



RECORD OF DECISIONS AND FOLLOW-UP ACTIONS PAME I-2010 (3-5 March 2010)

Arctic Ocean Review Project (AOR)

The Meeting agreed to the following:

- *The PAME Chair to send a letter to Arctic Council Working Group Chairs requesting the nomination of experts by 22nd of March 2010. The role of these experts is to review and provide input as necessary to Chapter 2.*
- *PAME members to provide names of appropriate experts by 22nd of March 2010 to the AOR Project Manager, in particular from Canada, Russia and the United States. The role of these experts is to review and provide input into Chapter 2 (The Status of the Arctic Marine Environment and Emerging Trends).*
- *Lead countries expressed the importance of PAME members' input into the development of the AOR Phase I Report and urged members to send relevant material (Arctic Council reports, scientific studies etc.) to the AOR Project Manager, with a copy to the PAME Secretariat, by the end of March 2010.*
- *Member States to provide a list of bilateral and multilateral arrangements and initiatives relevant to the Arctic marine environment by the end of March 2010 to the AOR Project Manager.*
- *PAME members to provide list of possible outreach opportunities for the AOR to the PAME Secretariat as appropriate.*
- *Approved the Communication and Outreach Plan for the AOR (Phase I: 2009-2011) – Annex 1.*
- *Lead countries to provide PAME members with first draft of the AOR Phase I Report in June 2010 for review and comment.*
- *Lead countries will confirm further details on proposed fall 2010 AOR expert workshop as soon as possible.*

Ecosystem Approach

The Meeting agreed to the following:

- *Request the EA Group of Experts to convene a meeting intersessionally (e.g. by email correspondence or conference call(s)) to come to agreement on the following:*
 - *Select a chair for the period 2009-2011 as soon as possible and inform the PAME Secretariat of the name and contact information.*
 - *To advance the EA Work Plan 2009-2011, report on its progress and implementation, and outline the work planned to be accomplished during the 2010-2011 period to the PAME II-2010 meeting.*
 - *Initiate the development of the biannual work plan to coincide with the PAME biannual work plan development for the 2011-2013 period as per the ToR of the EA Group of Experts.*
- *Welcome the proposal from Norway to convene a workshop in summer of 2010 on LMEs and the PAME/EA efforts and asked Norway to provide details on the workshop as soon as possible.*

Follow up on the 2009 Offshore Oil and Gas Guidelines

The Meeting agreed to the following:

- *Based on the replies received on the Questionnaire regarding Environmental Impact Assessment (EIA) process within the offshore oil and gas industry there is currently no need to develop harmonized Arctic EIA Guidelines*
- *PAME Secretariat to provide access on the PAME homepage that will link into relevant homepages of PAME countries on respective EIA reports and practices as a means of information sharing. Countries to provide the Secretariat with the appropriate links.*

Follow up on the 2009 RPA

The Meeting agreed to the following:

- *Await the outcome of the GPA survey results which is expected by end of April 2010 and request the PAME Secretariat in cooperation with IPS, to coordinate with the GPA work on next steps on the application of a clearing house and provide status on this work intersessionally.*

Arctic Marine Shipping Assessment

The Meeting agreed to the following:

- *Welcome with appreciation leads and follow up activities for the following AMSA Recommendations:*
 - *I(B) actions 1 and 2 – Work is underway in IMO and Denmark will update PAME on progress at the PAME II-2010 meeting.*
 - *I(B) action 3 – Norway and USA confirmed co-lead role. Agree to implement Phase I of the project on considering the identification of, and environmental risks and potential options for, avoiding or minimizing risks regarding the use and carriage of heavy fuel oil in the Arctic, as per the project description in Annex II:*

