

Expected black carbon emissions reductions from fuel switching

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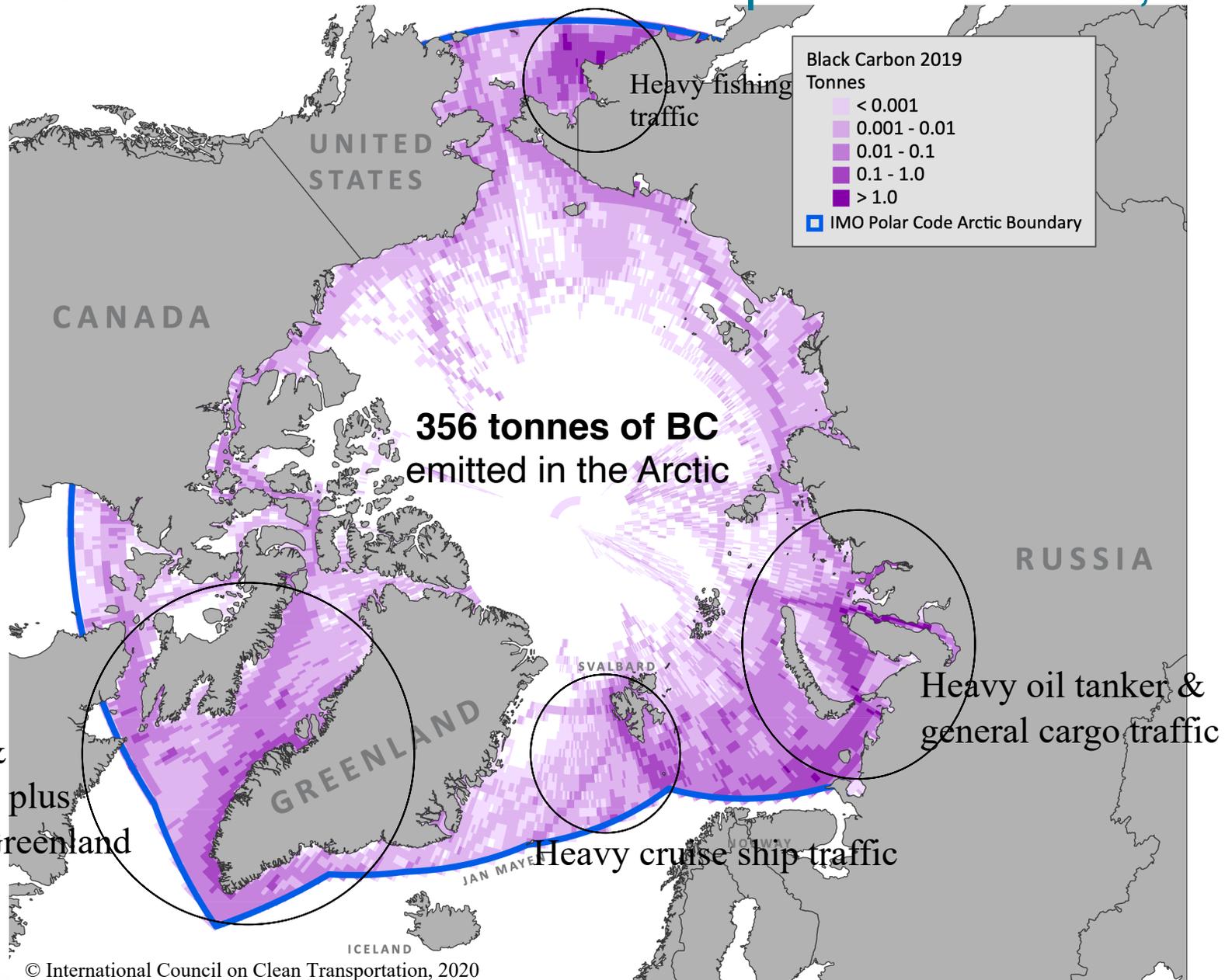
Clean Arctic Alliance PPR 8 Side Event

What to expect

Today, I'll do the following:

