On Thin Ice: Why black carbon demands urgent action

Arctic shipping is expanding, releasing black carbon — a climate super-pollutant — into the air, which then settles on snow and ice, accelerating dangerous melting. Almost 15 years after pledging action, the U.N.'s maritime shipping body still ignores the simple solution: require ships to immediately switch to cleaner fuels.

PACIFIC ENVIRONMENT

CLEAN ARCTIC ALLIANCE

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JULY 2025

Glossary

AA: Arctic amplification
AHDR Arctic: Arctic Human Development Report-designated geographic area
Albedo effect: the reflection of solar energy from snow and ice
AMOC: Atlantic Meridional Overturning Circulation
ASTD: Arctic Ship Traffic Data system
CO2: Carbon dioxide, a climate pollutant
COPD: chronic obstructive pulmonary disease
DMA and DMZ: marine distillate fuels
DPF: diesel particulate filter
ECA: Emission Control Area
EGCS: Exhaust Gas Cleaning Systems
eNGO: environmental non-governmental organization
EU: European Union
HFO: Heavy fuel oil
ICCT: International Council on Clean Transportation
IMO: International Maritime Organization
ISO: International Organization for Standardization
LNG: Liquefied natural gas
MARPOL Convention: International Convention for the Prevention of Pollution from Ships
MEPC: IMO's Marine Environment Protection Committee
MGO: marine gas oil
MRV: EU Monitoring, Reporting, and Verification system for ship navigation
MT: metric ton
NOx: nitrogen oxides
PM2.5: Fine particulate matter
PPR 13: IMO's 13th Session of the Sub-Committee onPollution Prevention and Response
SECA: Sulfur Emission Control Area
SOx: sulfur oxides
ULSFO: ultra low sulfur fuel oil
VLSFO: very low sulfur fuel oil
VOC: volatile organic compound
WHO: World Health Organization

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Introduction

Time for the IMO to mandate that maritime shipping reduce black carbon in the Arctic

With the Arctic warming at unprecedented and alarming levels, upending global climate systems, the moment has come for action.

The Arctic meltdown has profound implications for global weather patterns, ecosystems and sea level rise, as well as for the Arctic's Indigenous peoples and wildlife.

One major cause of the accelerated Arctic warming is black carbon, a super-pollutant characterized mainly by its high degree of warming potential as a powerful "short-lived climate forcer" — small particles with a relatively brief lifespan in the atmosphere compared to long-lived greenhouse gases like carbon dioxide (CO_2). Cutting black carbon emissions will result in immediate climate benefits that slow warming in the Arctic and improve public health.

By mandating a swift transition to distillates and other cleaner fuels, the International Maritime Organization (IMO) can enact a high-impact policy that achieves immediate benefits and reduces black carbon in the Arctic.

Black carbon has a warming impact up to 1,500 times greater than that of CO_2 per unit of mass. When released in the Arctic, its impact is amplified by the loss of the albedo effect — the reflection of solar energy — due to the melting of snow and ice.

International maritime shipping is one of the big emitters of greenhouse gases and, by consuming residuals (the dirtiest of all transport fuels), is also a major source of black carbon.

Action needed

A rapid, large-scale reduction of black carbon emissions from ships in the Arctic can be practically and quickly accomplished by mandating a switch away from highly-polluting residual fuels to marine distillates or other cleaner fuels. To address the scale and urgency of the problem, the switch needs to be mandatory for all ships operating in the Arctic, as calls for voluntary action by ships have been ineffective.

IMO member states should immediately act to reduce black carbon emissions in the Arctic by enacting a mandatory amendment to the International Convention for the Prevention of Pollution from Ships (MARPOL) requiring ships to use cleaner fuels in the Arctic.

MARPOL regulated air pollutants in 2008 by limiting fuel sulfur levels that cut sulfur dioxide emissions and associated particulate matter (PM), but did not regulate black carbon, the climate warming component of PM. IMO action to do so is now long overdue.

When the IMO Pollution, Prevention and Response 13 Sub-Committee (PPR13) meets Feb. 9-13, 2026, it must act to protect the Arctic by recommending a mandatory switch from residual fuels to "polar fuels" such as cleaner distillates, in support of a Treaty decision later in 2026.

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Edward Carr (Energy & Environmental Research Associates) contributed to the section on the status of fuel prices and trends.

Executive **summary**

The Arctic is warming three to four times faster than the global average, driven in part by accelerating black carbon emissions from shipping. Black carbon — a potent, short-lived climate pollutant with a warming impact up to 1,500 times greater than that of carbon dioxide (CO2) per unit of mass — darkens snow and ice, triggering feedback loops that amplify regional melt and contribute to global sea level rise and disrupted weather patterns leading to more frequent and intense extreme weather events like heat waves, droughts, floods and storms. Black carbon also poses acute health risks and compounds threats to food security for Indigenous and coastal communities reliant on local subsistence resources.

Despite more than a decade of technical work at the International Maritime Organization (IMO), black carbon from Arctic maritime shipping remains unregulated, with only a voluntary resolution and guidance in place. **Immediate, mandatory action to switch vessels operating in and near the Arctic to cleaner "polar fuels," such as marine distillates DMA and DMZ, offers a ready solution to "slam the emergency brake" on Arctic warming and protect the marine environment and human health.**

This report examines the sources, environmental and health impacts and policy gaps surrounding black carbon emissions from Arctic shipping and makes the case for immediate action to reduce black carbon emissions from Arctic shipping.

Key takeaways

Sources and trends of black carbon

- At any given moment, more than 100,000 merchant ships are crossing the oceans. These ships move 90% of world trade, burn the world's dirtiest fossil fuels and emit more than 1 billion metric tons of climate pollution a year and rising, making the industry one of the world's top climate polluters.
- In addition to emitting carbon dioxide, maritime shipping emits black carbon, which in the Arctic is a major contributor to rapid sea ice decline.
- Between 2015 and 2021, Arctic shipping-related black carbon emissions approximately doubled. Globally, roughly 20% of shipping's total climate forcing is from black carbon.
- The rapid retreat of Arctic sea ice is unlocking new Arctic shipping corridors such as the Northwest Passage and Transpolar Sea Route while also extending the season

of the Northern Sea Route, heightening the risk of maritime accidents, oil spills and harmful emissions — threatening human health, ecosystems and coastal livelihoods.

- Increased shipping traffic in the Arctic, especially from vessels burning residual fuel (the most commonly-used shipping fuel), is driving more emissions and air pollution. When combusted, residual fuels produce higher concentrations of black carbon and other hazardous pollutants, contributing to more intensive regional warming with global climate repercussions.

Climate impacts

- Per unit of mass, black carbon has a warming impact up to 1,500 times greater than that of CO_2.

- Black carbon has an outsized impact in the Arctic, heating the atmosphere and accelerating snow and ice melt. This exposes darker land and water surfaces that absorb more heat, amplifying warming and diminishing the region's reflective albedo effect.

- Darkened surfaces absorb more solar radiation, accelerating melt and freshwater runoff from glaciers into the oceans. Glacier melt and sea ice decline can disrupt major ocean currents — such as the Atlantic Meridional Overturning Circulation (AMOC) — with cascading effects on weather patterns in the mid-latitudes.

- Disruptions extend beyond the Arctic, with research linking Arctic sea ice loss to shifts in summer monsoons in India, warmer atmospheric temperatures in Central and East Asia and anomalous cold fronts in North America. Accelerated Greenland ice cap melting also contributes to global sea level rise, threatening low-lying coastal and island communities worldwide.

Human health risks and community impacts

- Beyond its climate impacts, black carbon is a component of fine particulate matter ($PM_{2.5}$) and poses acute public health risks. Inhalation of black carbon-laden air increases rates of cardiovascular disease, respiratory illness and premature mortality.

- In the Arctic, where communities rely on local subsistence hunting and fishing, increased black carbon and associated pollutants degrade air quality, impact traditional food sources through loss of sea ice and exacerbate existing health disparities among Indigenous and remote populations.

