

Arctic black carbon emissions from ships: Patterns, trends, and policy options

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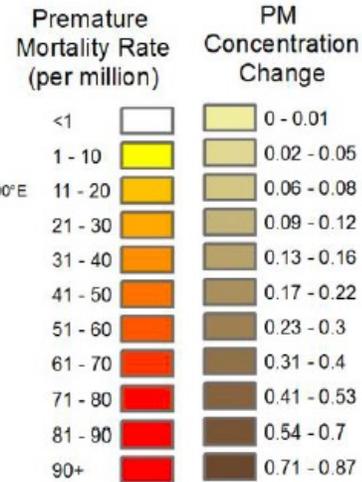
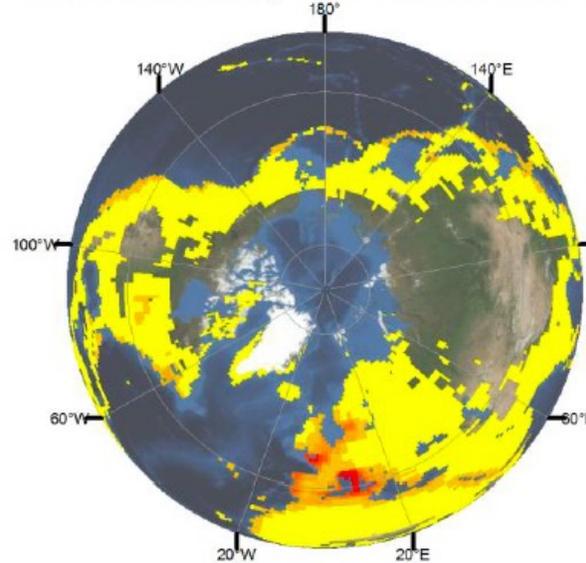
What to expect

Today, I'll do the following:

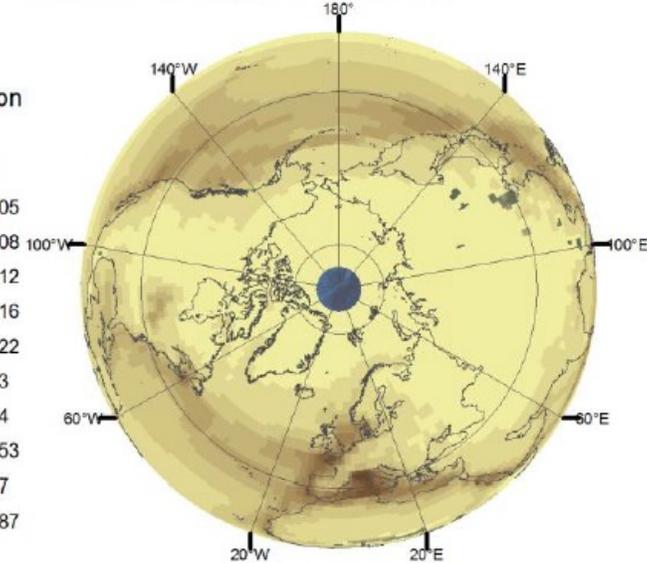
- Explain trends in BC emissions from ships in the Arctic and globally
- Describe the impact of IMO's Arctic HFO ban on BC emissions
- Present the BC emissions reduction potential of switching from HFO to distillates
- Explain the additional benefits of switching to distillates compared to HFO and VLSFO
- End with some conclusions

