

Briefing 2

Heavy Fuel Oil use in the IMO Polar Code Arctic
Summarized by Ship Type, 2015

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Introduction

The use of heavy fuel oil (HFO) as a marine fuel poses serious environmental and economic risks, especially in ecologically sensitive areas like the Arctic. Using HFO is risky not only because of potential fuel oil spills, but also because burning it produces harmful air and climate pollutants, including black carbon (BC). As ship traffic increases in the Arctic, the risk to the Arctic environment and its peoples will also increase.

The International Council on Clean Transportation (ICCT) has been investigating the use of HFO in the Arctic and the BC emissions that result from it. In 2017, the ICCT published a report titled *Prevalence of Heavy Fuel Oil and Black Carbon in Arctic Shipping, 2015 to 2025*¹ which showed that while less than half of the number of ships in Arctic waters, as defined in the IMO Polar Code, operated on HFO, it represented 76% of the quantity of fuel onboard Arctic ships, since larger ships (with larger fuel tanks) tend to use HFO. The Clean Arctic Alliance, a coalition of environmental non-profit organizations, has used this and other research findings to advocate for an end to the use of HFO in the Arctic. In light of recent advocacy efforts, and as proposed by several IMO Member States, the IMO has agreed to consider ways to reduce the risks of HFO in the Arctic, with the work commencing in 2018.

Many different types of ships operate in Arctic waters. IHS, a company that, among other things, maintains a list of commercial ships and their characteristics, categorizes ships into various categories called “ship classes” which describes, generally, the ship type (e.g., cruise, fishing vessel, general cargo, etc.); thus, for simplicity, we will refer to the IHS ship class designation of a ship as its “ship type.” This briefing paper takes a closer look at the use and carriage (as fuel) of HFO and BC emissions by ships, summarized by ship type. We focus on ships operating in Arctic waters as defined in the IMO’s Polar Code, which we refer to as the “IMO Arctic” (Figure 1).

¹ Comer, B., Olmer, N., Mao, X., Roy, B., and Rutherford, D. (2017). *Prevalence of heavy fuel oil and black carbon in Arctic shipping, 2015 to 2025*. The International Council on Clean Transportation. Available at: <http://www.theicct.org/2015-heavy-fuel-oil-use-and-black-carbon-emissions-from-ships-in-arctic-projections-2020-2025>



Figure 1. The Arctic as defined in the Polar Code (the "IMO Arctic").

Methodology

From a climate perspective, the risks of using HFO as a fuel in the Arctic are related to the amount of HFO consumed, since burning HFO emits climate warming pollutants, including BC. From a spill risk perspective, the risks of using HFO in the Arctic are related to the amount of HFO carried onboard ships in their fuel tanks and the distance HFO-fueled ships sail in Arctic waters.

To analyze the risks of using HFO as a marine fuel in the Arctic we consider the metrics in Table 1 and summarize the results by ship type.

Table 1. Metrics

| Metric | Unit | Description ² |
|-------------------------------|----------------------|------------------------------------------------------|
| HFO used | tonnes | Quantity of HFO a ship burned |
| HFO carried | tonnes | Quantity of HFO a ship had in its bunker fuel tanks |
| Distance-weighted HFO carried | tonne-nautical miles | Product of HFO carriage and distance the ship sailed |
| BC emitted | tonnes | Quantity of BC a ship emitted |

Results

In 2015 in the IMO Arctic, 2,086 ships operated for 2.6 million hours, traveling 10.3 million nautical miles, with 1.1 million tonnes of fuel onboard, collectively, at any given time. These ships consumed 436 thousand tonnes of fuel and emitted 193 tonnes of BC. As shown in Figure 2, 889 of the 2,089 ships, or 42%, operated on HFO in the IMO Arctic in 2015. HFO represented 57% of fuel use by weight, 76% of fuel carried by weight, and 56% of distance-weighted fuel carried. In total, 68% of the 193 tonnes of BC these ships emitted resulted from burning HFO. The appendix contains summary statistics by ship type.