- *PAME countries to nominate experts for the contact group and inform Norway by end of March 2010.*
- *The contact group to develop and agree on the ToR for Phase I as soon as possible.*
- *Progress Report to be presented to the PAME II-2010 working group meeting*
- *I(C) – PAME Chair/Secretariat to collect information from AC member states and report to PAME II-2010 meeting*
- *I(D) action 1 – Work is underway in IMO and Denmark will update PAME on progress at the PAME II-2010 meeting.*
- *I(D) action 2 – for PAME consideration at a later stage. Denmark has done this in an informal way by providing web-based information and PAME countries are asked to provide information on best practices to Denmark to inform at next PAME meeting*
- *II(D) - Denmark will inform on progress at the PAME II-2010 meeting, including the outcomes of the meeting of environmental ministers in Greenland in 9-11 June 2010, and propose the way forward in the PAME Working Group including confirmation of its possible lead country role.*
- *Welcome the information from EPPR on their follow-up activities on AMSA Recommendations II(F) and III(C).*
- *Based on the SAO's support of the PAME recommendations for follow-up activities, invite AMAP, CAFF and SDWG to consider follow-up activities on AMSA Recommendations II(C) on the identification of areas of heightened ecological and cultural significance. Identification of such areas could serve as a basis for possible development of proposals for IMO "Special Areas", PSSA's and/or associated protective measures.*
- *PAME Secretariat to add a fourth column to the AMSA Matrix to track status on progress of the AMSA follow-up activities and post on the PAME homepage.*
- *PAME agrees to produce an AMSA status report to the 2011 Ministerial meeting. AMSA co-leads (Canada, Finland and the United States) to confirm their role by PAME II-2010 meeting.*
- *Welcome Norway providing a list of most relevant IMO meetings for information purposes at the PAME II-2010 meeting.*

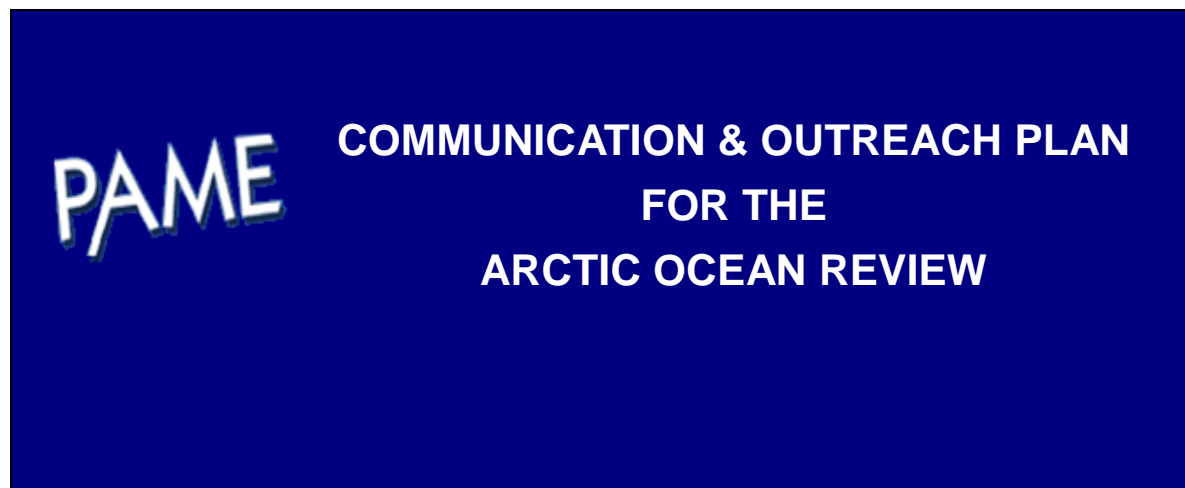
PAME Administration Next Meeting

The Meeting agreed to the following:

- *The timing and location of the next PAME Meeting (fall 2010) to be confirmed as soon as possible.*
- *Invite PAME delegations to include IMO experts in their delegations to the PAME II-2010 meeting.*
- *PAME Chair/Secretariat to send request to the Chairman of the SAOs that the AOR Project and the AMSA follow-up activities remain on the agenda of the upcoming SAO meeting 28-29 April 2010.*

- *The PAME Secretariat to present status on the AMSP 2004 actions and start the drafting of possible PAME Work Plan items for the 2011-2013 period for the PAME II-2010 meeting.*

Annex I-Communication and Outreach Plan for AOR Phase I



1. BACKGROUND

As conditions continue to change, and new opportunities and challenges emerge, the Arctic has become an area of intense international focus and discussion, especially with respect to the governance of the Arctic marine environment. At the forefront of these emerging issues is the Arctic Council - an intergovernmental forum that successfully promotes cooperation, coordination and interaction among Arctic States on circumpolar sustainable development issues, with involvement from Arctic Indigenous communities and Observers.

