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**Review of candidate Measures to Reduce GHG emissions from international shipping**

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**SUMMARY**

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| *Executive summary:* | This document reviews each of the candidate GHG emissions reduction measures contained within the Initial IMO strategy on reduction of GHG emissions from ships and provides comments for the consideration of the Committee. |
| *Strategic direction:* | |
| *High-level action:* | |
| *Output:* | |
| *Action to be taken:* | Paragraph 86 |
| *Related documents:* | MEPC.304(72), MEPC.281(70), MEPC.282(70), MEPC.1/Circ.850/Rev.2, MEPC.1/Circ.684, MEPC 65/22, MEPC.67/5/4, MEPC.65/4/30, MEPC.72/Inf.5, ISWG-GHG 2/2/7, ISWG-GHG 3/2/10, SSE.5/17 |


## Introduction

1. The Committee, at MEPC 72, adopted the Initial IMO strategy on reduction of GHG emissions from ships (MEPC.304(72)) (the initial strategy). The co-sponsors welcome the adoption of the initial strategy and consider it to be a major step forward for the international shipping sector, setting out a pathway for the phase-out of GHG emissions.

2. The initial strategy includes candidate short-term, mid-term and long-term measures for reducing GHG emissions. Short-term measures should be finalized and agreed by the Committee between 2018 and 2023.

3. The co-sponsors consider that GHG emission reduction measures should be effective, and that short term measures should be agreed and implemented as quickly as possible. This document reviews each of the candidate measures within the initial strategy and provides comments for the consideration of the Committee.

**Discussion - Consideration of candidate short term measures to reduce GHG emissions from ships**

**Further improvement of the existing energy efficiency framework with a focus on EEDI and SEEMP, taking into account the outcome of the review of EEDI regulations**

4. This candidate measure would strengthen existing mandatory provisions of MARPOL Annex VI Chapter IV.

5. The co-sponsors consider that strengthening these existing mechanisms would offer compelling advantages relative to other candidate short term measures included within the initial strategy:

1. Since both the EEDI and SEEMP are already mandatory requirements. The necessary regulatory amendments to strengthen them are minor and could be agreed relatively quickly;
2. Ship builders, classification societies and owners already understand the EEDI and SEEMP;
3. The EEDI and SEEMP allow shipbuilders and shipowners to identify the most appropriate means of improving efficiency and lowering GHG emissions;
4. The weighting of installed power in the EEDI calculation already pushes ship designers towards designing ships with lower service speeds, obviating the need to consider speed reduction and optimisation as a separate measure;
5. The EEDI calculation already includes provision for low carbon fuels and innovative efficiency measures;
6. Unlike other candidate measures, the attained EEDI value of a ship is verified under controlled, standardised conditions and so is not influenced by factors and parameters beyond the ship's control;
7. The SEEMP already provides a mandatory mechanism to promote improved operational energy efficiency. Strengthening the SEEMP would be effective and quicker than implementing alternative short term measures;
8. The SEEMP guidelines (MEPC.282(70)) provide comprehensive guidance which already includes speed optimization and use of operational indicators. The guidelines recognize that no two shipping companies are the same and that ships operate under a wide range of different conditions, making them scaleable and suitable for all ships;
9. The SEEMP guidelines are based on four steps; planning,implementation, monitoring, and self-evaluation and improvement. Thus they already include an assessment and improvement stage;
10. Both the EEDI and SEEMP are relatively straightforward to verify, minimising administrative burden for Member States and industry.

6. There are, however, some concerns with the EEDI and SEEMP, principally:

1. The EEDI reference lines were established following an analysis of the existing fleet up to 2009. This has resulted in some ship types facing severe challenges in achieving EEDI phases 2 and 3 (e.g. bulk carriers and tankers) while other ship types have reduced EEDI values more quickly and more deeply than was anticipated;
2. The weighting of installed power in the EEDI calculation has incentivised reducing installed power, leading to concerns that ships may be provided with insufficient power

to manoeuvre safely. The co-sponsors consider the interim guidelines for minimum power (MEPC.1/Circ.850/Rev.2) to be suitable. However, work to develop new guidelines is still not complete; thus, for affected ship types, the guidelines should be finalized before further strengthening of the EEDI regulation is considered. These issues are described in detail in document MEPC 73/xx/yy.