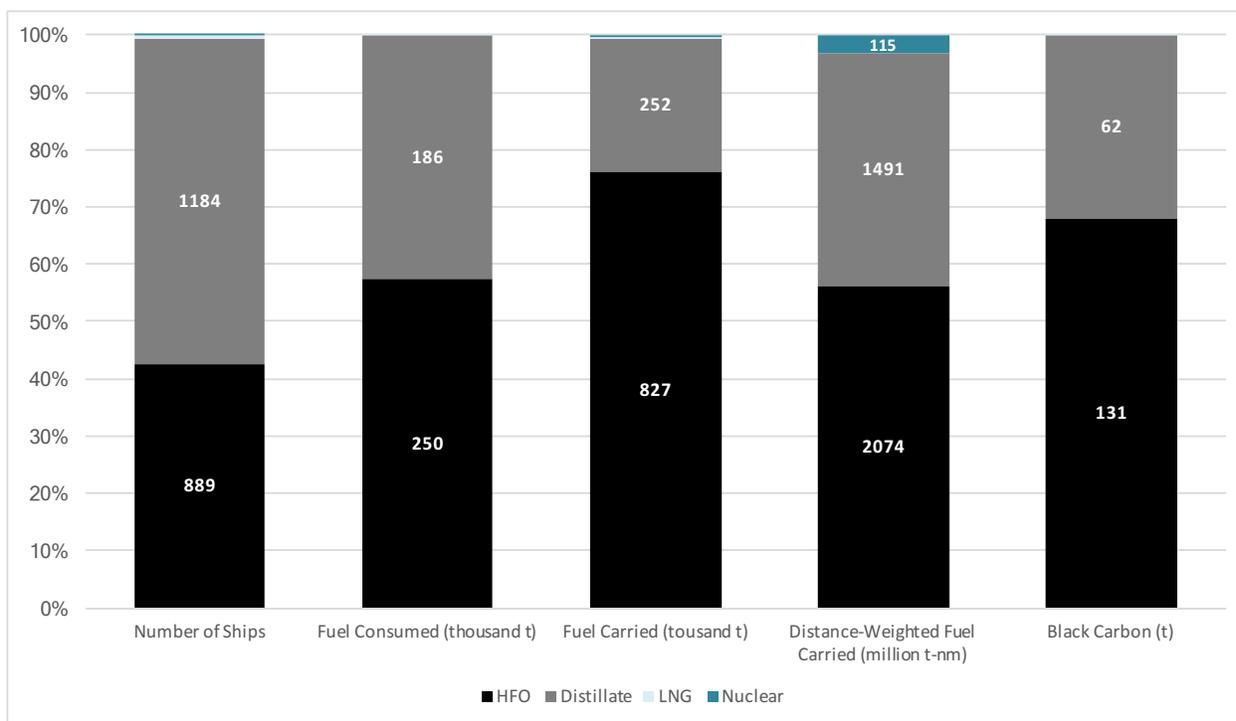


Figure 2. Fuel used, fuel carried, and black carbon emitted in the IMO Arctic, 2015

² Estimated according to the methodology in the report referenced in footnote #1.

As shown in Figure 3, bulk carriers, fishing vessels, and general cargo vessels accounted for the greatest number of HFO-fueled ships in the IMO Arctic in 2015. There were also significant numbers of HFO-fueled chemical tankers, oil tankers, refrigerated bulk carriers, container ships, and cruise ships operating in the region in 2015. These are all relatively large ships (aside from most fishing vessels, which tend to be relatively smaller), with large fuel tanks, operating on HFO in the Arctic.