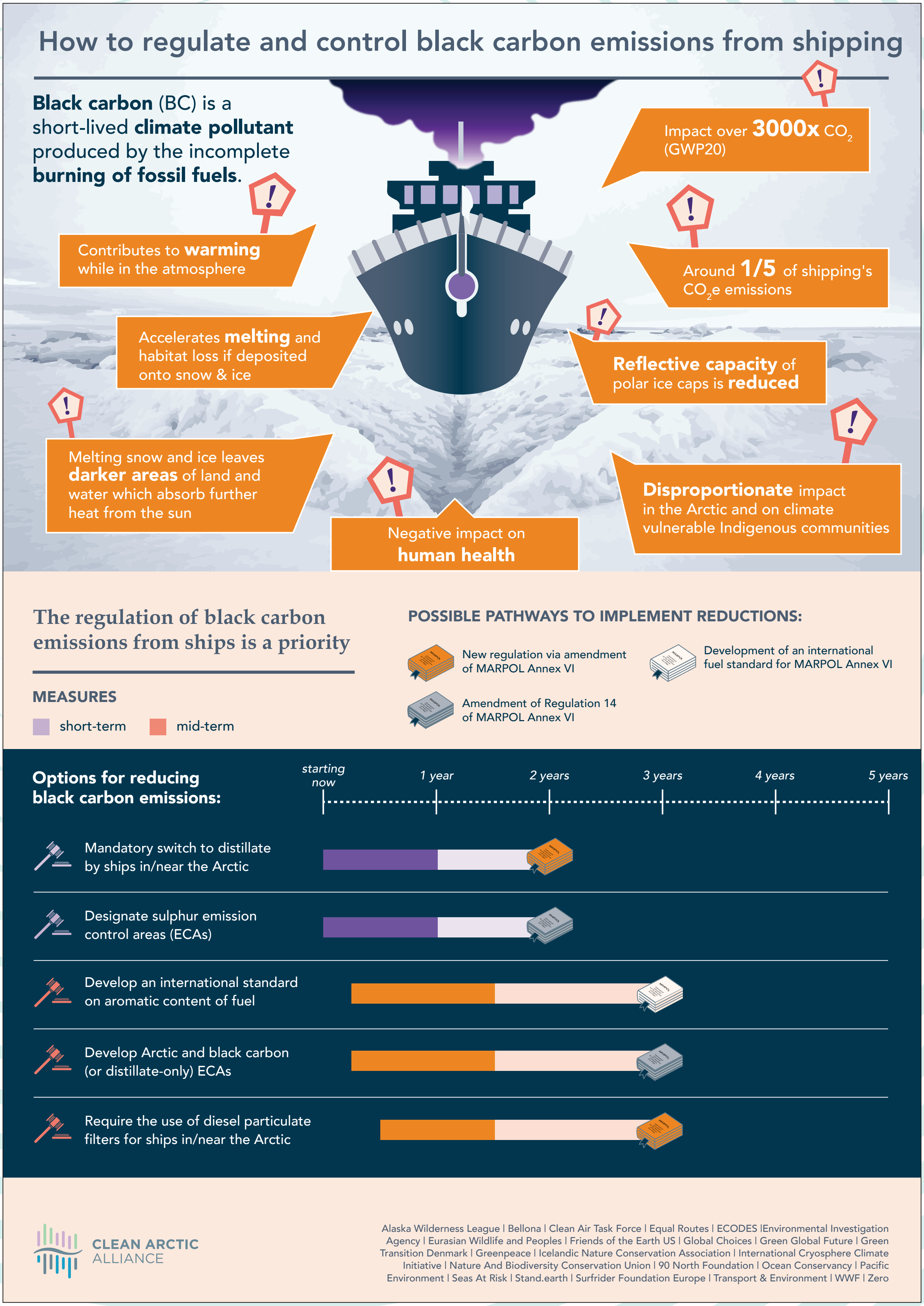
Regulatory landscape

- Despite over a decade of debate, technical assessments and calls for voluntary measures at the IMO, black carbon emissions from Arctic shipping continue their unregulated growth. Absent mandatory requirements, markets lack the certainty needed to shift fleet operations toward options that emit less black carbon.

Recommendations

- Unchecked black carbon emissions from Arctic shipping represent a clear and present danger to the integrity of the Arctic cryosphere, global climate stability and the health and well-being of Arctic Indigenous and coastal communities. By mandating a swift transition to "polar fuels," the IMO can enact a high-impact policy that achieves immediate benefits. The IMO's Pollution Prevention and Response 13 Sub-Committee (PPR 13) meeting in February 2026 has the opportunity to help arrest Arctic warming and uphold the IMO's mandate to protect the marine environment and adjacent communities.

- The mandate to use cleaner fuels should apply throughout the sea areas encompassed by the Arctic Human Development Report-designated geographic area (AHDR Arctic), which was defined in a process led by the Arctic Council. The requirement should be enacted via a mandatory MARPOL Convention amendment requiring ships to switch from residual to polar fuels, such as cleaner distillates, in support of a Treaty decision later in 2026.



https://cleanarctic.org/2025/01/23/infographic-how-to-regulation-and-control-black-carbon-emissions-from-shipping/

Overview

The Arctic is undergoing rapid climate change, with temperatures rising three to four times faster than the global average (Arctic Council, 2025; Osipova & Gore, 2025). One of the major contributors to Arctic warming is black carbon — a potent yet short-lived “super-pollutant” that accelerates climate change and degrades air quality. Black carbon, also known as soot, is the product of incomplete combustion of fossil fuels and biomass. An important growing source of black carbon emissions is maritime shipping.

After carbon dioxide, black carbon is considered the second largest shipping-related contributor to global warming and one of the primary causes of rapid sea ice decline (Comer et al., 2017; Zhang et al., 2019).

Emitted by maritime ships that burn fossil fuels, black carbon makes up one-fifth of international shipping’s global climate impact. When released in the Arctic, the impact of black carbon is amplified by an almost five times larger surface temperature response (per unit of emitted mass) compared to midlatitude black carbon emissions due to the accelerated loss of the albedo effect — the reflection of solar energy from snow and ice (Sand et al., 2013). As these reflective surfaces melt, darker land and water are exposed, absorbing more heat and further intensifying regional warming.

In addition, the retreat of Arctic sea ice is opening new shipping lanes and extending the months in which shipping is feasible. Increased shipping traffic is driving up emissions from vessels burning residual fuel, the most commonly-used shipping fuel. Residuals comprise the leftover product after higher quality hydrocarbons including lighter marine distillates have been extracted in refineries from crude oil. Heavy Fuel Oil (HFO) is tar-like and, as with lower sulfur residual fuels, needs to be heated. Marine distillates have lower viscosity, burn more cleanly, produce fewer emissions and, being more refined, cost more.

When combusted, residual fuels produce high concentrations of black carbon and other hazardous pollutants, contributing to intensified regional warming in the Arctic with global climate repercussions (Arctic Council, 2021). If spilled, this highly viscous oil can persist for weeks in cold waters or become trapped within and beneath sea ice, posing long-term threats to marine ecosystems and shorelines while complicating cleanup efforts.

Targeted mitigation of black carbon emissions — alongside reductions in CO2 and methane — would help “slam the emergency brake” on global warming, substantially improving the likelihood of limiting global temperature rise (Clean Air Fund, 2025; Clean Arctic Alliance, 2025b). The Clean Air Fund’s latest recommendations emphasize the urgency of reducing black carbon emissions from ships, citing the potential for swift and tangible climate benefits.

The International Maritime Organization committed to act on black carbon emissions from Arctic maritime shipping in 2011, and doing so remains one of its longest-standing agenda items. To date, the IMO has defined black carbon, decided how best to measure black carbon, adopted a resolution encouraging voluntary action and agreed on two sets of guidance for ships operating in the Arctic on measurement of black carbon and best practices to reduce emissions. While some steps encouraging voluntary action have been taken, they have fallen far short of meaningfully reducing emissions.

Although the IMO has adopted a heavy fuel oil ban in the Polar Code Arctic, its exemptions and waivers still allow a significant amount of HFO and other residual fuels to be burned until 2029. The geographic area of the Polar Code Arctic is too limited to adequately address reducing the effects of black carbon.

Pacific Environment and its partner organizations in the Clean Arctic Alliance call on IMO member states to jointly develop a robust Arctic black carbon proposal amending MARPOL Annex VI to be reviewed at PPR 13 in early 2026.

What is black carbon?