3. Although the SEEMP is a mandatory requirement, and the guidelines for developing a SEEMP (MEPC.282(70)) include provisions for review and improvement there is no mandated requirement for it to be amended based on ship performance.

7. The co-sponsors consider that the concerns identified in paragraph 6 could be addressed by:

1. Finalizing the development of new minimum power guidelines;
2. Agreeing further EEDI reductions where appropriate;
3. Making the SEEMP subject to the same mandatory review process as the ships Safety Management System (SMS) to drive continuous improvement.

8. Measures to strengthen the EEDI and SEEMP could be implemented quickly, requiring relatively minor amendments to existing IMO instruments and providing a quick and effective way for the Organization to begin implementing the initial strategy.

9. Future EEDI reduction rates should balance stretching the industry to produce more efficient designs with ensuring that safety is not compromised. This is consistent with 3.1.1 and 3.1.2 of the initial strategy (MEPC.304(72). The steady improvements seen in attained EEDI values demonstrate the achievements of the industry in reducing GHG emissions.

**Technical and operational energy efficiency indicators in line with the three-step approach that can be utilized to indicate and enhance the energy efficiency performance of shipping**

10. A number of operational energy efficiency indicators have been proposed to the Committee, including the Energy Efficiency Operational Indicator (EEOI) (MEPC.1/Circ.684), Annual Efficiency Ratio (AER) (MEPC.67/5/4), Individual Ship Performance Indicator (ISPI) (MEPC.65/4/30), Energy Efficiency per Service Hour (EESH) (MEPC.65/4/19) and Fuel Oil Reduction Strategy (FORS) (MEPC.65/4/30). Each of these indicators has both positive and negative attributes.

11. None of the proposed indicators listed in paragraph 10 is suitable for all ship types and all ship operating patterns.

12. The indicators listed in paragraph 10 rely to some extent on assumptions. For example, some are based on the use of transport supply (deadweight tonnes) as a key metric and in general they fail to consider asymmetric trading patterns or influence of sea conditions, weather and current. Importantly, the co-sponsors would draw attention to the fact that many important decisions which determine operational efficiency (for example, route deployment, vessel loading, passage speed) are made by charterers, not shipowners or the ship's crew. They would not provide meaningful, comparable values but it is almost certain that should such values enter the public domain they would be used unfairly to promote some ships as being better than others.

13. Document MEPC.72/Inf.5 (INTERTANKO) analysed some operational efficiency indicators by studying a series of identical sister ships operated by the same company. The results obtained varied significantly, despite the ships being sister ships operated in the same way. This is not surprising since the trading pattern of a ship is determined by factors beyond the

control of shipowners (i.e. charterers' requirements, global trade and geography), whilst weather conditions are outside of all human control. The INTERTANKO study proposed another indexing measure, the Energy Efficiency Technical Index (EETI) which introduces corrections for speed and vessel utilisation in order to reduce variability. Document ISWG-GHG 2/2/7 (Argentina, China, India and the Philippines) also analysed operational energy efficiency indicators and arrived at similar conclusions to those found in MEPC.72/Inf.5.

14. The AER is derived from the EEOI and is intended to even out per-voyage variations. It is based on transport supply (deadweight) and distance travelled. Although AER is relatively simple to calculate, use of transport supply means the resulting figure is somewhat arbitrary, with no correction for ballast voyages, actual vessel loading or for conditions outside the control of the ship such as weather.

15. ISPI expresses ship performance in gCO2/nm. Data such as fuel consumption, fuel type, and distance travelled would be used to establish ship specific operational reference values. The proposal does not account for ship utilisation. This has been expanded to propose measures for existing ships without a certified EEDI value based on using the Estimated Index Value (EIV) along with an Energy Efficiency Standard Value (EESV) to establish a ship specific Variance (Vc) factor which could be used to compare ships. The standard reference (Vc) datum point would be 1 (i.e. EIV = EESV), a value greater than 1 would indicate lower efficiency, a value less than 1 greater efficiency. This could be used with an Efficiency Improvement Target (EIT). The scheme would be based on fuel consumption and distance travelled and appears to rely on a series of currently ill-defined assumptions which could result in some ships being assigned inappropriate reference values resulting from their trading patterns during the period for which data was collected to establish these values. Importantly, the EIV is not a certified value. The co-sponsors do not consider the ISPI to be a workable tool and that it would distort markets and penalise certain trade routes and ships. Establishing reference values based on historic operational data which will be used to quantify future operational performance is highly problematic since such historic data which may be completely irrelevant in terms of future operations. As such, it is not supported.