Black carbon is a climate pollutant and a health hazard

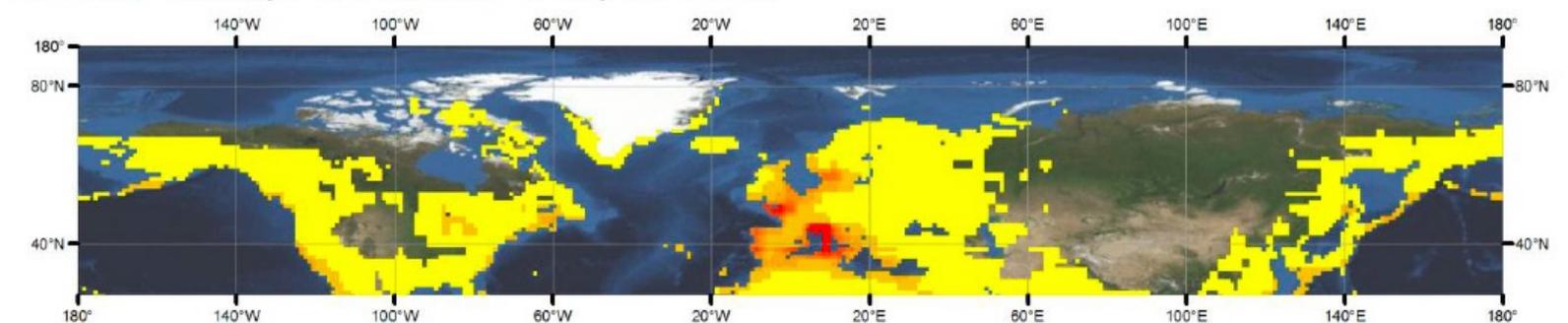
Premature Mortality Rates Attributed to Ship BC & POM