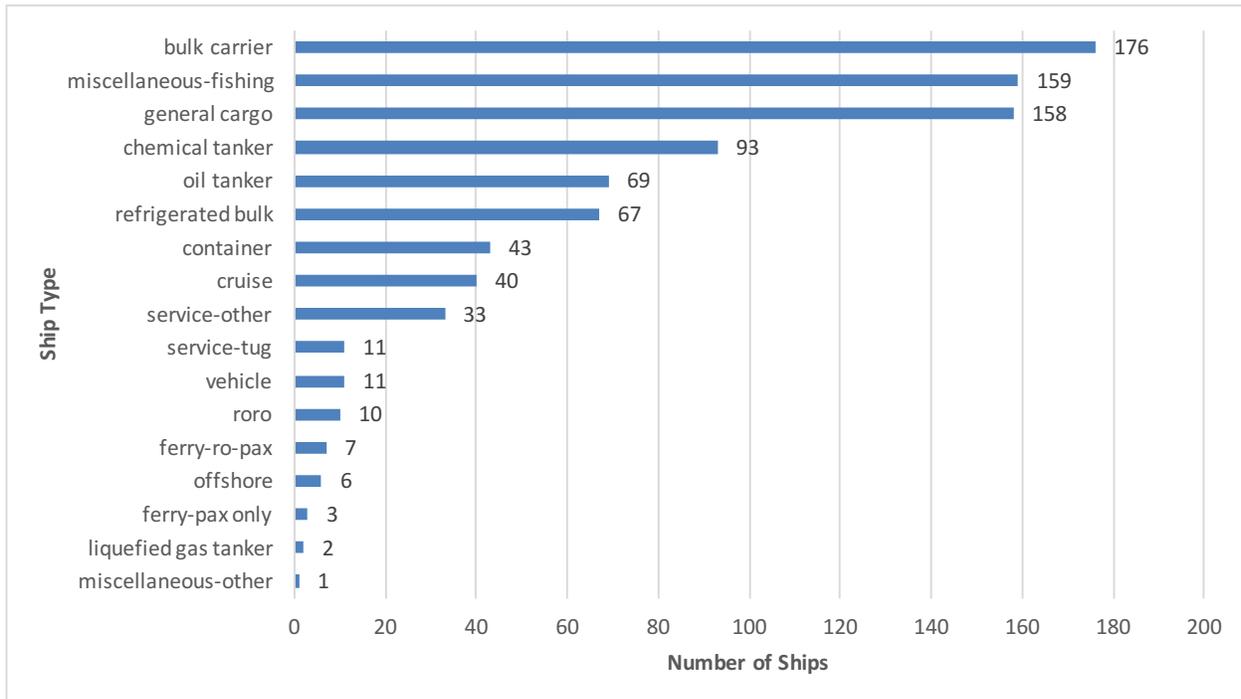


Figure 3. Number of HFO-fueled ships by ship type in the IMO Arctic in 2015.

HFO use and BC emissions

There were 17 ship types operating in the IMO Arctic in 2015. General cargo ships consumed the most HFO in the IMO Arctic in 2015, followed by oil tankers and cruise ships (Figure 4). General cargo ships consumed nearly 66 thousand tonnes of HFO in the IMO Arctic in 2015, emitting approximately 34 tonnes of BC (Figure 5). As such, HFO-fueled general cargo ships accounted for 26% of HFO consumption and 18% of BC emissions from ships in the IMO Arctic in 2015. HFO-fueled general cargo, oil tanker, and cruise ships together consumed nearly 134 thousand tonnes of HFO and emitted 70 tonnes of BC, representing 55% of HFO use and 36% of BC emissions from ships in the IMO Arctic in 2015.