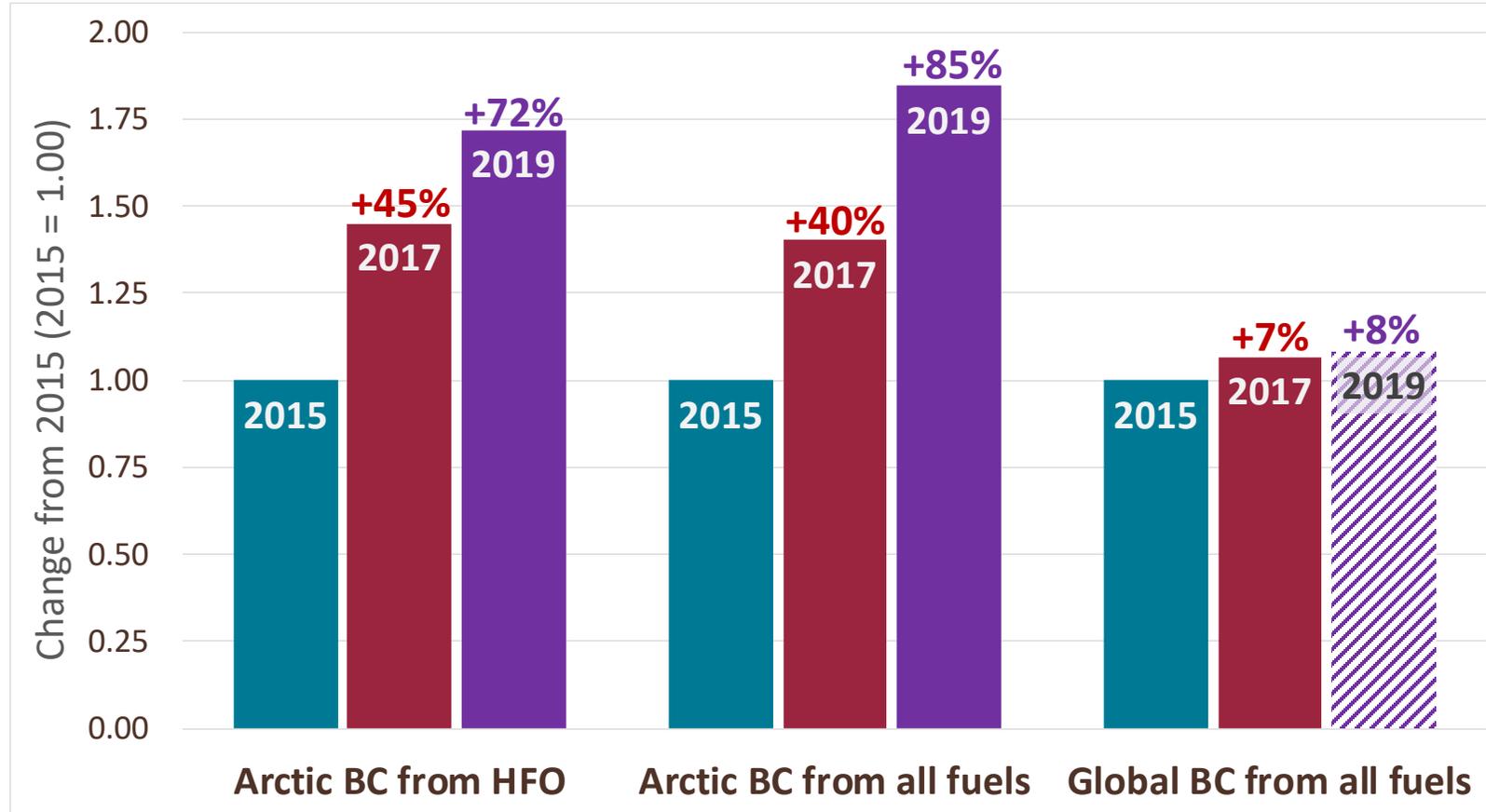
- Explain trends in BC emissions from ships
- Describe the BC emissions reduction potential of switching from HFO to distillates
- Explain why a switch from HFO to distillates, and not VLSFO, is needed for an effective BC control policy
- Explain the additional benefits of switching to distillates compared to HFO and VLSFO
- End with some conclusions