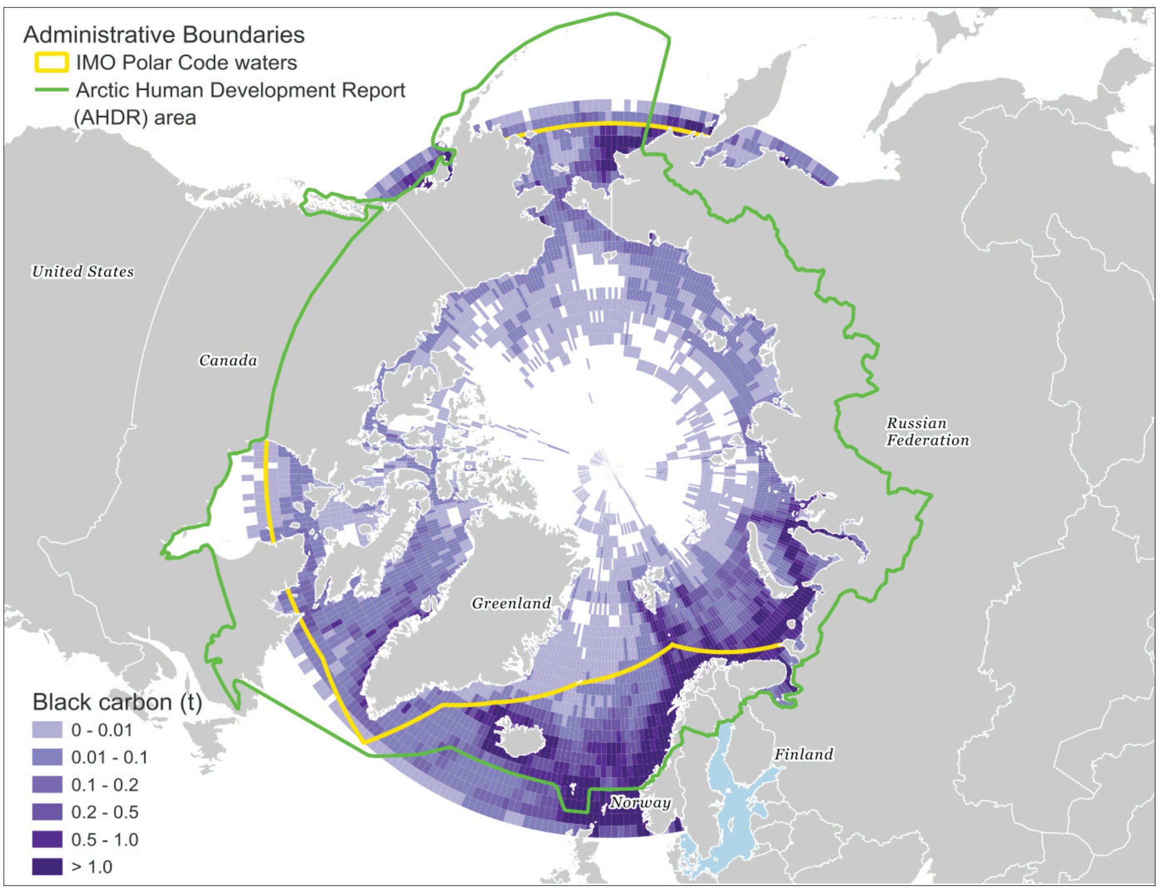
Black carbon is a fine carbonaceous material measured as a substantial component of particulate matter below 2.5 micrometers (PM2.5) and produced primarily during the incomplete combustion of fossil fuels and biomass. Internal combustion engines burning fossil fuels — for example, on maritime vessels — emit black carbon into the atmosphere, where it absorbs visible light, exists in the atmosphere in clusters of small particles and is water insoluble (Bond et al., 2013). Black carbon has a relatively short atmospheric lifetime of three to four days, hence its designation as a “short-lived climate pollutant” (Aamaas et al., 2018). It is removed from the atmosphere via precipitation and deposition onto surfaces such as ice and snow, reducing reflectivity and causing more rapid melting (Bond et al., 2013).

Where would the regulation be applicable?

Determining precise geographic boundaries is critical to ensuring that mandatory regulations both capture and curb Arctic maritime shipping black carbon emissions. The IMO’s Polar Code — formally the International Code for Ships Operating in Polar Waters — sets a relatively limited boundary around Arctic waters where ice may be encountered, aiming to reinforce vessel safety and environmental protection. However, it excludes large swaths of Arctic sea areas where most of Arctic ship black carbon is emitted (Osipova & Gore, 2025). In contrast, other Arctic definitions encompass a much broader sea area, particularly off Norway's coast and beyond the Bering Strait. For example, the Arctic Human Development Report does so and is defined by the extent of Indigenous Arctic communities, taking a socio-cultural perspective on what constitutes the Arctic, in a process led by the Arctic Council.

In a 2021 study, the International Council on Clean Transportation (ICCT) found that only 22% of vessels — those responsible for 27% of black carbon emissions in the sea areas of the broader Geographic Arctic — actually operated within the Polar Code Arctic waters (Osipova & Gore, 2025). A broader definition of the Arctic is needed. Of the available options, the AHDR-defined area is a workable solution that best reflects the wider Arctic. Any measure to address Arctic ship black carbon should include all sea areas encompassed by the AHDR definition.

Black carbon emissions in the Arctic in 2021



Black carbon emissions across the Geographic Arctic in 2021. Map designed by Liudmila Osipova. Source: Osipova & Gore (2025).

The importance of a wider scope becomes especially relevant in that nearly three-quarters of all ships of 5,000 gross tonnage or more operating during 2021 in the Geographic Arctic, and half of those in Polar Code waters, were voyaging to or from European Union (EU) ports, highlighting the importance of EU-linked traffic as captured by the EU's ship Monitoring, Reporting and Verification system. With regard to the fuel source of emissions, the study showed that 72% of black carbon emissions from EU-regulated vessels resulted from the combustion of residual fuels, while 85% of smaller ships (under 5,000 gross tonnage) — predominantly fishing vessels — already operated on cleaner distillate fuels, suggesting significant variability in fuel use and emission profiles across vessel classes (Osipova & Gore, 2025).

Warning Signs

- Some areas of the Arctic are already experiencing temperature rise at levels 2.5°C (or more) relative to pre-industrial levels. The Arctic has warmed three to four times faster than the global average since 1979 due to a combination of factors, including feedback mechanisms such as the loss of sea ice, which reduces the albedo effect (Rantanen et al., 2022).

- Keeping global temperature increase to less than 1.5°C above pre-industrial levels is likely already beyond reach considering current fossil fuel infrastructure, projections from the International Panel on Climate Change (IPCC) show (IPCC, 2023).

- Continuing emissions of greenhouse gases and short-lived climate forcers are expected to drive further warming in the Arctic, with predictions suggesting even more significant changes in the coming years.

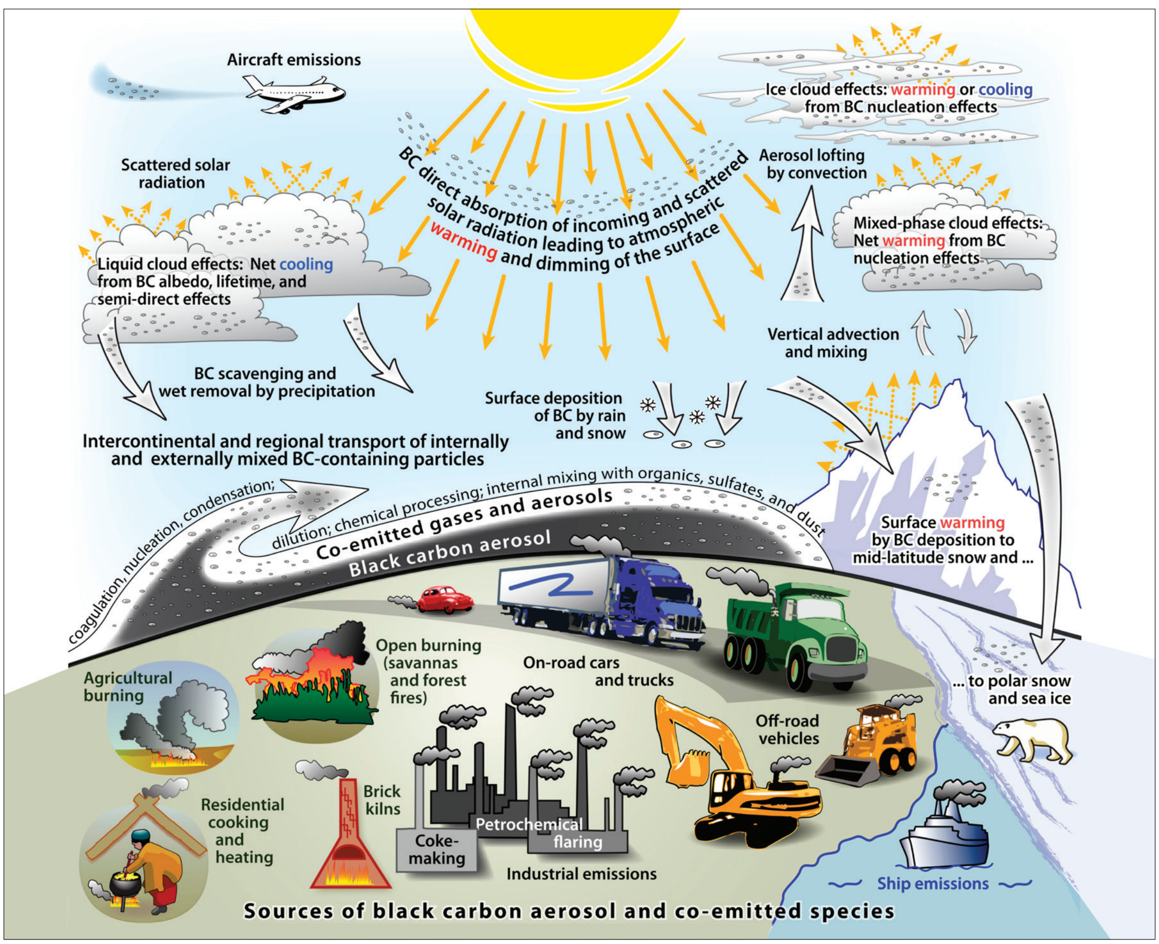
- In mid-June 2025, Alaska issued its first-ever heat advisory as Fairbanks, Alaska, temperatures were forecast to exceed 86°F — underscoring the state's rapid warming, its vulnerability to extreme heat and the escalating health risks posed by human-driven climate change (Mellen, 2025).