The Working Group for the Protection of the Arctic Marine Environment (PAME) is one of six working groups of the Arctic Council, and is responsible for promoting the protection and sustainable use of the Arctic marine environment through a broad range of policy issues that relate to the state of the Arctic marine environment, including pollution prevention, marine biodiversity, and marine resource development.

In April 2009, Arctic Council Ministers approved a proposal by PAME to conduct an Arctic Ocean Review (AOR) as a follow-up to the 2004 Arctic Marine Strategic Plan, which states that the Council shall:

“Periodically review the status and adequacy of international/regional agreements and standards that have application in the Arctic marine environment, new scientific knowledge of emerging substances of concern, and analyze the applicability of a regional seas agreement to the Arctic.” (Strategic Action 7.3.4)

This initiative is being co-led by Canada, Iceland, Norway, the Russian Federation and the United States. In essence, the AOR is a multi-phased project that will result in a review of global and regional measures that are in place for the protection and sustainable use of the Arctic marine environment, and analyze options to strengthen Arctic governance as necessary. In Phase I (2009-2011), the AOR will focus on information gathering and outreach, which will be done in close coordination with other Working Groups of the Arctic Council and Permanent Participants. Phase I will result in a report to Arctic Council Ministers in 2011, outlining existing measures.

Although not the focus of this communication plan, Phase II (2011-2013) will focus on analyzing information gathered in Phase I and reporting to the Arctic Council. Phase II will place an emphasis on areas where the Arctic Council can effectively add value to the existing

mechanisms of governance for the Arctic marine environment, and will serve as validation for future direction of the Arctic Council in relation to the Arctic marine environment.

It is important to note that the AOR will not initiate a new assessment, but will be based on existing work. The overall objective is to provide guidance to Arctic Council Ministers as a means to support strong governance in the Arctic through a cooperative, coordinated and integrated approach to the management of the Arctic marine environment. The AOR will be an important initiative that will provide a voice for the Arctic Council about how Member States are addressing opportunities and challenges facing the Arctic.

Because of the work of the Arctic Council, the pressures to the Arctic marine environment can be better understood and are higher on the international agenda than in recent years. It is therefore timely to undertake a review of the global and regional measures (voluntary and mandatory) that are relevant to the protection and sustainable use of the Arctic marine environment, as well as activities of the Arctic Council, in order to clearly demonstrate Arctic Council Member States' stewardship efforts to the global community.

2. GOAL

The goal of this communication and outreach plan is to provide clear and thorough information about the AOR project during the development of Phase I, and encourage input and participation by members of the Arctic Council, inhabitants of the Arctic Region, and the global community.

3. OBJECTIVES

The overall objective of this plan is to provide effective communication and outreach, both within and outside of the Arctic, on efforts related to the AOR project. This includes:

- Informing target audiences of the AOR, with a specific focus on Phase I activities and outcomes;
- Ensuring that relevant stakeholders have access to information supporting the AOR; and,
- Encouraging participation in the AOR by members of the target audiences.

4. TARGET AUDIENCES

The Arctic Council and PAME understand that there is a variety of stakeholders interested in the conservation and sustainable use of the Arctic marine environment. If the AOR is to be a thorough and credible Arctic Council product, effective communication with the following target audiences will be important:

- **Members of the Arctic Council and its six working groups;**
- **Inhabitants of the Arctic;**
- **Members of the international community interested in the management/governance of the Arctic marine environment;**
- **Relevant environmental non-governmental organizations; and,**
- **National and international media.**

5. EFFECTIVE COMMUNICATION

Phase I of the AOR should be communicated in a way that is accessible to Arctic inhabitants and others interested in the conservation and sustainable use of the Arctic marine environment. Communication tools should be developed with attention to the various language, literacy and cultural profiles existing among the target audiences.