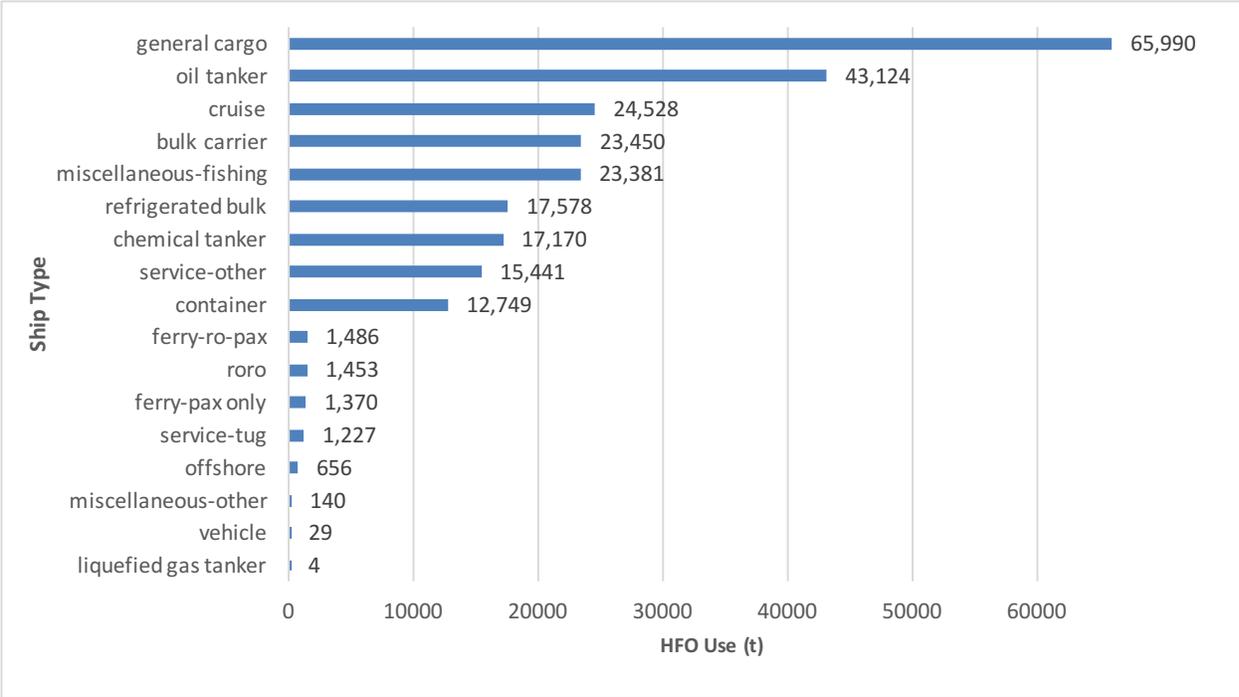


Figure 4. HFO use (t) by ship type in the IMO Arctic, 2015

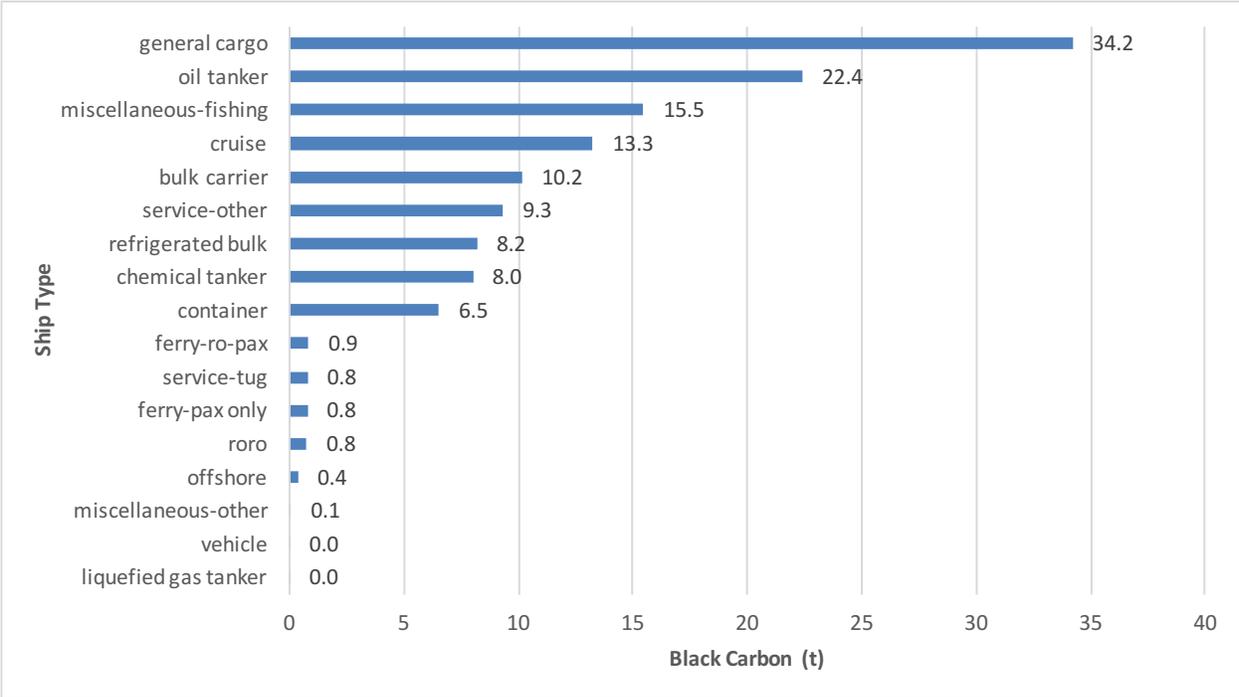


Figure 5. Black carbon emissions (t) from HFO-fueled ships operating in the IMO Arctic, 2015.