Δ PM due to ship BC and POM



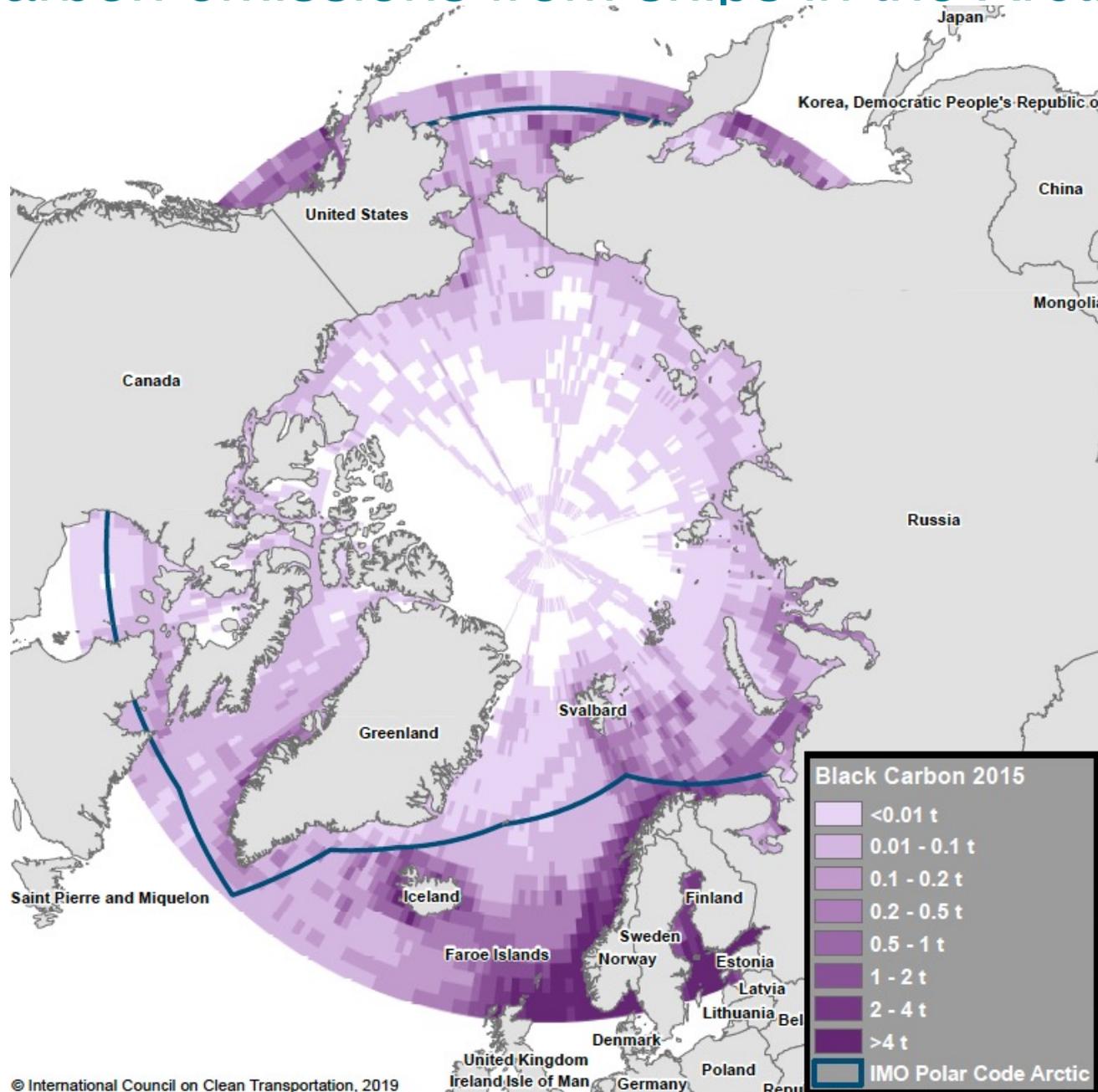
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