6. ARCTIC OCEAN REVIEW KEY MESSAGES

Communication and outreach activities during Phase I of the AOR will highlight the vision, goals and strategic importance of the AOR, and Arctic Council Member States' stewardship efforts related to the conservation and sustainable use of the Arctic marine environment.

Vision:

Promote a healthy and productive Arctic Ocean and coasts that support environmental, economic and socio-cultural values for current and future generations.

Goals:

- Provide guidance to Arctic Council Ministers as a means to support strong management of the Arctic marine environment; and,
- Clearly demonstrate Arctic Council Member States' efforts in governing the Arctic marine environment and addressing opportunities and challenges facing the Arctic Region.

Strategic Measures:



7. PRODUCTS AND ACTIVITIES

Phase I of the AOR will consist of the following communication and outreach products and activities:

- Communication and Outreach Plan for the Arctic Ocean Review (Phase I: 2009-2011);
- AOR brochures and posters;
- Dedicated AOR area on the PAME website;
- Outreach activities (e.g. presentations) within and outside of the Arctic; and,
- AOR Workshop in Fall 2010.

This variety of products and activities will assist PAME with conducting effective communication and outreach with each of the target audiences. For example, Arctic Council Working Group Chairs have been informed about the AOR by way of a letter from the PAME Chair, and have been invited by the Project Manager to actively participate in and contribute to the AOR, starting with a meeting among the Working Group Chairs in March 2010. Members of the six Arctic Council Working Groups will have access to the AOR communication and outreach products and activities listed above in an effort to strengthen their understanding of the AOR and encourage participation.

Inhabitants of the Arctic, as well as members of the international community and relevant environmental non-governmental organizations will have access to the communication and outreach plan, AOR brochures and posters, and information posted on the PAME website. They are also welcome to provide information to the Project Manager and input at selected outreach sessions within and outside of the Arctic.

8. OPPORTUNITIES

Ensure Arctic Council Ministers, Senior Arctic Officials, Working Group Chairs, Permanent Participants, and relevant Observers are aware of the AOR, and by way of this communication and outreach plan, the AOR will be introduced to the broader public. Further communication of the AOR should be undertaken in the short-term in order to take advantage of the current high level of interest in the management and governance of the Arctic marine environment, and to clarify potential confusion with similar non-Arctic Council initiatives. However, long-term communication efforts should also be considered given the AOR is a multi year, multi-phase initiative.

Communication activities will be undertaken by PAME and AOR lead countries in order to reach as many members of the target audiences as possible. In addition to planned PAME events, AOR lead countries and Project manager will also conduct outreach sessions within and outside of the Arctic using relevant regional and national fora.

9. EFFECTIVENESS

The AOR is expected to be a high profile project for both PAME and the Arctic Council given the current high level of interest in the Arctic marine environment. The effectiveness of this communication and outreach plan will be measured by:

- Input received from target audiences during Phase I of the AOR (2009-2011);

- Attendance at the AOR technical workshop, and various regional and national outreach sessions; and,
- Effective collaboration with other Arctic Council Working Groups and Permanent Participants, as well as expert input from Observers and other relevant stakeholders as needed.

Media coverage and other reports that result from the AOR will be monitored and analyzed by lead countries and the PAME Secretariat to assist in evaluating the effectiveness of the communication and outreach efforts proposed in this plan. The Communication and Outreach Plan for the Arctic Ocean Review (Phase I: 2009-2011) will be periodically reviewed and updated by PAME as necessary.

Annex II - Norwegian draft proposal for a PAME project as a follow up of the AMSA-report recommendation (I)B

Project to compile existing knowledge on risks related to, and effects on, the environment in the high Arctic from use, carriage and spills of heavy fuel oils (HFO) from ships, including possibilities in international regulations to reduce the identified risks and effects.