Black carbon emissions from ships in the Arctic, 2019



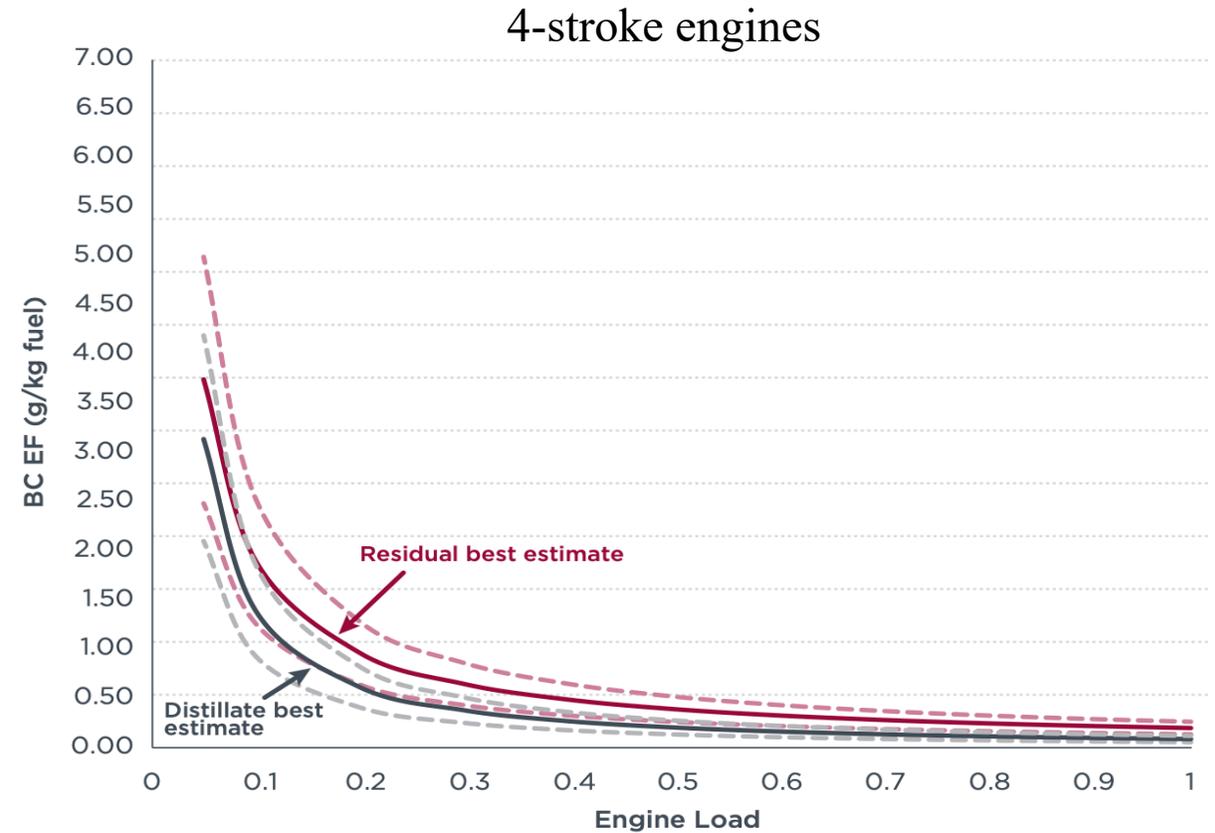
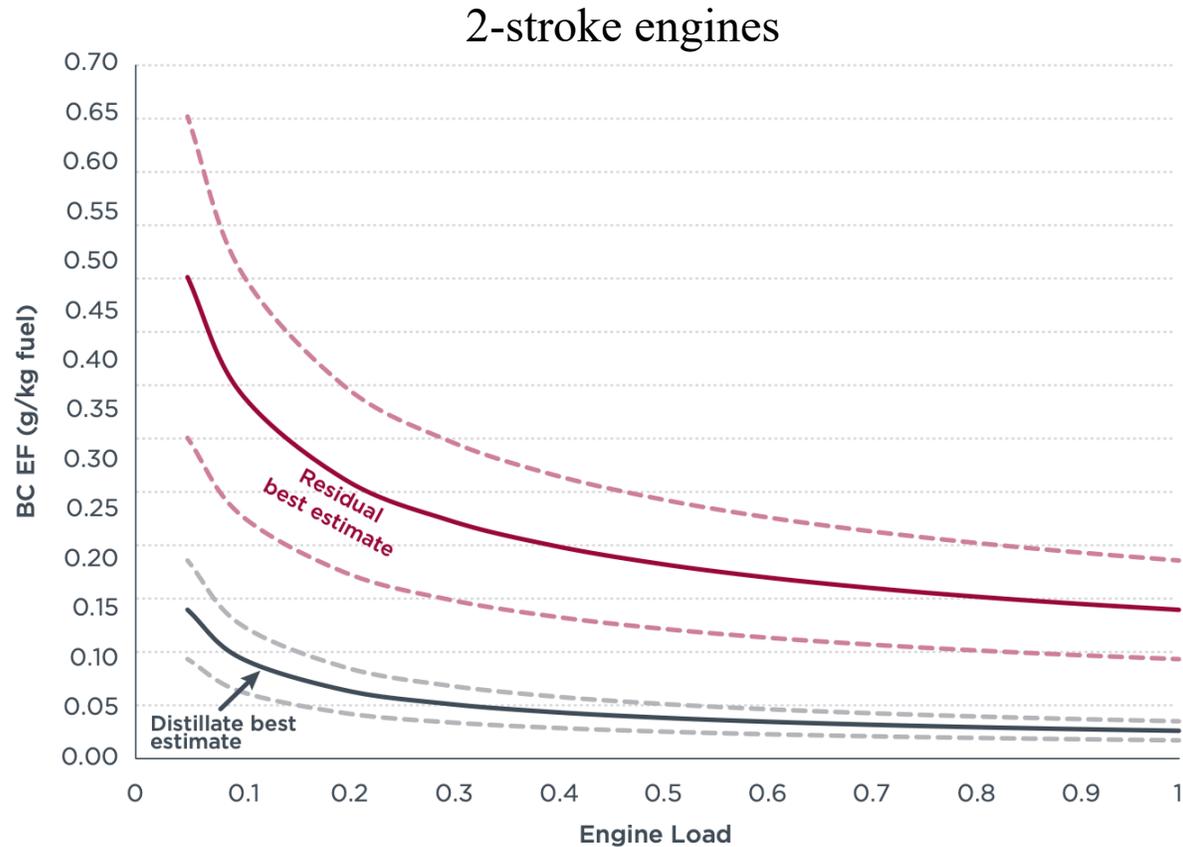
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Black carbon emissions from ships in the Arctic and globally relative to 2015