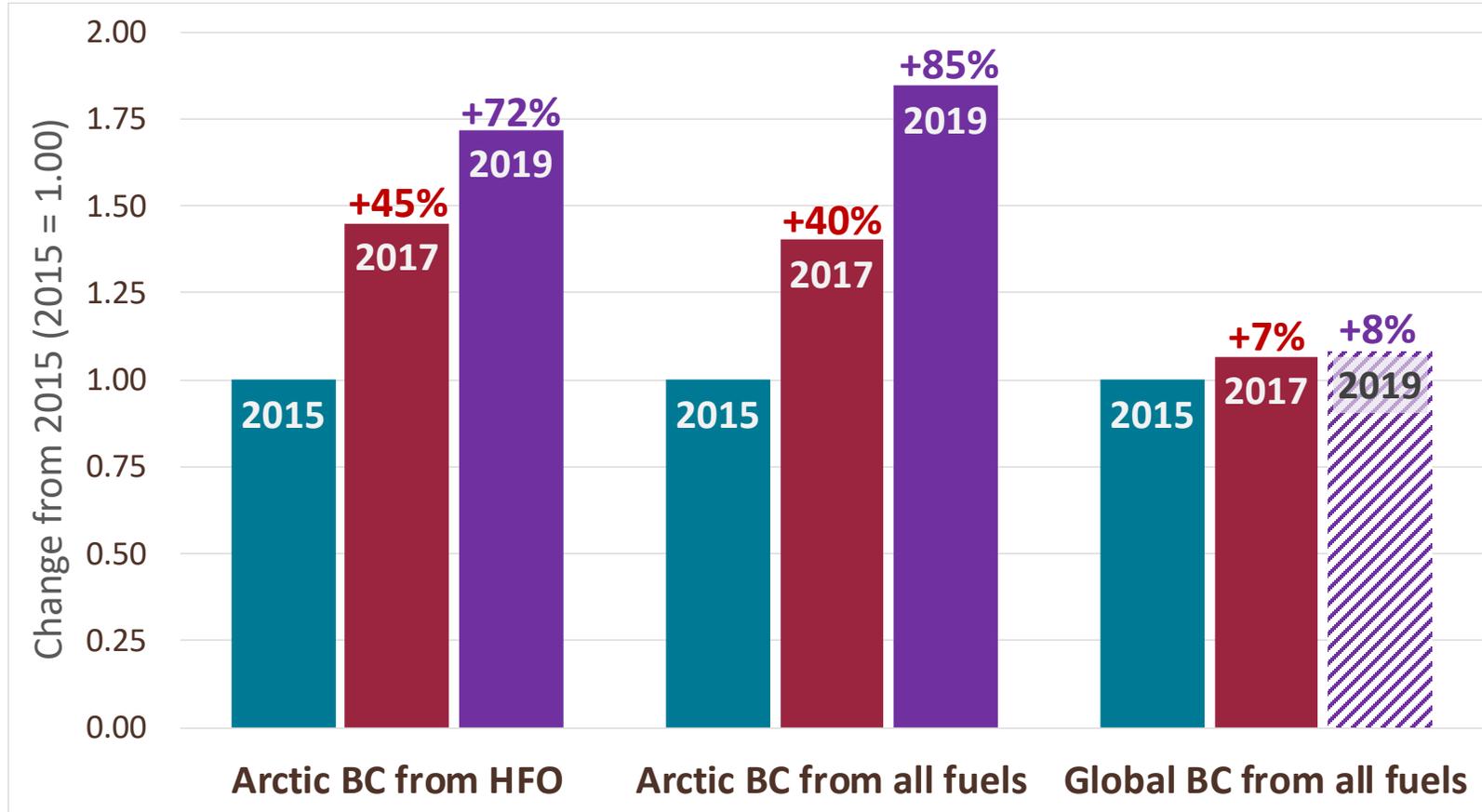
BC and solid particles emitted $>40^{\circ}$ N account for approx. **6200 premature deaths each year**