Sources & trends of **Arctic black carbon**

Major sources of black carbon

Globally, major emitters of black carbon in order of contribution include commercial and residential energy (cooking, lighting and heating), transport (e.g., trucks and maritime shipping), industry (particularly brick kilns), agricultural burning, waste burning, wildfires and fossil fuel operations (CCAC, n.d.; Clean Air Fund, 2025). That said, sources vary by region (Bond et al., 2013). In the Arctic, diesel engines, gas flares and households have historically been the primary contributors of black carbon emissions (AMAP, 2021). Arctic wildfires are predicted to become more frequent and thus a more significant source of black carbon (Grigorieva, 2024). As sea ice melts and shipping lanes open up for longer periods of time, black carbon emissions from maritime vessels are also predicted to increase (Osipova & Gore, 2025).

Black Carbon Aerosol Processes in the Climate System



Sources and climate processes associated with black carbon emissions. Source: Bond et al. (2013).

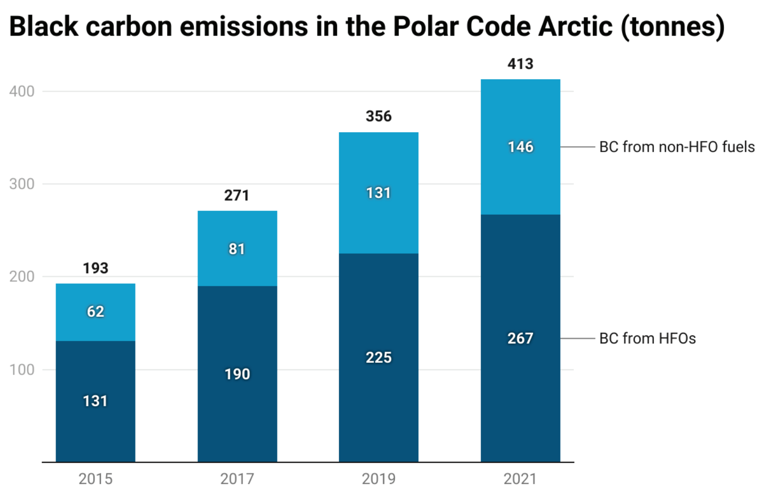
Rising Arctic ship black carbon emissions

Following carbon dioxide, black carbon is the second-largest contributor to the climate impact of shipping (Clean Arctic Alliance, 2025b). Per unit of mass, black carbon has a warming impact up to **1,500 times greater than that of CO2** (CCAC, n.d.).

Between 2015 and 2019, **the volume of residual HFO use surged by 75% among all vessel types**. Over the same period, HFO consumption specifically by oil tankers operating in the region increased **nearly fourfold**. As a result, black carbon emissions from ships burning HFO grew by 72%, and total black carbon emissions from the **entire Arctic fleet rose by 85%** (Comer et al., 2020). Since the sulfur content of marine fuel was capped at 0.5% by MARPOL beginning in 2020, HFO (any marine fuel oil with a sulfur content over 0.5% but capped at 3.5% by mass) has only been permitted for use on ships fitted with Exhaust Gas Cleaning Systems (EGCS), also known as scrubbers. Residual blends — very low sulfur fuel oil (VLSFO) developed to meet the cap requirement and residual ultra low sulfur fuel oil (ULSFO) to comply with the 0.1% sulfur limit in coastal emission control areas — emit even higher levels of black carbon.

Significant levels of black carbon, though emitted at a lower intensity, are also generated from burning distillate fuels, which are already widely used by smaller ships and the many fishing vessels operating in the Arctic.

Ships burning HFO and using scrubbers emit more black carbon than ships burning distillates, which do not require the use of scrubbers.



*Within the Polar Code, black carbon emissions from **HFO grew from 131 to 267 tonnes** between 2015 and 2021. During the same period, black carbon emissions from all fuel sources increased **from 193 to 413 tonnes**.* Source: Osipova & Gore (2025).

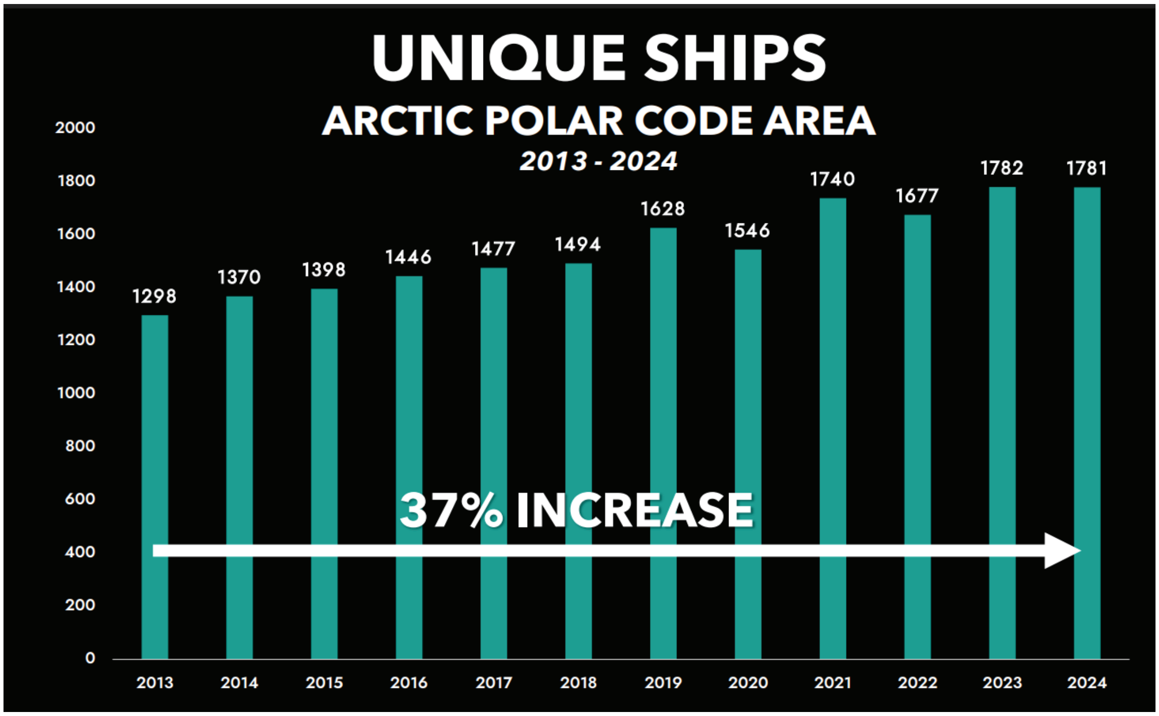
Share of Arctic ship black carbon increasing

A 2025 ICCT study found that between 2015 and 2021, **black carbon emissions from ships in the Polar Code region approximately doubled**. Globally, black carbon emissions grew 8% over the 2015 to 2019 period. In 2021 alone, shipping north of 59°N produced an estimated 1.5 kilotonnes of black carbon and 12 kilotonnes of CO2, with roughly one-quarter of these emissions occurring within the Polar Code boundaries. Within that zone, black carbon emissions rose from **193 tonnes in 2015 to 413 tonnes in 2021**, indicating a clear and sustained growth trend (Osipova & Gore, 2025).

As sea ice recedes: more ships, more black carbon

The retreat of Arctic sea ice is opening new shipping lanes and extending the months in which shipping is feasible, including on the Northern Sea Route, the Northwest Passage and the Transpolar Sea Route. Shorter transit times and reduced fuel costs offer commercial draws to shipping companies. These routes, however, also carry substantial environmental risks. Increased potential for maritime accidents, oil spills and polluting emissions from vessels pose serious threats to human health, the climate and people's livelihoods (Osipova & Gore, 2025).

The Arctic Council's Working Group on the Protection of the Arctic Marine Environment (PAME) employs its Arctic Ship Traffic Data system to record vessel traffic information within Polar Code waters. **According to PAME's Arctic Shipping Status Report, the number of individual vessels entering the Arctic increased from 1,298 in 2013 to 1,781 in 2024 — a 37% rise — while the cumulative distance traveled within these polar waters rose by 108%, from 6.51 million to 12.7 million nautical miles**. Commercial fishing vessels made up the largest share of vessel mileage at 34%. Bulk carriers, icebreakers and research ships also made up significant shares (PAME, 2025a).