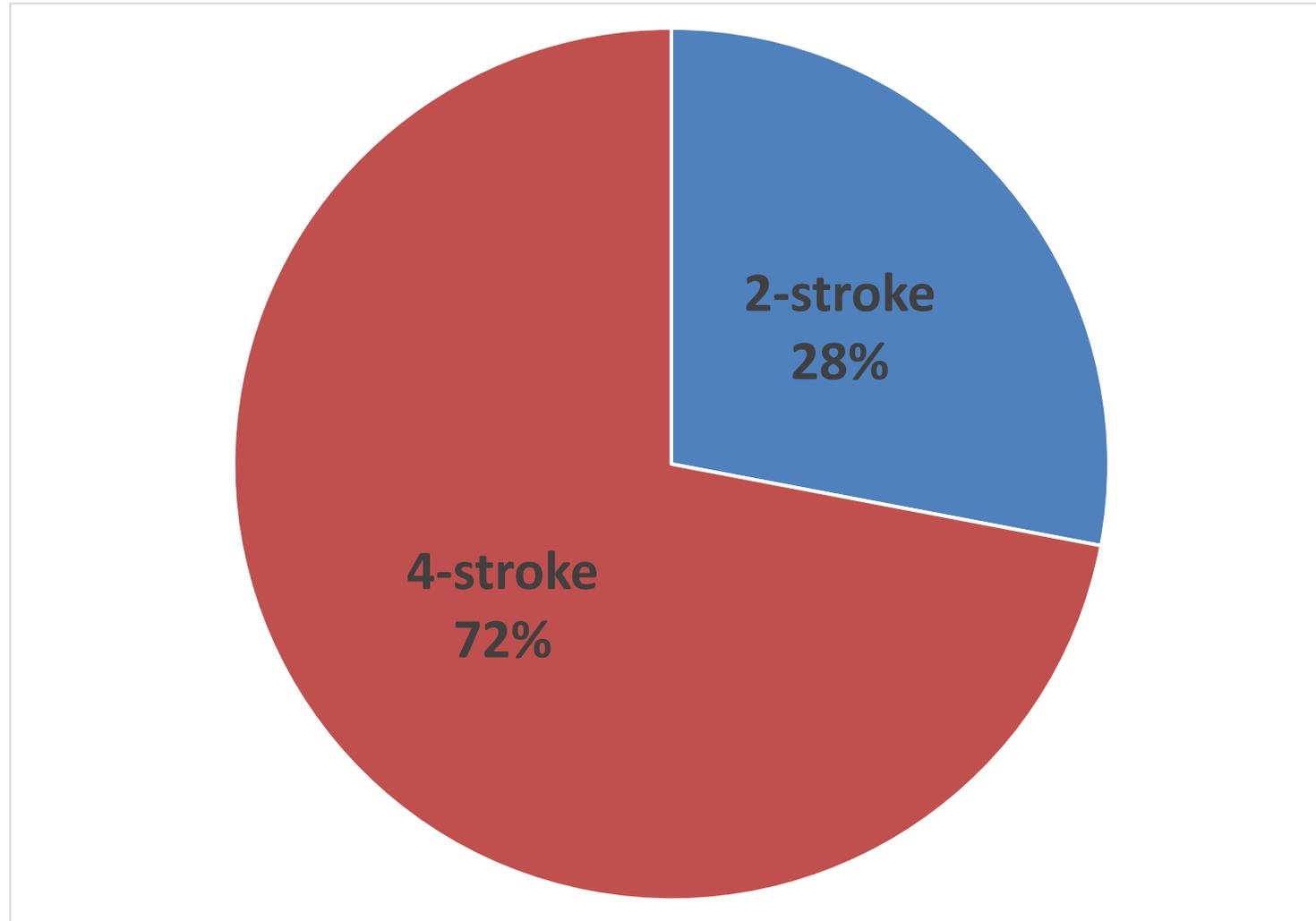


Year	Arctic BC from HFO (t)	Arctic BC from all fuels (t)	Global BC from all fuels (t)
2015	131	193	93,400
2017	190	271	99,700
2019	225	356	101,000

