At Berth Regulation*

<<https://ww2.arb.ca.gov/our-work/programs/ocean-going-vessels-berth-regulation/about>>

¹⁹² See Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, 86 Fed Reg 7619 (Feb 1, 2021) pertaining to the U.S. path to net-zero emissions by 2050. See also The White House, *Biden-Harris Administration Launches American Innovation Effort to Create Jobs and Tackle the Climate Crisis*

<<https://www.whitehouse.gov/briefing-room/statements-releases/2021/02/11/biden-harris-administration-launches-american-innovation-effort-to-create-jobs-and-tackle-the-climate-crisis/>> See also The White House, *Fact Sheet: The American Jobs Plan, Establish the United States as a leader in climate science, innovation, and R&D* (Mar 31, 2021) proposing investment of \$15 billion in demonstration projects. <<https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/>> For industry efforts, see, e.g., *Practical Steps Toward a Carbon-Free Maritime Industry: Updates on Fuels, Ports, and Technology before the Subcommittee on Coast Guard and Maritime Transportation of the House Committee on Transportation and Infrastructure*, 117th Cong, 1st Sess (Apr 15, 2021) (Statement of B. Lee Kindberg, Head of Environment & Sustainability – North America Maersk Line).

<https://transportation.house.gov/committee-activity/hearings/practical-steps-toward-a-carbon-free-maritime-industry_updates-on-fuels-ports-and-technology>

<<https://transportation.house.gov/imo/media/doc/Kindberg%20Testimony1.pdf>>

The IMO recently hosted a virtual symposium on alternative low-carbon and zero-carbon fuels for shipping, made available online. International Maritime Organization, *Symposium on alternative low-carbon and zero-carbon fuels* (Feb 9-10, 2021) <<https://www.imo.org/en/About/Events/Pages/Symposium-alternative-low-carbon-and-zero-carbon-fuels.aspx>>

<<https://www.imo.org/en/About/Events/Pages/Symposium-alternative-low-carbon-and-zero-carbon-fuels.aspx>>

<<https://www.imo.org/en/About/Events/Pages/Symposium-alternative-low-carbon-and-zero-carbon-fuels.aspx>>

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<<https://www.imo.org/en/About/Events/Pages/Symposium-alternative-low-carbon-and-zero-carbon-fuels.aspx>>

7.0 Anticipated Legal Issues

7.1 Divergence from International Cooperation

The United States has remained very involved with the IMO.¹⁹³ It is possible that independent U.S. action using port State jurisdiction could lead to weaker IMO regulations, since there exists the ability for those countries interested in stronger regulations to operate outside the process. And it is possible that unilateral U.S. actions could harm relationships at the Arctic Council by forgoing multilateral solutions.

However, if Congress adopts the model laws to better protect the Arctic, it could help spur other port States, especially Arctic States, to adopt similar laws. It could also lead to IMO action. For instance, it was the U.S. requirement for double-hulled tankers which helped bring about IMO adoption.¹⁹⁴ The European Union in part also operates independently of the IMO with regards to climate issues. Its efforts towards inclusion of international maritime shipping within its emission trading system “may help to concentrate minds to reach an agreement on the short-term measures to implement, however, if not, work is underway for unilateral action from the EU in order to regulate their shipping emissions.”¹⁹⁵

7.2 Use of Port State jurisdiction

U.S. reliance on port State jurisdiction could lead to opposition from the shipping industry for its extra-territorial nature.¹⁹⁶ It could also cause opposition due to the model laws’ required measures. However, the model laws’ port State jurisdiction is based fundamentally on sovereignty.¹⁹⁷ As former U.S. Secretary of State Colin Powell had noted, a State’s acquiescence “does not, as a matter of international law, prohibit Parties from imposing more stringent measures as a condition of entry into their ports or internal waters, unless a particular regulation ... expressly imposes such a limitation.”¹⁹⁸

¹⁹³ See, e.g., Department of Homeland Security, United States Coast Guard USCG, *IMO Homepage* (“The U.S. Coast Guard has been a key participant at the IMO for all policy development since the IMO Convention entered into force over 50 years ago.”) <<https://www.dco.uscg.mil/IMO/International-Maritime-Organization-Sub-committees-HWT/>>

¹⁹⁴ See *Oversight of the U.S. Role in the International Maritime Organization Hearing before the Subcommittee on Coast Guard and Maritime Transportation of the House Committee on Transportation and Infrastructure*, 105th Cong, 2d Sess 15 (1998) 15 (Testimony of Rear Admiral Robert C. North, Assistant Commandant for Marine Safety and Environmental Protection, U.S. Coast Guard) (“Since the late 1970’s, the United States has taken the initiative to improve the international standards for maritime safety and protection of the marine environment... Over the past two decades, most of the vessel design, equipment, and operational standards adopted in IMO instruments have evolved to the point of substantial parity with U.S. requirements.”)