Black carbon emissions from ships in the Arctic, 2015

1450 tonnes of BC
emitted $>59^{\circ}\text{N}$; including
193 t BC in IMO Arctic



Black carbon emissions from ships in the Arctic and globally relative to 2015



Year	Arctic BC from HFO (t)	Arctic BC from all fuels (t)	Global BC from all fuels (t)
2015	131	193	93,400
2017	190	271	99,700
2019	225	356	101,000

What impact will IMO's Arctic HFO Ban have on BC emissions?

- In November 2020, MEPC 75 approved the HFO ban, which begins in July 2024, but:
 - It only covers the IMO Arctic
 - Ships built after August 2010 are exempt for 5 years because they have protected fuel tanks
 - Russia, USA, Canada, Norway, and Denmark can grant 5-year waivers to their ships in their waters, including their EEZs

2019 Arctic HFO use

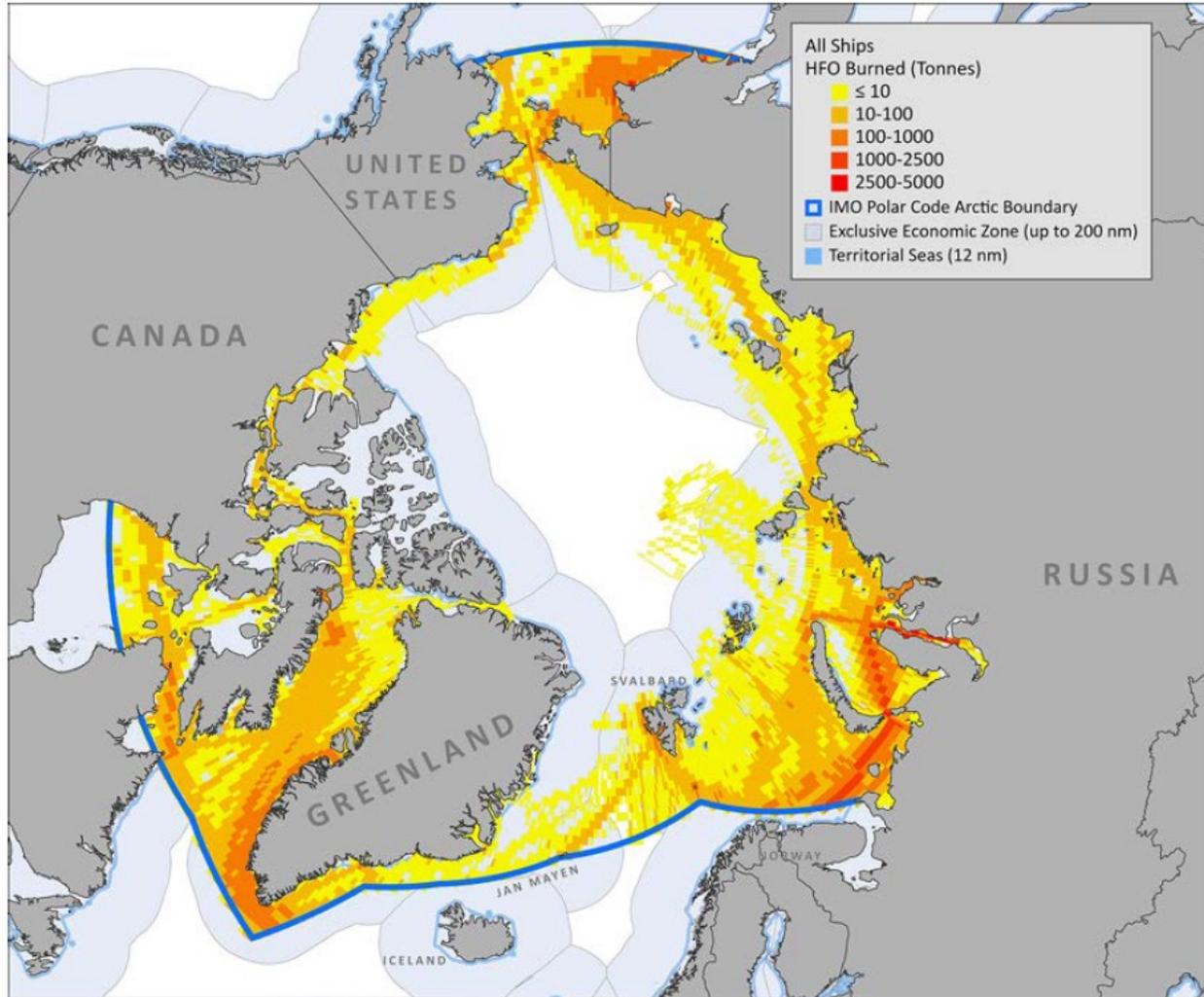


Figure 6. HFO used by ships in the Arctic in 2019

Arctic HFO use remaining under the ban: Due to exemptions and waivers, only 16% of HFO use is banned