1. Introduction

The Ministers of the Arctic Council in its Tromsø meeting in the spring 2009, in the Tromsø Declaration, agreed to:

Encourage active cooperation within the International Maritime Organization (IMO) on development of relevant measures to reduce the environmental impacts of shipping in Arctic waters.

One of the follow-up recommendations in the AMSA report is to “Especially consider the identification of, environmental risks and options for, avoiding or minimizing those risks regarding the use and carriage of heavy fuel oil, aiming at establishment of appropriate international regulations.” And in that context to encourage co-operation and the development of unified positions to the extent possible among Arctic states”.

This is further elaborated in Colum 2 and 3 of I)B of the Matrix for AMSA-follow-up, as agreed to at PAME I-2009, which states: To develop, and possibly forward, a jointly supported proposal to IMO amending Annex I of MARPOL 73/78 with the aim to reduce the probability for heavy fuel oil (HFO) spills from ships in the high Arctic.

The Marine Environmental Protection Committee (MEPC) of the International Maritime Organization (IMO) at its 59th session in July 2009 approved in principle to amend Annex I of the International Convention for the Prevention of Pollution from Ships (MARPOL), in effect banning the use and carriage of heavy fuel oil (HFO) on ships in the Antarctic Sea Area (South of 60 degrees south). This amendment is due for final adoption by MEPC 60 at its meeting commencing 22nd Mars 2010.

However the degree of present civil infrastructure (human settlements, industry, ports and harbours etc), the present use of maritime areas and a number of environmental conditions are different in the Arctic compared to the Antarctic. As a first step towards developing a joint Arctic proposal on this issue to the IMO it may therefore be necessary to compile existing knowledge on the use and carriage of HFO in the Arctic, as well as on effects of HFO spill. This would enable us to estimate the consequences of possible HFO spills as a function of risk and effects for the Arctic. The same analysis should also look into possibilities in existing international regulations that could reduce the identified risks and effects. In addition to the risk of oil spills the use of HFO as fuel may have consequences on air pollution, including the formation of black carbon. This should also be looked into by the analysis.

Based on the report(s) from this project the eight Arctic states could, if agreement is reached, possibly forward, a jointly supported proposal to IMO amending Annex I of MARPOL 73/78 with the aim to reduce the probability for HFO spills from ships in the high Arctic.

The purpose of this document is therefore to agree to start a process to this aim.

2. Objective

The overall objective of the project is to reduce or avoid risks to and effects on the environment in the high Arctic from spills of heavy fuel oil from ships. Based on the above we propose a project in two phases:

Phase I: 2010-2011:

The aim of phase I) is to compile existing knowledge on actual use and carriage of HFO, risks related to it , and potential effects on the environment in the high Arctic from spills of heavy fuel oils (HFO) from ships, including possibilities in international regulations to reduce the identified risks and effects. In addition to the risk of oil spills, the use of HFO as fuel may have consequences on air pollution, including the formation of black carbon. This should also be looked into by the analysis.

Phase II: 2011-2012:

The aim of phase II) is to develop a draft joint proposal from PAME to the Arctic Council. Based on this, possibly the 8 Arctic states could develop and forward an agreed proposal to IMO amending Annex I of MARPOL 73/78 with the aim to reduce the probability for HFO spills from ships in the high Arctic.

3. Project management

The HFO-project will be led by Norway. Co-leads will be appreciated.

4. Outcomes

Phase I): Report(s) compiling existing knowledge on the issues mentioned above.

Phase II): Joint PAME proposal to the Arctic Council effectively reducing the risk of oil spills involving HFO oils in the Arctic Marine Environment.

5. Workplan phase I)

February 2010 – proposal put forward by Norway

March 2010 – decision to initiate the project made at PAME-I 2010.

March 2010 – April 2010: Intersessional agreement on mandate for compilation survey (which issues should the consultant cover, see possible items in annex I)

December 2010: Consultant delivers final report.