<http://commdocs.house.gov/committees/Trans/hpw105-74.000/hpw105-74_1.HTM> See also Clear Seas Centre for Responsible Marine Shipping, *Double Hulls* <<https://clearseas.org/en/blog/double-hulls/>>

¹⁹⁵ EU Parliament Briefing at 11 (cited in note 99).

¹⁹⁶ See O’Leary and Abbasov, *Let’s end the debate* (cited in note 138).

¹⁹⁷ Id. Churchill, *Port State Jurisdiction* (cited in note 137).

¹⁹⁸ Colin L. Powell, Secretary of State, *Letter of Submittal*, accompanying President George W. Bush, *Message from the President of the United States transmitting Protocol of 1997 to Amend the International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 thereto (hereinafter the "Protocol of 1997")*. *The Protocol of 1997, which would add Annex VI, Regulations for the Prevention of Air Pollution from Ships, to the International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol*

7.3 Penalty Provision

The penalty provision in each of the model laws is based primarily on the APPS penalty provision, since each law in turn addresses maritime shipping.¹⁹⁹ However, the penalty provision in the model laws goes beyond that in APPS. First, the model laws make payment mandatory to persons providing information that leads to conviction under the law.²⁰⁰ Mandatory payment will further incentivize persons to report noncompliance, especially in situations where a person's alternative is remaining silent in order to preserve employment. This mandatory nature is particularly important under the model laws since shipping operations in the Arctic almost by definition occur in remote locations with isolated conditions, and outside of U.S. ports. Finally, to further incentivize compliance, the model laws increase the civil penalty for a fraudulent statement or representation from \$5,000 (as APPS has retained since initial enactment in 1980) to \$25,000.²⁰¹

7.4 Applicability to Seagoing Ships

The administration and enforcement of the model laws is limited to "seagoing ships" in order to maintain partial alignment with those ships subject to MARPOL Annex I under U.S. law.²⁰² Absent the model laws, the MARPOL ban would go into effect one year later, on July 1, 2024,²⁰³ for ships not otherwise subject to exemptions,²⁰⁴ and six years later for those subject to exemptions.²⁰⁵ The model laws thereby serve to accelerate implementation of these MARPOL requirements.²⁰⁶

7.5 Inclusion of Jones Act Ships

The MARPOL Arctic ban would allow waiver of its requirements until 2029 for U.S.-flagged ships operating in U.S. waters.²⁰⁷ A number of these ships would be considered Jones Act ships under U.S. law.²⁰⁸ Yet the model laws do not permit such a waiver in order to apply the port

of 1978 (hereinafter the "MARPOL Convention"), was signed by the United States on December 22, 1998, Letter of Transmittal, Senate, 108th Cong, 1st Sess, Treaty Doc 108-7 (2003) VIII <<https://www.congress.gov/treaty-document/108th-congress/7/document-text>> See also Ex. Rept. 109-13 - Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 Relating Thereto (Treaty Doc. 108-7) S Exec Rep No 109-13 109th Cong, 2nd Sess (2006) <<https://www.congress.gov/congressional-report/109th-congress/executive-report/13/1>> See also APPS, 33 USC 1902(i), 1911, and 1912 (cited in note 156).

¹⁹⁹ See note 156 pertaining to APPS.

²⁰⁰ A similar payment is discretionary under APPS. See APPS, 33 USC § 1908(a) and (b) (cited in note 156).

²⁰¹ See Id 33 USC 1908(b)(2). See Pub L 96-478, §9(b)(2), 94 Stat 2301 (1980).

²⁰² See notes 156 and 166.

²⁰³ MARPOL Annex I regulation 43A.1 (cited in note 175).

²⁰⁴ Id regulation 43A.2. The MARPOL waivers would be limited to U.S.-flagged ships as set forth in subsection 7.5.