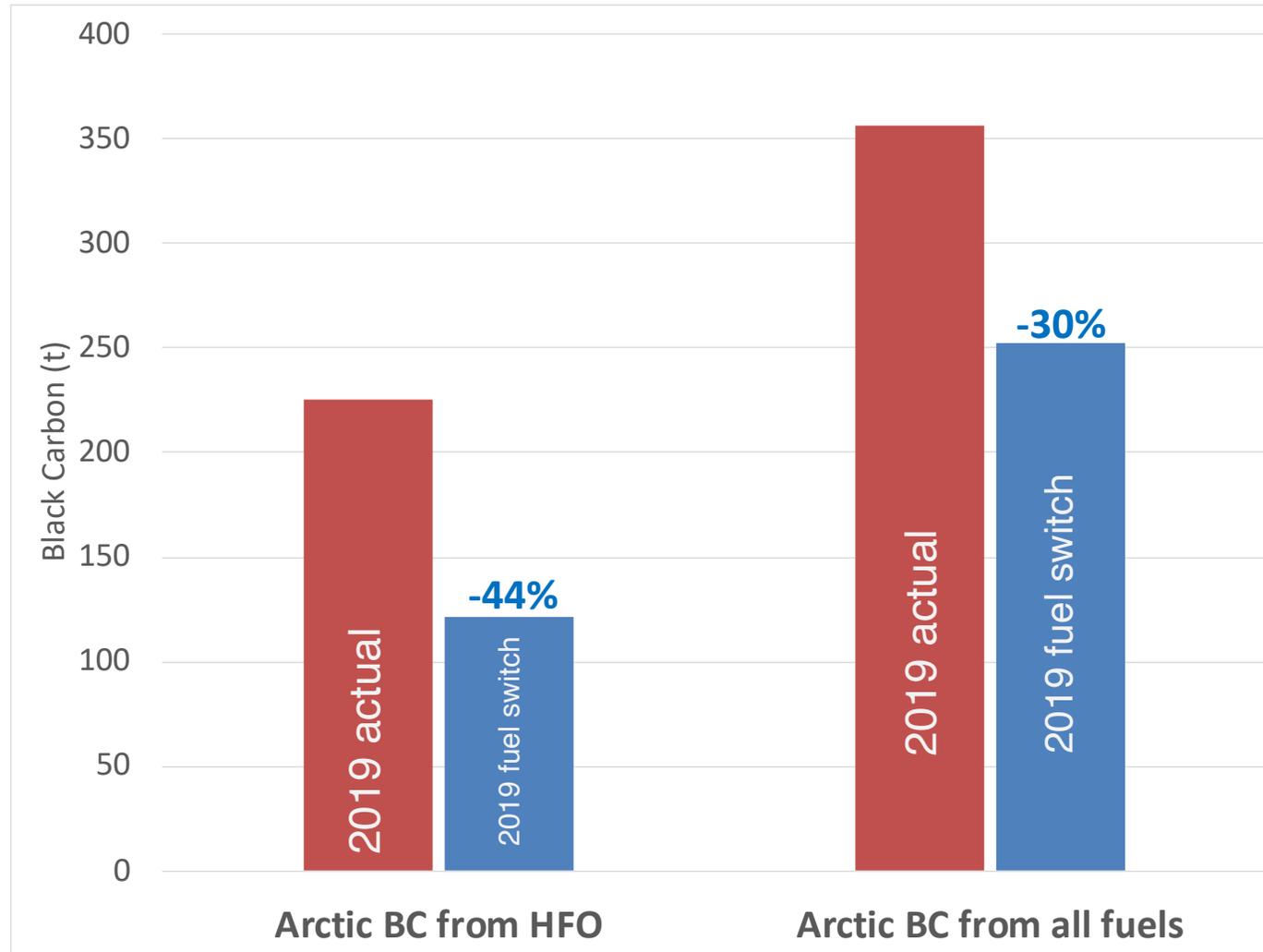
Switching from HFO (residual) to distillates reduces BC about 80% for 2-stroke engines and 40%-50% for 4-stroke engines, depending on load