6. Budget

The work should be done in conjunction with the ordinary PAME-meetings, or by. Research and development projects would have to be supported by states involved in the project.

7. Based on the above PAME-I 2010 is asked to:

- Discuss and agree to the proposed project proposal
- Consider whether to establish a contact group with national (IMO) experts. The contact group should meet in conjunction with the ordinary PAME-meetings, and when necessary by correspondence (e-mail)

Annex I: Points which needs to be considered in a mandate for a compilation of existing knowledge regarding the carriage, use of heavy fuel oils by ships in the high Arctic:

Use

Black Carbon

The use of heavy grade fuels will most probably release large amounts of Black Carbon (BC) into the Arctic atmospheric environment (see for reference MEPC 60/4/xx). The amount of release of BC is partly a function of in engine processes, but partly also a function of the grade of oil used for fuel, basically it could be expected that there is a relation between higher sulphur and asphaltene content and higher BC discharge. The knowledge base could however be better and more information is needed.

Formation of oily waste

Ships may use heavy grade oil as fuel (heavy fuel oil). All engines produce a certain amount of engine room waste due to in engine processes including fuel filtering etc. Under the conditions present in the Arctic it could be assumed that the amount of waste produced from handling of the fuel may possible be larger than in more temperate conditions. The knowledge base on formation of oily waste under arctic conditions could however be better and more information is needed.

Safety aspects

Heavy grade oil as fuel or heavy fuel oil an only be functional above certain temperatures to be pumped around on the ship into the engines. At certain ambient temperatures, use of heavy fuel oil therefore represent increased risk for ships in polar waters. The main effect could be black out in the engine room i.e. that the main engines abruptly stops with the effect that the ships loses control possibilities. The time that elapses whilst such situations are dealt with could very well be critical. Our knowledge in this area is not good and more knowledge should be sought.

Oil Spills

Regarding oil spills, heavy grade oils represent oils that are particularly more difficult to handle and for example remove from the environment after accidental releases than lighter products. This has already led IMO to develop and agree on a proposed ban on use and carriage of heavy grade oils south of 60 degrees south, to be finally decided at MEPC 60.

Whilst there are striking similarities between the Arctic and the Antarctic marine environment regarding remoteness, harsh climatic conditions, the light conditions and ice conditions, there are also striking differences in that whilst the Antarctica as in the world south of 60 degrees south is unpopulated, (no human settlements) and without any civil infrastructure, the Arctic is at least partly heavily populated including cities and population centres. Antarctic is not exploited regarding mining or oil and gas whilst there are huge mining operations and oil and gas fields operating in the Arctic or transporting their production through arctic waters.

ⁱ MARPOL Annex I is the Annex regulating discharges and pollution from oil in the International Convention on protection of the marine environment from ships (MARPOL)

Annex II

INTERNATIONAL MARITIME ORGANIZATION



IMO

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MARINE ENVIRONMENT PROTECTION
COMMITTEE

60th session
Agenda item 4

MEPC 60/4/xx
15 January 2010
Original: ENGLISH

PREVENTION OF AIR POLLUTION FROM SHIPS

Reduction of emissions of black carbon from shipping in the Arctic

Submitted by Norway, Sweden and the United States

SUMMARY

<i>Executive summary:</i>	This document discusses the impacts of black carbon (BC) emissions from shipping on the Arctic climate, the importance of that impact, and several approaches to reduce those emissions. This document also sets forth several potential initial proposals for action that MEPC might consider to reduce BC emissions from shipping that impact the Arctic.
<i>Strategic direction:</i>	7.
<i>High-level action:</i>	7.
<i>Planned output:</i>	7.
<i>Action to be taken:</i>	Paragraph 17
<i>Related documents:</i>	MEPC 58/INF.21

Introduction

1 This document discusses the impacts of black carbon (BC) emissions from shipping on the Arctic climate, the importance of that impact, and several approaches to reduce those emissions. This document also sets forth several potential initial proposals for action that MEPC might consider to reduce BC emissions from shipping that impact the Arctic.