16. EESH would use service hours as a proxy for transport work and transport supply with no consideration of deadweight or cargo carried. The EESH would be expressed in Joules of energy. It is claimed that this would incentivise non-fuel energy such as wind power. After a data collecting phase a series of baseline curves would be established followed by attained energy efficiency standards. This proposal assumes that historic ship operating data can be used to establish a series of baseline curves despite the fact that such historical data may be irrelevant if a ship is re-deployed or market demands change.

17. FORS is intended to reduce fuel consumption by establishing a ship specific reference value and then mandating a reduction factor below this reference value. The reduction factor would be set by MEPC taking into account the reduction potential of ships. This would risk penalising highly efficient ships by requiring them to meet fuel use reduction targets derived from an analysis of ship type average performance. The same concerns with respect to using historic operational data to set targets for future operational performance expressed in paragraphs 15 and 16 also apply to this proposal.

18. No single operational energy efficiency indicator is suitable for all ships. For example, ships engaged in bulk/tramp shipping have to obey charterers' instructions regarding service speed, itinerary and amount of cargo to be shipped when under time charter. Such ships carry 83,36% of world seaborne trade in cargo ton-miles (UNCTAD, 2016). Such interaction with charterers is not limited to tramp trades, as many ships engaged in liner trades operate on charter and are redeployed between different routes with very different operating conditions. Owner operated liner vessels are also redeployed between different routes with very different

operating profiles meaning that historic data for operational performance may be rendered irrelevant as a means to assess future (or current) performance. The co-sponsors consider that any suitable key performance indicator (KPI) could be considered where it can be demonstrated to be an effective performance monitoring tool and more appropriate for a particular ship than the operational energy efficiency indicators listed in paragraph 10. Unlike the EEDI regulation which affects ship types with an assigned EEDI, the SEEMP requirements are applicable to almost all ships which make international voyages. Many ships do not carry either passengers or cargo, and some ships are unique. Operational energy efficiency indicators or KPIs for such ships must recognise that efficiency metrics may be very different in these cases.

19 If published, the results could lead to erroneous conclusions and distortion of trade as a result of using non-comparable values to unfairly rank ships.

20. If used appropriately operational energy efficiency indicators or KPIs could be a useful internal tool, supporting the SEEMP. This is fully consistent with 4.3.1 and 4.3.3 of MEPC.282(70) - *2016 Guidelines for the development of a ship energy efficiency management plan (SEEMP)*. The shipowner could select the most appropriate indicator, or KPI(s), for a particular ship in order to quantify efficiency improvement. This would allow shipowners to define metrics appropriate for particular ships and avoid the potential market distortion that could result from publishing values for different ships which are not comparable.

**Establishment of an Existing Fleet Improvement Programme**

21. Improving the efficiency of existing ships could make a significant contribution to lowering GHG emissions from shipping and is supported.

22. Strengthening the SEEMP, see paragraphs 4 – 9, would improve the efficiency of existing ships without needing to develop a separate existing fleet improvement programme.

**Speed optimization and speed reduction, taking into account safety issues, distance travelled, distortion of the market or trade and that such measure does not impact on shipping's capability to serve remote geographic areas**

23. Reducing the speed of a ship reduces the required power and hence fuel consumption. The significant GHG emissions improvements seen in international shipping over the last decade are the result of reducing speed combined with improvements in machinery and hull design as well as shipowners paying close attention to operational optimisation.

24. How simple speed reductions may appear at first glance it may not be that simple to implement it in the short term. The Committee has recognised that speed reduction could adversely affect areas which are remote from the principal shipping routes and population centres, hence the inclusion of optimization alongside speed reduction (see ISWG-GHG 3/2/10 for analysis of this matter).