HFO Carriage as Fuel

Bulk carriers carried the most HFO onboard as fuel, carrying nearly 248 thousand tonnes of HFO as fuel (Figure 6), equivalent to 30% of HFO fuel onboard ships in the IMO Arctic in 2015. Other large cargo ships (with large fuel tanks) including container ships, oil tankers, and general cargo ships round out the top 4 (Figure 6). Together, bulk carriers, container ships, oil tankers, and general cargo ships carried 66% of HFO as fuel in the IMO Arctic in 2015. Ranked 5th is fishing vessels; as a group, they carry a lot of HFO fuel because there are so many of them operating in the IMO Arctic.

When each ship's fuel carriage is multiplied by the distance it sailed, general cargo ships dominate (Figure 7), followed by oil tankers. Fishing vessels rank 3rd, despite usually having smaller fuel tanks than most cargo ships. This is because fishing vessels are very active in the IMO Arctic. In fact, as a group, fishing vessels covered the most distance in the IMO Arctic in 2015, traveling over 1.2 million nautical miles, ahead of general cargo ships, which sailed nearly 800 thousand miles (see Appendix).

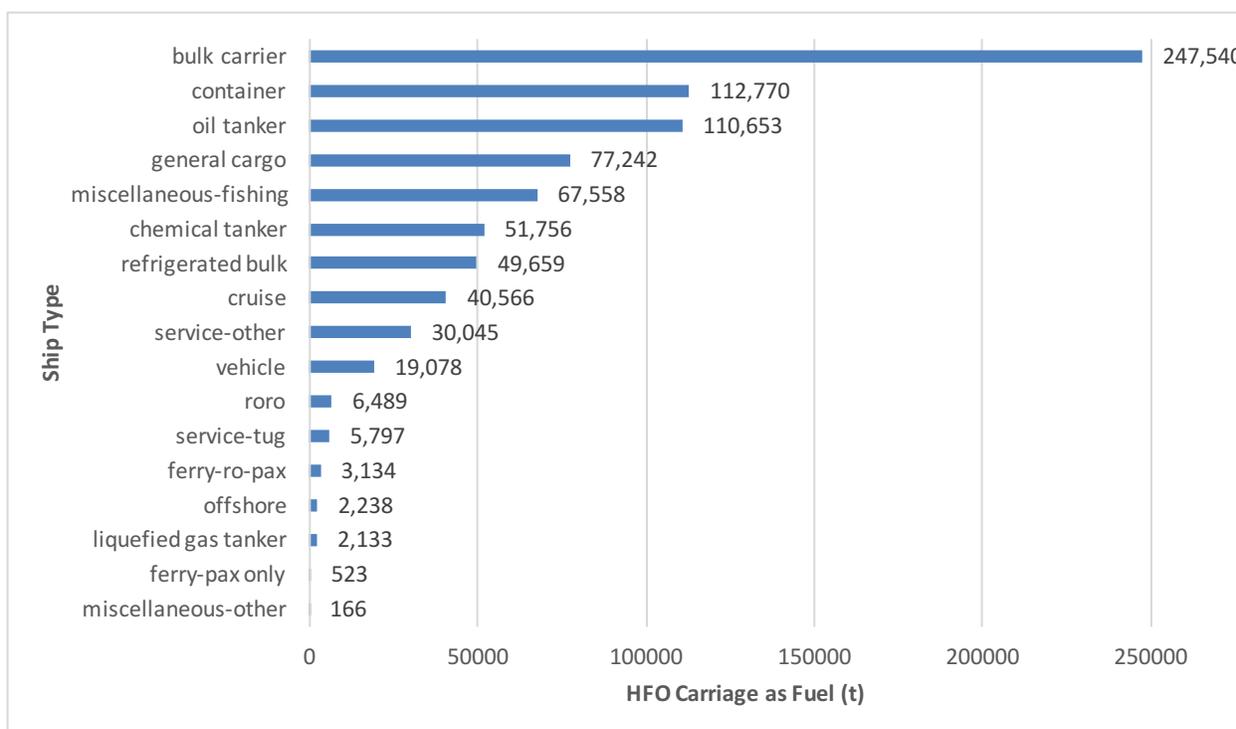


Figure 6. HFO fuel onboard at any given time by ship type in the IMO Arctic, 2015

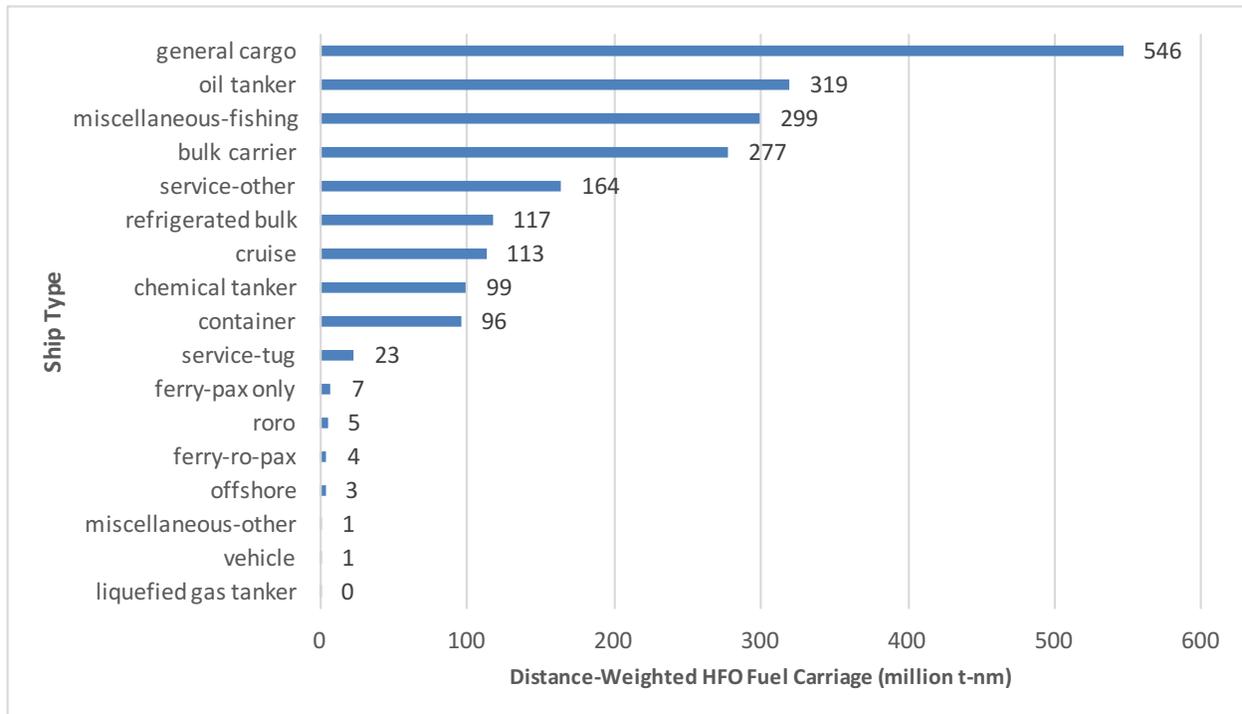


Figure 7. Distance-weighted HFO fuel carriage by ship type in the IMO Arctic, 2015

Conclusions

In 2015 in the IMO Arctic, 889 of 2,086, or 42%, of ships operated on HFO. Moreover, HFO represented 57% of fuel use, 76% of fuel carried, and 56% of distance-weighted fuel carried. Additionally, HFO-fueled ships emitted 131 tonnes of BC in the IMO Arctic in 2015, or 68% of BC emitted from all ships.