Brief Introduction to Black Carbon Impacts

2 Black carbon is a component of particulate matter (PM) and is produced by ships through the incomplete combustion of diesel fuel. Black carbon has a positive climate-forcing effect because it is dark in color. It warms the atmosphere by absorbing incoming sunlight; heated air is available to move around the hemisphere as part of global circulation. Moreover, the impact of black carbon on climate is heightened by several factors:

- .1 Black carbon's warming effect is especially important in the Arctic and within the Arctic Front which extends north of ~40 degrees latitude north. When deposited on snow and ice in the Arctic and lower latitudes, it darkens light surfaces and absorbs energy, causing snow and ice to melt, which further darkens the surface, resulting in the absorption of even more energy in a positive feedback loop.¹
- .2 The Arctic climate is a particularly important part of the global climate system, and the Arctic is warming at an unexpectedly fast rate.
 - a. Over the past century, observed average temperature increases in the Arctic have been more than double the global average of 0.7 degrees C.
 - b. Spring melt date at the North Pole this century is occurring seven days earlier than in the mid twentieth century.
 - c. Arctic sea ice is in a state of ongoing decline, with an 11.7 percent per decade rate of decline since 1979, and an especially sharp drop in 2007. Computer models have substantially under-predicted the speed and size of this decline.
 - d. Many of Greenland's major outlet glaciers have seen rapid acceleration, thinning, and discharge this century; as these land-based glaciers melt, they contribute to global sea level rise.
 - e. Warming temperatures trigger feedback loops that are already melting permafrost, where hundreds of billions of tons of carbon dioxide and methane (another potent greenhouse gas) are stored.
- .3 Black carbon has a much shorter atmospheric lifetime (days to weeks) compared to CO₂ in which a portion of any pulse of emission remains in the atmosphere and heats the planet for 1,000 years or more. Black carbon's shorter lifetime means that the benefits of reductions will be felt much more rapidly in the Arctic and elsewhere.

3 The total warming effect of global BC emissions is estimated to be between 22% and 61% that of annual CO₂ emissions.¹ Over shorter time horizons, black carbon's climate impact is especially great: it is estimated to cause 680 times more warming than the same amount of CO₂ over 100 years, and 2,200 times over 20 years.¹

4 Emissions of black carbon, as a constituent of PM, produce not only climate impacts, but also significant impacts on human health. These impacts include heart attacks, lung cancer, and other heart and lung damage up to and including premature death. Reduction of shipping PM emissions therefore will provide benefits to human health as well as climate.

Black Carbon Shipping Emissions

5 International shipping is a significant emitter of black carbon, emitting between 71,000 and 160,000 metric tons annually.¹ At present, marine vessels emit an estimated 2% of total global BC (and about 3% of CO₂). An estimated 85% of shipping emissions occur in the northern hemisphere, and the release of BC emissions in northern shipping routes affecting the Arctic is particularly damaging and magnifies their impact, as discussed above. Furthermore, as sea ice melts, more sea lanes open up. Although shipping emissions of BC in the Arctic region are relatively small at present, some estimates project they will increase by 2-3 times the global rate between now and 2050.

6 Recent studies indicate that black carbon constitutes between 5% and 15% of world shipping emissions of particulate matter.ⁱ Black carbon, a product of incomplete fuel combustion, is dependent on engine type and combustion efficiency. A recent study found that medium speed marine engines typically used on tugboats, fishing vessels and ferries emit BC at more than twice the rate of slow speed engines used on large ocean-going ships (excepting containerships) and high speed engines used on passenger ships.ⁱ

Potential Approaches to Reduce Black Carbon Emissions

7 Emissions of black carbon is a result of incomplete combustion of the fuel. Combustion depends strongly on the air fuel ratio, fuel injection quality and the temperature and pressure of the air charge. Fuel grade has less influence than the aforementioned factors. It should be underlined though, that it is essential that the engine is optimized towards the fuel grade used. BC emissions are most prominent during start up and transient engine load. Reductions in visible smoke have been achieved successfully through in-engine measures where such reductions have been mandated, e.g for certain cruise ships.