²⁰⁵ MARPOL Annex I regulation 43A.2 (cited in note 175).

²⁰⁶ Again, an even better outcome would be an Arctic ban commensurate with the MARPOL Antarctic ban. See subsection 4.3.

²⁰⁷ See subsection 4.3.2. Such a waiver would be allowed under MARPOL Annex I regulation 43A.4 (cited in note 175).

²⁰⁸ The Jones Act is §27 of the Merchant Marine Act of 1920, Pub L No 66-261, 41 Stat 988 (1920), codified at 46 USC § 55102. See Congressional Research Service, *Shipping Under the Jones Act: Legislative and Regulatory Background*, R45725 (Nov 21, 2019) (CRS, Jones Act Report) 3 <<https://fas.org/sgp/crs/misc/R45725.pdf>>

State requirements in a non-discriminatory manner as required by UNCLOS.²⁰⁹ For this reason, as well as for parity and further protection of the Arctic, the model laws would also apply to domestic seagoing ships. Indeed, this could lead Canada to pass laws similar to the model laws, as Canadians tend to be passionate in their view of a Canadian Arctic.²¹⁰

7.6 Ships Switching to Foreign Ports

There could be a possibility of ships switching to foreign ports in order to avoid the fuel cost differential caused by the model laws' requirements. For instance, for cruise ships, the Port of Vancouver in Canada is approximately 150 miles north of the Port of Seattle (a common departure point for Alaska cruises).²¹¹ The Arctic model laws could be modified to include a provision to eliminate the possibility of switching to foreign ports to avoid the model laws' requirements, if deemed necessary.²¹²

7.7 Other Climate Priorities

When Congress is faced with numerous climate priorities, it may choose not to advance laws that seem more removed, which may seem to have a small impact on a global level. Yet part of the need for laws like the Arctic model laws are to help evade the potential of a Blue Arctic.²¹³ And to assist in raising awareness of the critical importance of the top of the world in national and global efforts to address climate change. The wood of the Resolute desk in the Oval Office came from the ship the H.M.S. *Resolute*, which was first abandoned and then found above the Arctic Circle.²¹⁴ The President's signing, leading to the return of the United States to the Paris Agreement, took place at the Resolute desk. There's a connection to maintain.

²⁰⁹ See UNCLOS art 227 (cited in note 122) ("States shall not discriminate in form or in fact against vessels of any other State."). See also Churchill, *Port State Jurisdiction* at 448 (cited in note 137). Additionally, UNCLOS requires each State Party to fulfill its UNCLOS obligations in good faith, and not disabuse its authorities. UNCLOS art 300.

²¹⁰ See, e.g., Danita Catherine Burke, *The Northwest Passage Dispute*, Oxford Research Group (Feb 26, 2018) <<https://www.oxfordresearchgroup.org.uk/blog/the-northwest-passage-dispute>> Texas Archive of the Moving Image, *Passage to Prudhoe* <https://texasarchive.org/2016_04071> See also note 128.

²¹¹ Port of Seattle, *Cruise Seattle* <<https://www.portseattle.org/maritime/cruise>>

²¹² Under laws existing prior to 1920, U.S. shipping companies were able to circumvent a requirement that ships traveling solely between U.S. ports be U.S.-built, crewed and owned. They accomplished this by docking in Vancouver, Canada, and sending cargo from there to the United States by rail. The Jones Act eliminated this practice (by expanding beyond U.S. ports to include transportation "by water, or by land and water, between points in the United States.") Id. 46 USC § 55102(b). See CRS Jones Act Report at 3 (cited in note 208).

²¹³ See subsection 3.1 at note 32.

²¹⁴ White House Historical Association, *Treasures of the White House: "Resolute" Desk*. The ship was abandoned above the Arctic Circle in May 1854, and found above the Arctic Circle in September 1855. Id. <<https://www.whitehousehistory.org/photos/treasures-of-the-white-house-resolute-desk>> The H.M.S. *Resolute* crew had been searching for Sir John Franklin and his ships, lost six years earlier while searching for the Northwest Passage from the Atlantic side on behalf of Great Britain. National Geographic, *How the Discovery of Two Lost Ships Solved an Arctic Mystery* (Apr 15, 2017) <<https://www.nationalgeographic.com/adventure/article/franklin-expedition-ship-watson-ice-ghosts>>