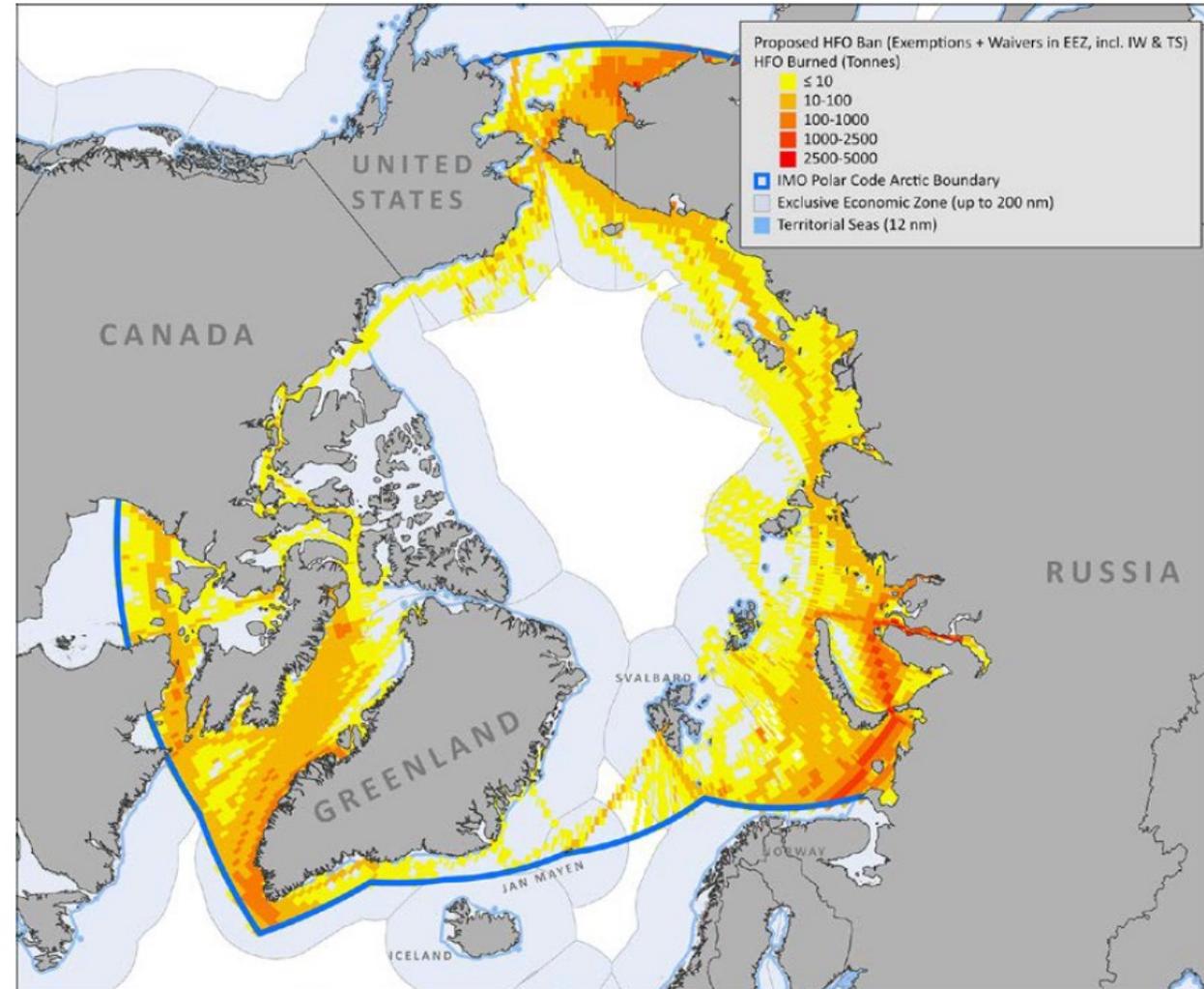


Figure 19. HFO use that would have been allowed under the proposed ban, had it been in place in 2019.

Due to exemptions and waivers, the proposed ban would only eliminate 30% of HFO carriage and 16% of HFO used in the Arctic, reducing BC emissions by just 5%