8 At this stage we do not want to be too descriptive in proposing reduction measures on ships, but opportunities to reduce fuel consumption from the world's shipping fleet can include:

- .1 Vessel speed reduction: Fuel consumption increases with a power function of speed (approximating a cubic function in large cargo ships), so a 10% reduction in speed of a vessel may result in ~23% reduction in CO₂ emissions, while a 34% speed reduction (even assuming a 40% increase in the number of vessels) can reduce emissions by ~57%. Additionally, speed reductions will also significantly reduce BC provided the engine load is not reduced to a point where soot emissions increase significantly) .
- .2 Modifications to vessel and propeller design can reduce fuel consumption. These modifications include: hull optimization (e.g. use of a stern flap which lengthens the bottom surface of a hull; replacement of flat bottom hull surface with air cavity system), propeller system improvements, propeller coatings, and a bulbous bow.
- .3 Maximum use of alternate power technologies: one of the most promising is wind-sails and kites can assist in ship propulsion, reducing fuel consumption

and thus BC and other pollutants.

- 4 Measures to improve ship routing and logistics: Such measures include: planning to better utilize existing fleets; weather routing to exploit favorable weather and currents; just-in-time routing; reduced time at port through optimal cargo handling, berthing, mooring and anchoring; and, improved terminal operations to reduce delays.ⁱ

9 Apart from reducing BC and other GHG emissions by reducing fuel consumption, BC may also be reduced by the use of specific pollution control measures. These include:

- In-engine measures
- Installation of diesel particulate filters (DPF);
- Use of water-in-fuel emulsification on demand; and
- Replacement of conventional fuel valves with slide valves.ⁱ

10 In-engine measures to reduce smoke include improved fuel injection systems (e.g. common rail) modified turbochargers and more. Several engine manufacturers presently use in-engine technology deliver engines with lower smoke emissions as compared to standard engines.

11 Diesel particulate filters (DPF) are after-treatment devices that are particularly effective at controlling BC, reducing emissions by 95 to 99.9% by mass (with 70-95% reductions in total PM).ⁱ This technology is suitable only for high grade (ideally ultra low sulphur automotive fuel) distillate fuels and cannot be used with residual fuels.

12 Emulsification on demand consists of introducing water into fuel prior to injection into the combustion chamber, and is estimated to reduce PM and BC by 2 to 3 times the amount of water introduced. Water injection also reduces NOx by an amount roughly equal to the amount of water used.ⁱ

13 Slide valves produce more complete combustion than conventional valves, reducing PM and BC by 25% or more. NOx is also reduced, by about 10-25%. Slide valve replacement is extremely cost-effective, having a total incremental installation cost of less than \$700 per valve.ⁱ Slide valves cannot be used on all engines.

Proposal

14 Emissions of black carbon have serious impacts on the Arctic, and we reiterate the following main points:

- .1 the Arctic climate is warming much faster than the rest of the planet;
- .2 rapid melting of Arctic land- and sea-ice is accelerating that warming;
- .3 black carbon emissions, especially when deposited on land- and sea-ice, are a significant contributor to that warming and melting;
- .4 reductions of black carbon now can provide short-term climate responses that are absolutely necessary to forestall a climate “tipping point,” thereby providing the climate “breathing time” for the needed reductions in CO2 to take hold over the longer term; and
- .5 reductions of black carbon will have positive effects on human health.

15 In light of the above, and because shipping is a contributor to black carbon emissions, and because shipping traffic in the Arctic is expected to grow substantially as the ongoing melting process opens up sea lanes in the region, it is important that MEPC consider actions to respond to the effects described above.

16 Consistent with the work being undertaken on SO_x and NO_x reductions, it is therefore proposed that the Committee discuss how to address this air pollutant by examining potential measures to be recommended or required to significantly reduce BC emissions from shipping having an impact in the Arctic. Such measures should not impose other environmental risks to the Arctic Environment.

Action requested by the Committee

17 The Committee is invited to consider the information and proposal presented in this document and take action as appropriate.