The number of unique ships operating in the Arctic Polar Code Area increased by 37% from 2013 to 2024, rising from 1,298 to 1,781 vessels — highlighting growing maritime activity in the region. Source: PAME (2025).

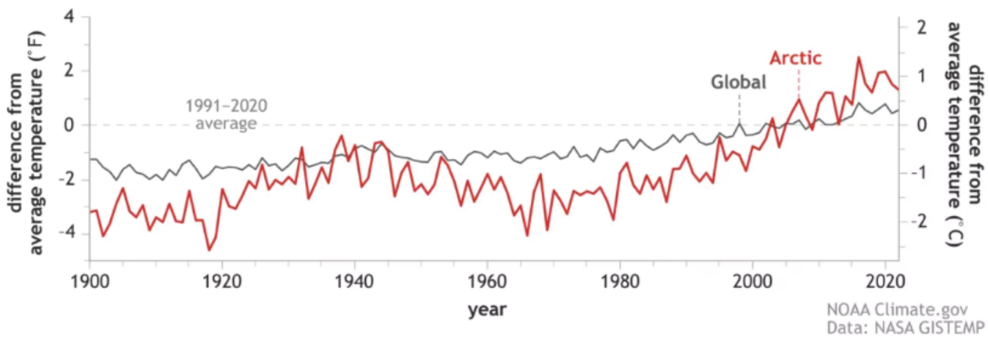
How black carbon accelerates the **Arctic meltdown**

Black carbon plays a distinct role in the Earth's climate system, with critical implications in the Arctic. Its climate forcing mechanisms are complex:
In the atmosphere, black carbon can accelerate regional warming by absorbing sunlight and trapping heat, but can also have a semi-direct cooling influence through the modification of cloud formation and behavior (Aamaas et al., 2018; Bond et al., 2013; Matsui et al., 2022).

When deposited on snow or ice, black carbon reduces surface reflectivity, allowing the surface to absorb more solar radiation and accelerating melt in a process called the albedo effect (Scott, 2023). As more snow and sea ice melt, the highly reflective surface opens up to darker land and open ocean, further reducing albedo and absorbing more heat. It is this feedback loop that plays a significant role in amplifying regional warming and contributing to global climate change (Comer et al., n.d.).

Accelerated regional warming, or Arctic amplification, has been observed in instrumental measurements, climate models and paleoclimate records alike (Rantanen et al., 2022; Scott, 2023). Sea ice decline is one of the main causes of Arctic amplification. Black carbon's warming impact on both the atmosphere and snow surface varies seasonally, reaching its peak during Arctic summer when solar radiation and deposition via rain are most intense (Aamaas et al., 2018; Matsui et al., 2022). Alaska has experienced a notable increase in extreme weather events, with temperatures rising approximately 50% faster than in the contiguous United States.

Arctic warming outpacing the global average



This time series graph compares global temperatures (gray) to Arctic temperatures (red). Since the year 2000, Arctic temperature increases have outpaced global temperature increases. — Credit: NOAA Climate.gov based on data from NASA Goddard Institute for Space Studies Surface Temperature Analysis

Arctic temperatures (red) have risen significantly faster than the global average (gray) since 2000, illustrating the phenomenon of Arctic amplification. Source: (Scott, 2023).

The rapid warming has altered temperature and precipitation patterns, accelerating permafrost thaw due to reduced seasonal snow cover and shrinking land ice. The Arctic environment is being reshaped as a result of permafrost thaw, which intensifies mudflows, glacial landslides, erosion and abrasion (i.e., the wearing down of landforms), frost heave and thermokarst (irregular terrain surface) formation. Higher average temperatures are also driving glacier loss and heightening coastal vulnerability to sea level rise and severe weather. These impacts are expected to worsen significantly by 2050 (Grigorieva, 2024).

How a melting Arctic **amplifies global warming**

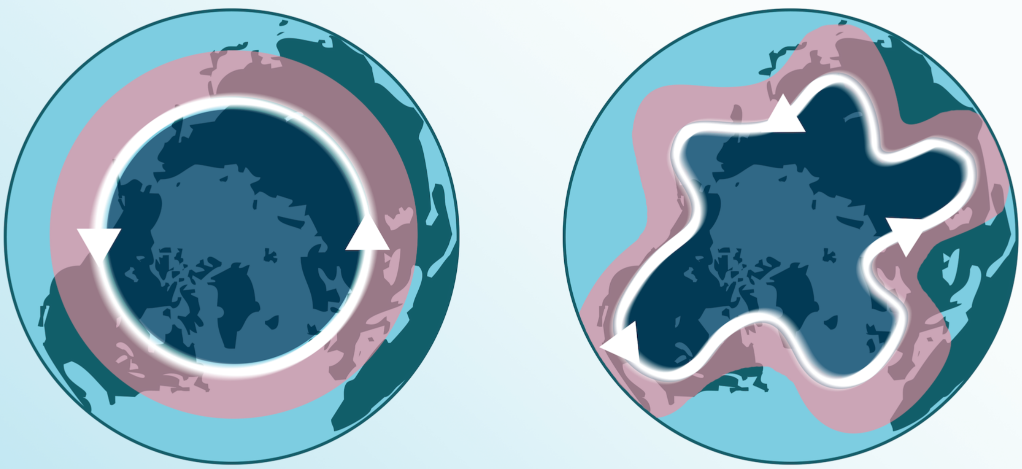
Arctic warming has far-reaching impacts beyond the Northern latitudes. Several studies have shown that the influx of heat and moisture into the lower Arctic atmosphere from warming oceans can weaken the temperature gradient between the Arctic and mid latitudes, causing the jet stream to become "wavier" and slower-moving.

A meandering jet stream can "park" weather systems in place, leading to prolonged heat waves, cold spells, heavy precipitation events and wildfire-exacerbating conditions across the Northern Hemisphere (Scott, 2023).

At a more local scale, reduced sea ice in the Barents and Kara Seas has been associated with below-average winter temperatures in Central and East Asia; low ice in the Chukchi and Bering Seas has been tied to anomalous cold in parts of North America (Kug et al., 2015; Warner et al., 2020). Arctic sea ice decline has also been linked to weaker summer monsoon seasons in India (Kulkarni & Agarwal, 2025; Yadav et al., 2024).

The weakening polar jet stream

The pressure difference between cold air in the Arctic and warm air in the mid-latitudes creates the powerful belt of wind we call the "polar jet stream." This natural barrier keeps the freezing temperatures of the Arctic winter from intruding further south.



When the polar jet stream is strong, powered by large temperature differences between the Arctic and mid-latitudes, it moves relatively straight. This keeps the coldest winter temperatures in a predictable ring: the Arctic environments of Alaska, northern Canada, Greenland, Siberia and Scandinavia.

A warming Arctic produces a weaker jet, more likely to bend off course. This wavy pattern can shift the boundary between cold Arctic air and warm mid-latitude air to strange places. Southerly regions used to mild winters may be exposed to freezing temperatures at the same time that parts of the Arctic deal with unusual warm spells.

Disruption of the Atlantic Meridional Overturning Circulation

The acceleration of black carbon-driven ice melt introduces large volumes of freshwater into the Arctic Ocean, which dilutes ocean salinity and reduces water density. These changes disrupt the Atlantic Meridional

Overturning Circulation (AMOC) a major global ocean current system that relies on the sinking of cold, salty water to drive its flow. Recent research indicates that the AMOC is already slowing due to greenhouse gas-driven warming (Allen et al., 2024).

A weakened or collapsed AMOC would be a critical tipping point with far-reaching climate consequences, including altered nutrient transport in the oceans, destabilized weather systems and severely impacted food production in regions like Scandinavia and Europe (Clean Arctic Alliance, 2025a). It would also intensify sea level rise and extreme weather events along the North American coast. One study projects that under current emissions trajectories, the AMOC could collapse by mid-century, underscoring the urgent need to address climate forcers like black carbon in the Arctic (Ditlevsen & Ditlevsen, 2023).

Implications for sea level rise

A comprehensive review estimates that accelerated mass loss from Arctic land ice, principally Greenland, is now a “guaranteed” contributor to future sea level rise (Moon et al., 2018). The retreat of sea ice also marks a critical climate tipping point: As the Arctic Ocean approaches the first summer ice-free conditions — potentially as early as the 2030s — positive feedbacks intensify, amplifying global warming trends. One study predicts the first ice-free day in the Arctic to occur in the next three to six years — that is, before 2030 (Heuzé & Jahn, 2024). These cascading climate effects underscore a profound feedback loop wherein black carbon-driven Arctic warming propels ice and glacier loss, further reinforcing global sea level rise and edging the climate system closer to dangerous thresholds.