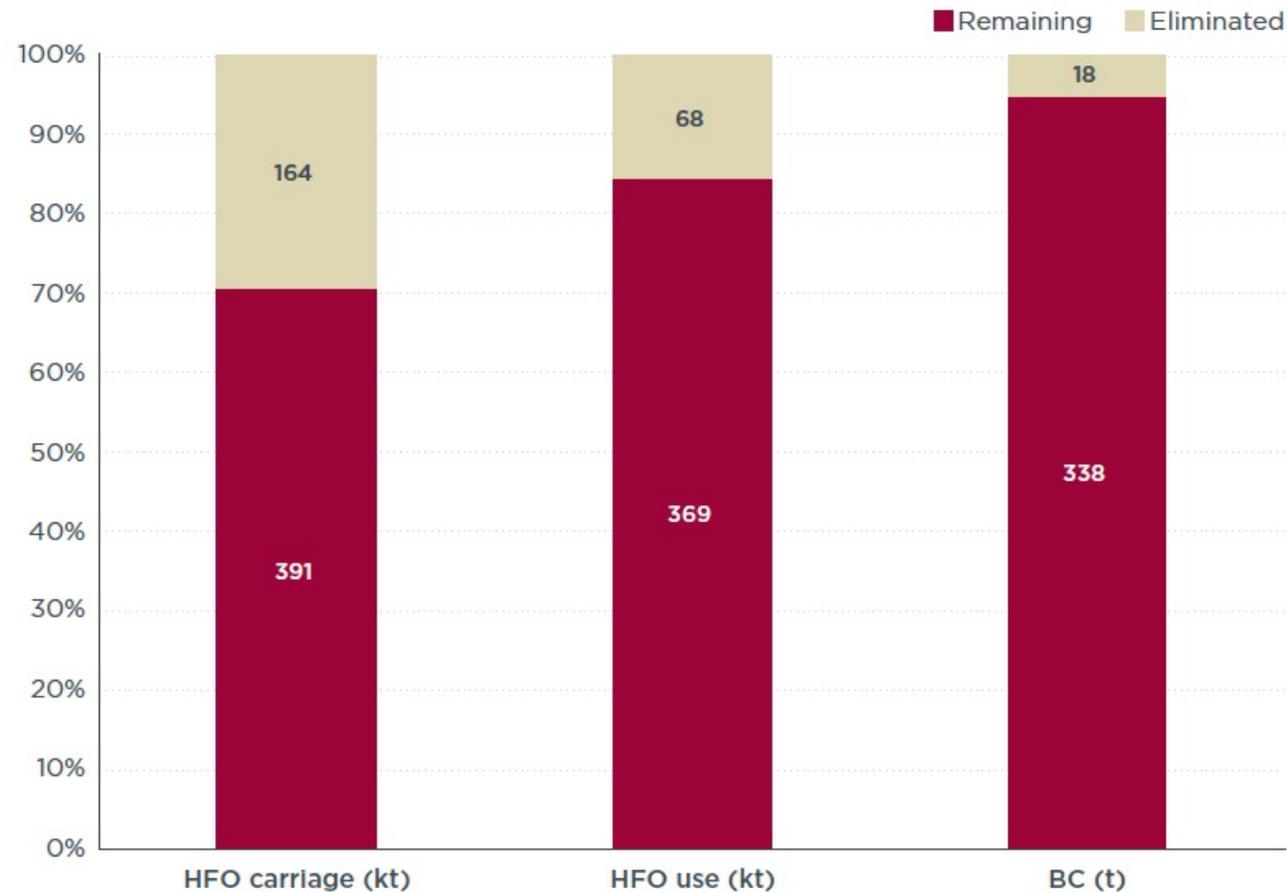
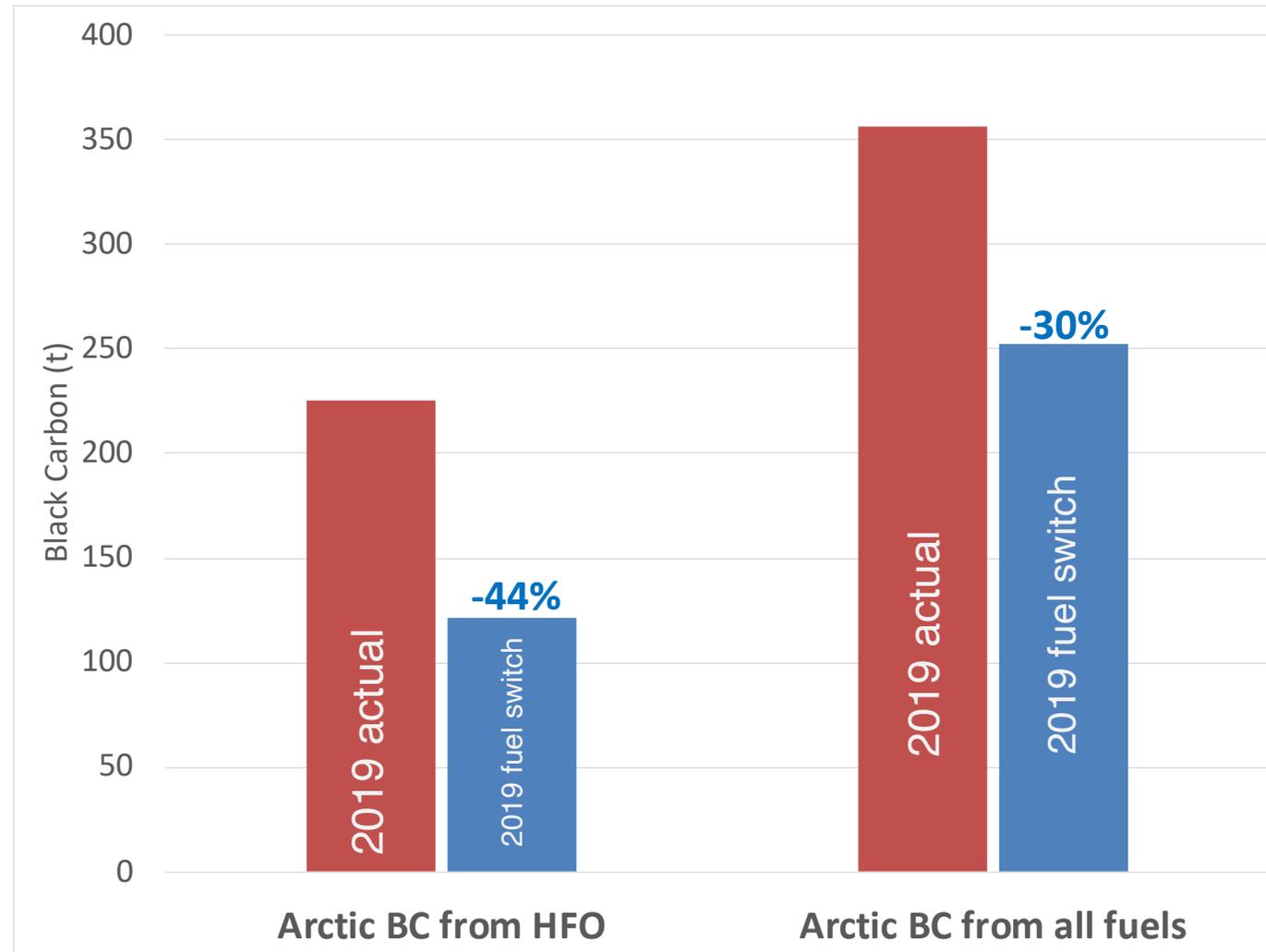


