Black Carbon and Maritime Shipping: The Long Road to Regulating a Short-Lived Climate Pollutant

Identifying black carbon’s contribution to maritime emissions and the lengthy process to control it.
If it were a country, the international maritime shipping sector would be the sixth largest greenhouse gas (GHG) emitter, producing more emissions than Germany. In April 2018, the United Nations’ International Maritime Organization (IMO) agreed to an initial climate strategy that aims to cut GHG emissions at least 50% below 2008 levels by 2050.

But, as written, the strategy ignores a pollutant that is second only to carbon dioxide (CO2) in driving global warming: black carbon.

Black carbon is a small, dark particle that is emitted when fuel burns incompletely. It’s about 100-times smaller than the width of a human hair, small enough that it can penetrate deep into the lungs where it contributes to lung and heart disease and early death.

In addition to its health impacts, black carbon is a potent climate forcer. Although as a “short-lived climate pollutant” it stays in the atmosphere for only a few days or weeks, in that short time, it can have a dramatic impact on the climate. Black carbon strongly absorbs sunlight, directly heating the atmosphere. When it falls on snow and ice, it accelerates melt, revealing darker land or water beneath, including in remote regions of the world, like the Arctic.

While there are other sources of black carbon, including land-side transportation, residential heating, and industrial energy use, shipping in and near the Arctic emits black carbon that can deposit directly on sea ice, and icebreakers are the only source that can emit black carbon in the ice pack itself.

**IMO’s Black Carbon Plan**

If black carbon is such a big problem, why isn’t it included in IMO’s GHG strategy? There were two arguments for omitting it. First, during the negotiations, several oil-producing countries argued that black carbon is not a “gas” and therefore it should not be included in a GHG strategy. Presumably, the point of a GHG strategy is to reduce climate pollution in all forms, whether or not it’s a gas or a particle. Black carbon is the second largest contributor to shipping’s climate impacts, representing 7–21% of CO2-equivalent emissions from the global shipping sector on a 100-year and 20-year timeframe, respectively.

The second argument for excluding black carbon from the climate strategy was that IMO is already (slowly) working to decide if it should regulate black carbon emissions from ships.

In 2011, the IMO began considering how it might reduce shipping’s impacts on the Arctic. Back then, the idea was that because black carbon is a short-lived climate pollutant, curbing emissions would provide an immediate climate benefit. But the process has dragged on. IMO’s black carbon work plan involved three initial steps: (1) define black carbon; (2) identify appropriate ways to measure black carbon from ship engines; and (3) identify appropriate ways to control black carbon from ships.

The IMO agreed on a definition of black carbon in 2015, even though black carbon had already been defined in a 2013 peer-reviewed paper authored by 31 leading scientists; in the end, IMO adopted that definition. It took another three years for IMO to agree on appropriate ways to measure black carbon, which it did in 2018. Thankfully, identifying appropriate black carbon control measures took only one year, as IMO just agreed that there are up to 41 appropriate ways to control black carbon from ships, including using cleaner
burning fuels and capturing black carbon in diesel particulate filters, similar to those already used on nearly every diesel truck in the developed world.

Much of the progress in recent years on black carbon can be attributed to dedicated research from marine engine manufacturers, as well as the governments of Canada, Denmark, Finland, Germany, Japan, the Republic of Korea, and the United States. Researchers have presented their results at annual technical workshops convened by my organization, the International Council on Clean Transportation (ICCT). These workshops bring together researchers, scientists, government officials, shipbuilders, engine manufacturers, and civil society to build stakeholder consensus on defining, measuring, and controlling black carbon so that faster progress can be made at the IMO.

Now that the technical work has been done, the political work begins. We know that ships are an important and growing source of black carbon emissions and they’re the only source that can sail to the Arctic and deposit black carbon exactly where you don’t want it: on the snow and ice.

Furthermore, in a recent special report, the Intergovernmental Panel on Climate Change (IPCC) says that black carbon emissions must fall across all sectors at least 35% from 2010 levels by 2050 if we are to have any chance to limit global warming to 1.5 °C.

The Future of Black Carbon Regulation

Given the urgent need to reduce climate pollution from all sectors, will the IMO actually regulate black carbon?

That remains to be seen. We expect IMO delegates to start discussing potential black carbon control policies in 2020. It’s not clear what type of policy IMO member states and organizations will propose. If we look to the past, IMO has regulated fuel quality for all ships, set efficiency requirements for new ships, and limited emissions from new ships. Let’s take a look at some policy options.

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. Other marine fuels, such as liquefied natural gas (LNG), emit nearly zero black carbon, but require specialized LNG-engines and lifecycle methane leakage concerns mean that LNG may solve one problem (black carbon) but exacerbate another (methane). Other alternative fuels, such as methanol, bio-oils, and hydrogen, emit low or zero black carbon, but these fuels are not widely used in the sector because traditional marine fuels are much less expensive; that may change as climate policies emerge.

Efficiency regulations for new ships under IMO’s Energy Efficiency Design Index (EEDI) are expected to continue to become more stringent and, by consequence, new ships will
burn less fuel and emit less black carbon than their predecessors. Eventually, new ship efficiency standards may be so stringent that ships will use low-carbon and zero-carbon fuels that dramatically reduce all types of emissions, including black carbon. But the pace of new ship efficiency improvements and fleet turnover is too slow to rapidly reduce black carbon from the sector.

A black carbon emission standard is another option. The IMO could set a black carbon standard for international ships when operating in particularly sensitive areas such as the Arctic or, given that emissions of black carbon outside the Arctic can affect the Arctic environment, the standard could apply to all ships. Ships could comply by using low-black carbon fuels or aftertreatment technologies such as diesel particulate filters. In the past, IMO has regulated nitrogen oxide emissions from new marine engines. There are no emissions standards that apply retroactively to existing ships. While it would be more politically palatable to regulate engines on new ships, the whole idea of regulating black carbon is to immediately reduce this short-lived climate pollutant. An emission standard would therefore need to apply to at least some portion of the existing fleet to be effective at reducing shipping’s climate impacts and its impacts on the Arctic.

**Summary**

Whatever the outcome, it will be several years until a black carbon control policy takes effect. New regulations require amending an international treaty called the International Convention for the Prevention of Pollution from Ships (MARPOL), and the fastest timeline between proposing an amendment and a new regulation entering into force is nearly two years. If IMO can move quickly, I reckon a black carbon regulation will be in effect by 2023, 12 years after IMO started this process. Better late than never, but we could have taken action much sooner. There can be no more delay. We’ve defined black carbon, we’ve agreed on appropriate ways to measure it, and we’ve identified several good ways to control it. The last step is to act. Here’s hoping for full steam ahead.

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**References**

5. The materials from the most recent workshop are available on the ICCT website at https://www.theicct.org/events/5th-workshop-marine-black-carbon-emissions.
6. 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; IPCC: Geneva, 2018; available online at https://www.ipcc.ch/sr15/.