Impacts on **people & communities**

Health impacts of black carbon

As a “super-pollutant,” black carbon poses significant threats to both the climate system and human health. Its health implications — particularly as a component of fine and ultrafine particulate matter — are increasingly recognized as a global public health concern. Due to its ultrafine size and widespread distribution, black carbon can penetrate deep into the lungs and even enter the bloodstream. Ambient air pollution, including black carbon (a component of PM2.5), ranks among the top 10 risk factors for premature death across Arctic Council Member and Observer countries (AMAP, 2021). Globally, ambient PM exposure contributed to nearly 3 million deaths in 2017 alone (WHO, 2012). The health effects of these pollutants are especially acute in vulnerable populations such as the elderly, children and those with preexisting conditions.

Epidemiological studies have linked black carbon exposure to a wide spectrum of health outcomes, including cardiopulmonary diseases, lung cancer and ischemic heart disease (Comer et al., 2017). Notably, short- and long-term exposure to black carbon has been associated with elevated cardiovascular risk, particularly among older adults. A 2022 scientific study found that mortality risks were highest on the day of cardiovascular events, with long-term exposure also tied to chronic obstructive pulmonary disease, or COPD, and atherosclerosis (Song et al., 2022). Seasonal patterns further reveal increased mortality during colder months, likely due to higher pollutant concentrations.

Despite these findings, toxicological research suggests that black carbon may not be inherently toxic on its own. Rather, it serves as a universal carrier for more harmful semi-volatile organic compounds, trace metals and polycyclic aromatic hydrocarbons (PAHs), which it absorbs during combustion or atmospheric transport (Niranjan & Thakur, 2017; WHO, 2012). These compounds, many of which are carcinogenic, adhere to black carbon particles and are transported deep into the human respiratory system. Experimental studies have shown that black carbon exposure can induce oxidative stress, DNA damage and altered gene expression via mechanisms such as DNA adduct formation and activation of the aryl hydrocarbon receptor, which plays a role in a wide range of biological processes like immune responses and metabolism (Niranjan & Thakur, 2017).

In 2018, emissions from ships — a major source of black carbon in the Arctic — were estimated to have caused around 266,000 premature deaths and over 6.4 million cases of childhood asthma worldwide. The size and age of black carbon aerosols influence their toxicity: Smaller particles are more harmful, and aged black carbon becomes increasingly reactive, exacerbating its health impacts (Hakkarainen et al., 2022).

Emerging research has also expanded the list of health conditions potentially linked to black carbon and PM2.5, including diabetes, preterm birth and low birth weight (AMAP, 2021). Alarmingly, black carbon has been detected in placental tissue and even in the urine of healthy children, highlighting its ability to infiltrate biological systems from the earliest stages of life (Bové et al., 2019; Saenen et al., 2017).

Ultimately, the spatial distribution and proximity of black carbon emissions to human populations strongly influences health outcomes. Urban centers, port regions and Arctic communities are disproportionately affected. As such, black carbon represents not just an environmental threat, but a multi-system public health hazard that requires urgent attention from both climate and health policy communities.

Effects on Indigenous Peoples and local communities

As ship traffic in the Arctic grows, so too does the effect of maritime pollution, ecological disruption and regional climate change on Indigenous and other Arctic communities. An increase in vessel traffic can impact subsistence communities' ability to harvest fish and marine mammals and strain local search and rescue and emergency response resources in the event of an accident (Arctic Council, 2021). Sea ice thaw is also triggering marine algal blooms and impacting the Arctic food web (Arctic Council, 2025).

Ambient air pollution ranks among the top 10 contributors to early death in Arctic Council Member and Observer countries. Although Arctic black carbon concentrations declined between 1990 and 2010, that downward trend has since plateaued. In 2015, Arctic Council Member countries were responsible for 8% of global human-caused black carbon emissions — primarily from road transport, residential burning and gas flaring in oil and gas operations. Notably, this estimate excludes shipping, suggesting that emissions could rise further as Arctic maritime traffic expands (AMAP, 2021).

Why is Arctic maritime shipping's **black carbon still an issue?**

What is blocking regulation?

Although black carbon emissions are accelerating climate warming and degrading public health, action to address them has been modest. Attempts to regulate black carbon emissions, particularly from the shipping industry, face challenges for several reasons:

Oil industry juggernaut: The oil industry remains a force with enormous reach and influence that shapes economies and political landscapes around the world. The oil industry makes and sells the product at the heart of the black carbon problem — residual fuel oil. International shipping has always sought to minimize fuel costs, which comprise a high proportion of operating costs. Although many countries have moved to mandate cleaner distillate and other fuels, the shipping industry continues to predominantly use the dirtiest of all transport fuels. This demand provides a convenient and ready means for oil refiners to dispose of residuum, the noxious waste from the refining process that would otherwise have to be disposed of in an environmentally safe way. HFO used in ships equipped with scrubbers is sold as fuel to the shipping sector at a price well below the cost of crude oil.

Complexity of the shipping industry: The shipping industry is fundamental to national economies, world trade and indeed the global economy, and has numerous stakeholders, including shipping companies, fuel producers, coastal states and flag states, and international organizations such as the IMO. Regulating emissions in this complex environment requires cooperative and coordinated international efforts. The shipping industry has powerful lobbyists that can influence international regulatory bodies like the IMO. Industry lobbyists have argued against strict regulations on the basis of economic viability, feasibility and potential impacts on global trade.

Costs: Many countries and companies are concerned about the potential economic impacts of stricter environmental regulations for shipping, such as potentially higher costs of shipping goods. The unspoken concern is that implementing regulations to mandate the use of cleaner and more costly fuels will lead to increased operating costs that need to be passed on. Emission Control Areas (ECAs) requiring cleaner fuels mandated via MARPOL have been around for about 15 years and are expanding. In addition, there have been changes in regulation relating to fuel quality and allowable content of sulfur in fuel oils. Although such regulations might be viewed as problematic, experience indicates that oil price fluctuations are absorbed without significant effect on commerce.

Scientific and technical challenges: Developing effective regulatory measures that can be uniformly applied potentially across different jurisdictions, engine types and other circumstances is technically challenging and leads to many questions. Furthermore, the measurement of black carbon is more challenging than some other air pollutants, given that black carbon can have both climate cooling and warming effects. There are many variables that affect emissions. The understanding of black carbon's impact on the planet is also imprecise and developing. For example, the Intergovernmental Panel on Climate Change's latest report (Sixth Assessment Report, or AR6) doubled the estimates of the warming potential of black carbon on snow and ice from 0.04 W m-2 in the Fifth Assessment Report (AR5) to 0.08 W m-2, due to improvements in the understanding of black carbon's warming on snow forcing, which is estimated to be two to four times that of equivalent CO_2 forcing.

Focus on other emissions: The widely recognized greenhouse gases, principally CO_2 and methane, have been the focus of intense emission reduction efforts at the IMO. The impact of ship black carbon on the Arctic, even though it is both an air pollutant and powerful short-lived climate forcer, has been less of an issue despite a clear understanding of the role of black carbon as an SLCF since 2011.

Lack of awareness: There appears to be less awareness or understanding among stakeholders of the specific impacts of black carbon compared to other pollutants, which has led to less urgency in addressing it.

Political will: Because the urgency to address climate change varies significantly among countries, the political will to adopt needed regulatory measures addressing Arctic ship emissions has been insufficient to date to make progress.

Shipping's **regulatory landscape**

History of efforts to eliminate black carbon in the Arctic

The issue of how to control black carbon from ships in the Arctic has been analyzed and debated at the IMO for over a decade.

In 1973, the IMO adopted the International Convention for the Prevention of Pollution from Ships (MARPOL), which aimed to minimize pollution of the oceans and seas from dumping, oil spills and toxic discharges from ships. Air pollution from ships gained attention in the 1990s due to the high levels of sulfur in marine fuel contributing to the formation of acid rain in the Baltic Sea area and accompanying environmental and infrastructure damage. As research on shipping's air pollution impacts on health and the environment developed, discussion at the IMO intensified.

Ship air pollution regulated

The first major regulatory framework covering air pollution from ships was the adoption of a new Annex VI to the MARPOL Convention, agreed upon in 1997 to take effect in 2005. This Annex set limits on sulfur oxides (SOx), nitrogen oxides (NOx) and volatile organic compounds (VOCs). Initial regulations were relatively lenient, and by the time the Annex came into effect it was clear that more stringent pollution limits and action on particulate matter were needed. Preparatory work to do so began later that year.

In 2008, the IMO adopted amendments to MARPOL Annex VI that established stricter limits on sulfur content and criteria to designate specific areas as Sulfur Emission Control Areas, or SECAs. The new regulations mandated a reduction in the allowable sulfur content in marine fuels to 0.1% in SECAs from 2015 and 0.5% globally starting in 2020. The requirements reduced the sulfur content of all fuels including both residual fuels and cleaner distillate fuels; however, ships operating with EGCS could continue to use heavy fuel oil globally whose sulfur content remained capped at 3.5% by mass.

MARPOL Annex VI regulations remain essentially unchanged today and have been monitored and enforced for almost 20 years.