Arctic HFO use by engine type, 2019



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



Switching to distillate is an “appropriate” Black Carbon control policy

- Participants identified six appropriate BC control policies (in no particular order):
 - BC emissions limit for new ships, globally
 - BC emissions limit for new ships, regionally (e.g., in the Arctic)
 - BC emissions limit for all ships, regionally (e.g., in the Arctic)
 - Modern ship requirement (e.g., prohibit access to the Arctic to higher emitting ships built before a certain date)
 - Shore power mandate (e.g., if shore power is available at port, ships must use it)
 - **HFO ban, with a switch to distillates or other cleaner fuels**

What about VLSFO?

Workshop participants agreed that an HFO ban with a switch to distillates or other cleaner fuels must prohibit VLSFO to be effective as a BC control policy

Potential BC control policies

Target	Policy	Description	Measurement required	Enforceability ¹	Other	Decision
Fuels	HFO ban with a switch to distillates or other cleaner fuels	Use distillates instead of HFO. <u>Do not use very low sulfur fuel oil (VLSFO).</u> Do not use desulfurized residual fuels. Non-residual fuels that emit less BC or no BC would be allowed.	No BC measurement, but fuel samples could be required.	High	1. Bunker delivery note and fuel log inspection would be easier than having to measure a fuel sample as for SECA. 2. Must prohibit fuels with high aromatic / low hydrogen content, <u>prohibit VLSFO, and prohibit desulfurized residual fuels to be effective as a BC control policy.</u>	Appropriate
	Fuel Quality Standard	Promotion of cleaner fuels. Could be an aromatic content limit or a minimum hydrogen content.	No BC measurement, but fuel samples could be required.	Unclear	Potential areas of investigation: aromatic/hydrogen content linked to BC; ISO 8217 revision.	Needs more work

¹ Qualitative scale where High means a policy can be enforced by using or modifying existing verification methods; Medium means that it could be enforced but new verification methods would be needed; Low means that it is difficult to ensure compliance.

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.

Conclusions

- BC emissions from ships are growing globally and even more rapidly (>10x faster) in the Arctic.
- ICCT workshop participants identified six appropriate BC control policies, including switching from HFO to distillates or other cleaner fuels, which does not include VLSFOs.
- 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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