Figure 8. Amount of HFO carriage, HFO use, and BC emissions remaining or eliminated as a consequence of the proposed HFO ban.

Arctic black carbon emissions if HFO-fueled ships switch to distillates, shown in blue (2019 example)



Additional benefits of switching to distillates

- **Lowers air pollution.** Using distillates reduces SO_x, PM, and BC relative to VLSFO and HFO.
- **Enables exhaust aftertreatment:** Using distillates allows for the possibility of using BC after-treatment technologies like diesel particulate filters and electrostatic precipitators. Both reduce BC emissions by >90%.
- **Lowers potential spill costs.** Distillate spills are expected to be 30% less costly than VLSFO and 70% less than HFO.

Sources (in order):

- Comer, B., Georgeff, E., & Osipova, L. *Air emissions and water pollution discharges from ships with scrubbers*. ICCT. Available at <https://theicct.org/publications/air-water-pollution-scrubbers-2020>.
- ICCT (2019). *6th workshop on marine black carbon emissions*. Available at <https://theicct.org/events/6th-workshop-marine-black-carbon-emissions>
- Comer (2019). *Transitioning away from heavy fuel oil in Arctic shipping*. ICCT. Available at <https://theicct.org/publications/transitioning-away-heavy-fuel-oil-arctic-shipping>

Conclusions

- BC is a climate pollutant and a health hazard
- BC emissions from ships are growing globally and even more rapidly (>10x faster) in the Arctic.
- IMO's HFO ban will only reduce Arctic BC emissions by only 5% until exemptions and waivers expire.
- Switching from HFO to distillates would immediately reduce BC emissions from ships. BC emissions from HFO-fueled Arctic ships would fall 44%, reducing Arctic-wide ship emissions 30%.
- Switching to distillates has the added benefits of lowering air pollution, enabling the use of exhaust after-treatment, and lowering potential spill costs compared to VLSFO and HFO.

Thank you for your attention!
Questions or comments?
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