Black carbon remains unregulated

From 2007 to 2010, the IMO received submissions recognizing and examining black carbon as a potent climate forcer in the Arctic.

Switching completely away from residuals to distillate fuels was an option already debated in the run-up negotiations to the 2008 MARPOL amendments. While accepted in principle, as based on the accepted science behind switching to cleaner fuels, it was not adopted due to practical considerations. Instead, the IMO determined the quickest way forward was to regulate sulfur content, thereby cutting SOx PM.

Recognizing that black carbon from ships in the Arctic had powerful, short-lived climate impacts as well as significant air quality and human health impacts, the IMO's Marine Environment Protection Committee (MEPC 62) agreed in 2011 on a new work program to address the impact of black carbon from shipping in the Arctic. The work envisaged defining ship black carbon, investigating and agreeing on methods to measure ship black carbon and then considering abatement options.

After considering ship-specific options, a universally accepted Bond et al. definition of black carbon was finally agreed upon in 2013. Subsequently, three years were spent identifying and agreeing on methods to measure black carbon emissions onboard ships. Work in parallel proceeded on abatement options with industry and shipping interests making clear their view that important determinants of ship black carbon emissions were engine type and size, engine load and maintenance conditions. A Canadian-sponsored study for the IMO Secretariat released in 2013 identified cleaner fuels as a principal means to generate significant across-the-board reductions in black carbon. Several intersessional correspondence groups followed, culminating in a 2017 non-prioritized list setting out 41 possible ship black carbon abatement measures.

Further meetings of the MEPC's Pollution Prevention and Response (PPR) Sub-Committee followed to consider abatement options, results of black carbon engine test bed analyses and issues related to black carbon emission differences between using residual and distillate fuels.

Voluntary switch to distillates encouraged

A resolution was finally proposed to pursue the distillate switch option notwithstanding differences of view from industry on the resultant black carbon reduction forecasts. MEPC Resolution 342 (77) was adopted in November 2021, calling on ships and member states to pursue a voluntary switch to distillates or other cleaner fuels in the Arctic (IMO, 2021). Subsequent debate focused not on encouraging implementation but rather furthering extensive work to develop a specific black carbon emission measurement regime for ships when operating in the Arctic. Several papers discussed a range of issues including engine emissions test results, what fuel tests could be used to assess sooting propensity, limits to the aromatic content of marine fuels and related issues in other transport sectors.

In 2024, IMO guidance (Resolutions MEPC.393(82) and MEPC.394(82)) was adopted recommending a maritime Arctic ship black carbon monitoring, reporting and best practices regime. It encouraged operators to set individual ship black carbon reduction targets when in the Arctic and to share monitoring and reporting results with flag states and eventually the IMO in order to analyze lessons learned. No information on uptake or initial results is as yet available.

Mandatory switch to distillates debated

The merits of a switch to cleaner fuels versus developing an Arctic ship black carbon reduction standard have been debated along with the idea of strengthening ECA provisions to limit black carbon. At the PPR 11 session in early 2024, environmental non-governmental organizations (eNGOs) proposed that the IMO proceed with the development of control measures starting with an immediate and mandatory switch to distillates or other cleaner fuels. The eNGOs proposed that such a measure should cover the wider Arctic — not just Polar Code waters. MEPC subsequently ruled that any proposal on geographic scope would need to originate with a member state(s).

The International Organization for Standardization (ISO) submitted PPR 12/6/1 setting out criteria for polar fuels such as marine distillates DMA and DMZ, which if mandated under Annex VI, would indeed lead to reduced ship black carbon emissions in the Arctic.

LNG is not the answer

Liquefied natural gas, or LNG, has emerged as an alternative fuel for maritime fleets worldwide, with operators increasingly switching from residual fuels in response to regulations targeting greenhouse gas reductions and environmental impacts (Carr et al., 2024). LNG is primarily composed of methane and is cooled to a liquid state for easier transport and storage (Palmer, 2024). Concerns about methane (CH4) emissions throughout the LNG life cycle are mounting given methane's potent global warming effect as an SLCF. **Compared to CO2, methane has an 80 times more powerful warming potential over a 20-year period.** The IMO's revised strategies now include methane in their life cycle analyses to better monitor progress toward net-zero GHG emissions (Carr et al., 2024). On a larger scale, the EU limits methane emissions through the EU Methane Regulation (European Commission, n.d.). And as of January 2025, 159 participants had signed onto the Global Methane Pledge, a global effort to reduce methane emissions at least 30% from 2020 levels by 2030 (Global Methane Pledge, n.d.).

Because the growing use of LNG in the Arctic heightens climate and air pollution worries, Pacific Environment, the Clean Arctic Alliance and other eNGOs oppose its choice as a maritime fuel in Arctic waters.

The pour point issue

Pour point refers to the lowest temperature at which the fuel can flow, or the temperature at which it begins to solidify into a gel-like state. At low sea temperatures as in the Arctic, high pour point marine fuels become increasingly more challenging to contain, recover and clean up when spilled, as the fuel does not flow easily in colder temperatures. If the oil solidifies or thickens due to low temperatures, skimmers and booms that rely on the fluidity of the oil become ineffective, and dispersants may not disperse effectively in cold water. Solidified oil can settle on the seafloor or become trapped in ice, causing long-term damage (PAME, 2025b).

After testing residual ultra low-sulfur fuel oil (ULSFO), developed to comply with the 2015 0.1% sulfur limit in ECAs, and very low-sulfur fuel oil (VLSFO) to comply with the 2020 0.5% limit on sulfur content globally, Norway identified these residual fuels as having very high "pour points," which if spilled in cold Arctic waters would pose serious oil spill cleanup challenges. Norway, supported by Iceland, subsequently proposed to MEPC 78 in early 2022 to include an upper pour point limit in the definition of HFO in regulation 43.1.2 of MARPOL Annex I, which implemented the IMO's HFO ban in the Arctic.

Norway's pour point proposal was further discussed in later meetings, but IMO's procedures for formal consideration require prior agreement of member states to expand the scope of existing work programs. The earliest meeting to agree on expanding the scope is now at MEPC 84 in 2026. The proposal would then need to be referred to PPR in 2027, require two years to discuss and the outcome then referred back to MEPC.

In parallel with these pour point discussions at the IMO, the Arctic Council's PAME — again in response to Norway — initiated a work program in 2019 to consider the characteristics and performance of low sulfur fuels developed to comply with the 2020 sulfur cap. This five-year work program culminated in a recent publication (PAME, 2025b, May) that examined the problems of residual marine fuels and oil spills in the Arctic in great detail. Significantly, the basis of this extensive work involving a number of Arctic countries and other bodies including industry experts focused solely on marine residual fuels, with PAME making clear that marine distillate fuels are not a problem regarding pour point.

Polar Fuels

In a further submission in early 2023 on pour point, Norway suggested an alternative approach to mirror the way ships operating in the territorial waters around Svalbard have been regulated by the Svalbard Environmental Protection Act. Ships operating in these waters shall not use or have on board petroleum-based fuel with a higher viscosity, density or pour point than permitted for marine gas oils, or MGOs. Norway referenced the ISO 8217 specifications for MGO (distillate) and added that this would be a better option than including a pour point parameter in regulation 43.1.2 and would lead to a better protection of the fragile marine environment.

Environmental NGOs then proposed to the MEPC 82 meeting in October 2024 that MARPOL Annex VI be amended to exclude residual fuel use and only allow polar fuels in Arctic waters. Discussion was deferred to PPR 12 in early 2025, where plenary instructed the air pollution working group to consider both the Arctic black carbon polar fuel and pour point issues. ISO had proposed to PPR 12 that four distillate fuel quality criteria contained in the 2024 edition of ISO 8217 could form the basis of an amendment to MARPOL Annex VI requiring a switch to polar fuels in the Arctic.

In a statement appended to the Intersessional Working Group on Air Pollution and Energy Efficiency's record, ISO noted that DMA/DMZ polar fuels have pour points at or below 0°C so that, in addition to reducing black carbon, their use would avoid pour point issues in Arctic waters. The statement also noted that there were no availability issues around the supply or bunkering of such polar fuels.

Recommended option for advancement at PPR 13: mandate switch to distillates

Pacific Environment and the Clean Arctic Alliance propose a mandatory switch from residual fuels to cleaner marine distillate fuels, dubbed "polar fuels," for ships operating in and near the Arctic. Acceptable "polar fuels" include DMA, DMZ and future alternative fuels that would be expected to deliver comparable black carbon emissions reductions.

Eliminating black carbon in the Arctic: **Economics and the impact on industry**

As recognized for decades by clean air regulations in other transport modes, the more refinery-processed the crude oil is, the more the pollutants contained in crude oil are removed from the end product and so less pollutants are emitted (EPA, 2010). This is the approach long adopted by the IMO, which cuts sulfur in marine fuel and so only allows the use of fuels resulting in lower SOx/PM emissions. Black carbon, like sulfur, is a component of PM. To reduce ship black carbon emissions in the Arctic will, as with sulfur, require more expensive cleaner fuels.