General cargo ships used the most HFO (66,000 t) and emitted the most BC (34 t), accounting for 26% of HFO use and 18% of BC emissions from HFO-fueled ships in the IMO Arctic in 2015. Bulk carriers carried the most HFO onboard as fuel, carrying nearly 248 thousand tonnes of HFO, equal to 30% of the HFO as fuel onboard ships in the IMO Arctic in 2015. In terms of distance-weighted HFO carriage, general cargo ships again rose to the top; however, fishing vessels ranked 3rd despite usually having smaller fuel tanks than most cargo ships, reflecting the fact that, as a group, fishing vessels sailed the greatest distance in the IMO Arctic in 2015, more than 1.2 million nautical miles.

From an HFO spill risk perspective, it seems that, at the moment, the greatest threat arises from general cargo ships, oil tankers, fishing vessels, container ships, and bulk carriers, as these ships carry a lot of HFO onboard as fuel, sail long distances through the Arctic while carrying HFO onboard, or both. From a BC perspective, the greatest threats from HFO-fueled ships appear to come from general cargo ships, oil tankers, fishing vessels, cruise ships, and bulk carriers; each emitted more than 10 tonnes of BC in the IMO Arctic in 2015. Given that many of the larger ships that use and carry considerable quantities of HFO and emit substantial amounts

of BC will be flagged to non-Arctic countries, a region-wide policy that applies to the entire Arctic, regardless of flag, would offer the most protection against the risks of HFO.

Appendix

Summary Statistics for HFO-fueled Ships Operating in the IMO Arctic in 2015 by Ship Type

Table A-1: Summary statistics for HFO-fueled ships operating in the IMO Arctic in 2015, by ship type

| Ship Type | Number of Ships | Operating Hours | Distance Traveled (nm) | Fuel Consumed (t) | Fuel Carried (t) | Distance-Weighted Fuel Carried (million t-nm)* | Black Carbon (t) |
|-----------------------|-----------------|-----------------|------------------------|-------------------|------------------|------------------------------------------------|------------------|
| general cargo | 158 | 183,979 | 790,790 | 65,990 | 77,242 | 546 | 34.2 |
| oil tanker | 69 | 58,830 | 275,978 | 43,124 | 110,653 | 319 | 22.4 |
| miscellaneous-fishing | 159 | 299,454 | 1,214,261 | 23,381 | 67,558 | 299 | 15.5 |
| bulk carrier | 176 | 58,132 | 238,577 | 23,450 | 247,540 | 277 | 10.2 |
| service-other | 33 | 52,239 | 202,188 | 15,441 | 30,045 | 164 | 9.3 |
| refrigerated bulk | 67 | 44,792 | 159,036 | 17,578 | 49,659 | 117 | 8.2 |
| cruise | 40 | 19,683 | 163,271 | 24,528 | 40,566 | 113 | 13.3 |
| chemical tanker | 93 | 56,018 | 252,377 | 17,170 | 51,756 | 99 | 8.0 |
| container | 43 | 22,478 | 180,263 | 12,749 | 112,770 | 96 | 6.5 |
| service-tug | 11 | 13,039 | 26,312 | 1,227 | 5,797 | 23 | 0.8 |
| ferry-pax only | 3 | 7,913 | 36,719 | 1,370 | 523 | 7 | 0.8 |
| roro | 10 | 3,297 | 15,871 | 1,453 | 6,489 | 5 | 0.8 |
| ferry-ro-pax | 7 | 2,467 | 18,684 | 1,486 | 3,134 | 4 | 0.9 |
| offshore | 6 | 5,734 | 11,256 | 656 | 2,238 | 3 | 0.4 |
| miscellaneous-other | 1 | 2,658 | 4,508 | 140 | 166 | 1 | 0.1 |
| vehicle | 11 | 27 | 377 | 29 | 19,078 | 1 | <0.1 |
| liquefied gas tanker | 2 | 2 | 32 | 4 | 2,133 | <1 | 0.1 |
| Total | 889 | 830,742 | 3,590,496 | 249,777 | 827,347 | 2,074 | 131 |

*Ordered by distance-weighted fuel carried