Because marine distillates are generally more expensive than the heavier HFO, VLSFO and ULSFO residual fuels, requiring the use of marine distillates could increase operational costs for shipping companies operating in the Arctic. Increased costs may lead to higher freight rates, which could affect the pricing of goods transported to and from Arctic regions.

How much would using marine distillates increase operational costs for ships in the Arctic?

A ship's operational costs can vary significantly depending on fuel prices, a ship's size, age and condition, operational efficiency, load, trade routes and operating conditions. Fuel costs typically account for a substantial portion of a ship's operational expenses (Stratiotis, 2018).

Ships are restructuring operations to cut costs and reduce fuel consumption, such as slowing down, adding wind assist technology, improving efficiency by consolidating services in multi-carrier alliances, consolidating routes to serve more locations with fewer ships, revising routes and arrival times to improve efficiency, and adjusting hull and propeller conditions to reduce resistance and improve efficiency.

Historically, high fuel prices have not interfered with trade or increased the cost of goods significantly for consumers.

Price stability and volatility

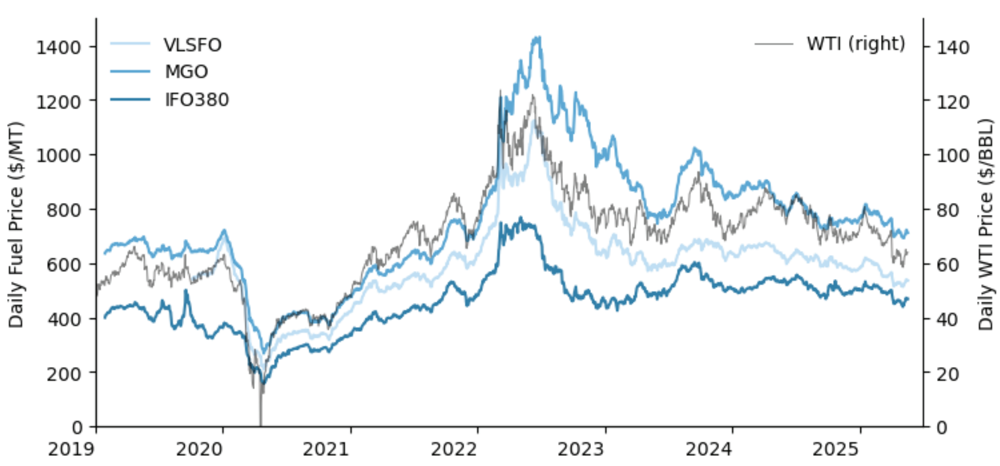
Marine fuel prices have remained relatively stable for the last 18 months, consistent with the recent stability in Brent crude trading prices (EIA, 2025). MGO and VLSFO are both sold at a premium over HFO (IFO380) (USDA, 2025). A slight downward price trend is now emerging.

The weekly mean price for HFO over the past 18 months is $508.23 per metric ton (MT) and the difference between MGO versus HFO is $287.47 per MT. The weekly mean price difference for VLSFO over that period was $100.91 per MT. On average for that period, MGO is 1.56 times the HFO price and VLSFO 1.20 times higher.

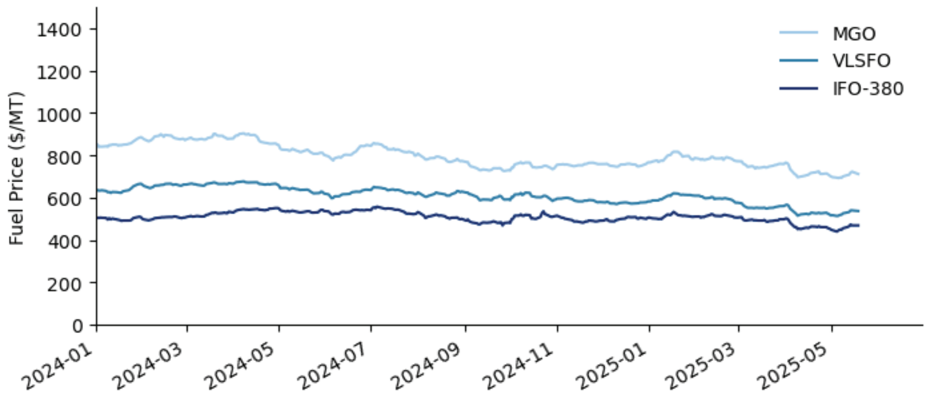
In 2022, the bunker industry experienced record prices and margins as the Russia-Ukraine War fueled global oil supply concerns. In response, national, shipping and bunker companies announced plans to reduce reliance on Russian business. HFO demand rose during the year, widening the gap between HFO and VLSFO (Jordan, 2023).

Marine Fuel Prices with WTI price

This graph shows global average bunker prices for VLSFO, MGO, IFO380 (HFO) and West Texas Intermediate (WTI) Crude over the last six years.



Global daily average prices for VLSFO, MGO, IFO380 (HFO) and West Texas Intermediate (WTI) Crude from 2019 to 2025. Source: EERA (2025).



Global fuel prices for MGO, VLSFO, and IFO380 (HFO) from January 2024 to June 2025 show modest fluctuations, with MGO consistently priced higher than other fuel types. Source: EERA (2025).

Results that could be achieved by **regulating black carbon**

Replacing residual fuel with distillate could reduce black carbon emissions by 50% to 80%, depending on engine type and operating conditions (Osipova & Gore, 2025). For EU-regulated ships over 5,000 GT in the Geographic Arctic, this would cut black carbon emissions by 115-183 tonnes — a 16% to 25% reduction of the total black carbon emissions in this size category. Installing diesel particulate filters could increase the emissions reductions to 206 tonnes, achieving up to a 29% total black carbon emissions reduction from ships over 5,000 GT sailing in the Geographic Arctic (Osipova & Gore, 2025).

The potential of installing diesel particulate filters, or DPFs, on ships to deliver very substantial reductions in black carbon emissions has been raised a number of times in successive IMO discussions drawing on longstanding regulatory experience in Europe and North America with filters to reduce air pollution from cars and trucks. Drastically cutting road fuel sulfur levels and limiting fuel aromatic content enabled mandatory requirements for road vehicles to install DPFs. It is the much cleaner fuel that does not clog the filters that enables the DPFs to function. It is accepted that for DPFs to work on ships would require very low levels of sulfur, but what level is not yet clear. And in the absence of any mandate on their use, development of DPF technology, especially for large ships, has been slow.

Conclusion

Time is running out to prevent the worst catastrophic impacts of climate warming.

The IMO's current GHG plan is to replace all fossil marine fuels with low- or zero-carbon fuels that do not emit such pollutants. However, it will take years or potentially decades for these new fuels to have an appreciable impact on black carbon emitted by ships in the Arctic. The environment and people of the Arctic cannot wait.

The IMO debate on Arctic ship black carbon has been lengthy, technically intense, detailed and deliberate. Although some interested parties have managed to forestall action, the worsening climate crisis is building support for immediate regulatory action.

Cleaner road transport fuels were mandated decades ago, so why should maritime shipping be exempt? For over a decade IMO regulation has required ships to switch to cleaner fuels in emission control areas around the European and North American coasts. Failure to act now to address Arctic ship black carbon emissions threatens to damage the IMO's own environmental credibility.

Reducing black carbon emissions from ships operating in the Arctic does not require development of new fuels or new technology and can be done with immediate effect. Mandating a switch from residuals to readily available and widely used distillate fuels, such as DMA and DMZ, will deliver a significant reduction in black carbon emissions, slow warming in the Arctic and improve public health globally.

By mandating a swift transition to distillates and other cleaner fuels, the IMO can enact a high-impact policy that achieves immediate benefits and reduces black carbon in the Arctic.

When the IMO's Pollution Prevention and Response 13 Sub-Committee meets Feb. 9-13, 2026, it must recommend a mandatory switch from residual fuels to cleaner "polar fuels."

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Made up of 24 not-for-profit organisations, the Clean Arctic Alliance campaigns to persuade governments to take action to protect the Arctic, its wildlife and its peoples.

Members include: Alaska Wilderness League, Bellona, Clean Air Task Force, Ecology and Development Foundation ECODES, Environmental Investigation Agency, Equal Routes, Eurasian Wildlife and Peoples, Friends of the Earth U.S., Global Choices, Green Global Future, Green Transition Denmark, Greenpeace, Iceland Nature Conservation Association, International Cryosphere Climate Initiative, Nature And Biodiversity Conservation Union, 90 North Foundation, Ocean Conservancy, Pacific Environment, Seas At Risk, Surfrider Foundation Europe, Stand.Earth, Transport & Environment, WWF and Zero.

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