25. In practical terms, there is significant uncertainty about what mandatory speed reduction would actually mean. Would there be a mandated speed limit or would the Organization develop measures to reduce speed without establishing speed limits? Would potential speed limits be absolute limits or relative limits (i.e. a % reduction against some reference value for a ship, perhaps design service speed)? Different ship types operate at different speeds and some ship types have much less scope to reduce speed than others. If relative reduction measures were proposed it would be essential to properly consider the requisite speed baselines and that these would almost certainly need to be ship specific and to consider the

nature of trade routes being operated. It is also important to take safety of crews and ships into consideration while fine tuning such measures

26. Despite tools such as AIS tracking and modern data capture technologies, monitoring and enforcement of speed limits would not be a simple task. For example, it would need to consider circumstances where ships need to increase speed to avoid adverse weather or other hazards to safety.

27. The propeller law (i.e. $P \alpha V^3$) is a simplification and breaks down at low speeds as wave resistance becomes more important. Ships reach a point where reducing speed will not result in further reduction of power (and hence fuel consumption) since the power required is a function of wave resistance. The exponential relationship between power and speed means that as speed reduces so the proportionate reductions in power reduce. The big GHG emission reductions which could be achieved by slow steaming have already been made for some ship types and further reductions in speed will not achieve the substantial improvements in GHG emissions reductions from ships seen over the last decade.

28. Emission reductions achieved by reducing speed would be offset by the necessity to operate more ships in order to provide the same transport.

29. Ships must be provided with sufficient power to manoeuvre safely in adverse weather and when in confined waters. Minimum power requirements are provided by the IMO guidelines for minimum power (MEPC.1/Circ.850/Rev.2).

30. De-rated engines must retain sufficient margin to provide sufficient power when needed in adverse weather. There are a variety of mechanisms which degrade engine performance and reduce both efficiency and reliability at high turn down ratios. Some of these problems have been solved in newer electronically controlled engines, however it should be noted that a large part of the existing fleet is not provided with these newer engines. Some of these issues include:

1. The combustion process is compromised at low power, thus reducing efficiency;
2. Waste heat recovery systems do not function effectively, reducing overall power system efficiency;
3. Low cylinder jacket water temperatures can cause accelerated engine wear and damage, such as cracked liners;
4. Inefficient combustion causes higher emissions of particulate matter (PM) and Black Carbon;
5. NOx emissions in g/KWhr are higher at low engine loads than for high engine loads; and
6. Cylinder oil is not burned properly, leaving residues which cannot be cleaned unless the engine is not running.

31. Operating ships below their design point may result in lower hydrodynamic efficiency, negating some of the gains made from operating with reduced propulsive power. This can be remedied by re-profiling the bow and stern contours, however this is time consuming, expensive and significantly reduces hull efficiency should it be necessary to increase speed.

32. Some ships have to increase speed for parts of their voyage to avoid missing a berth slot. Better management of congested ports would be a more effective measure to optimise voyage speeds. If ships are slowed down, then supplying the same transport capacity will require additional ship movements. Some ports already suffer congestion, this congestion would only be made worse by increasing the number of ship movements in order to compensate for the loss of transport capacity created by slower speeds.

33. Speed reductions could lead to modal shift and higher aggregate GHG emissions in the case of time sensitive cargo and particularly in the short sea segment.

34. Imposing reduced speed could create barriers to technological innovation, since it would prevent development of efficiency enhancing measures and technologies intended to achieve the necessary EEDI targets without reducing ship speed.

35. The positive attributes of speed reduction can be summarised as:

1. Provided ships do not reduce speed to the point at which the dominant factor affecting power is wave resistance then reducing speed can reduce power and fuel use;
2. For faster ships the resulting reduction in fuel use can be significant; and
3. Speed management, as opposed to speed reduction, is a smarter measure which can be scaled and applied so as to accomodate ships which carry time sensitive cargo or serve remote areas and applied in the most suitable way for each individual ship..

36. The negative attributes of speed reduction can be summarised as:

1. It would be time consuming and difficult to reach agreement on suitable speed limits, either absolute or relative;
2. There would be a heavy administrative burden and practical difficulties in enforcing speed limits;
3. There would be a risk of market distortion and damage to those economies removed from principal shipping routes and large markets unless proper consideration were given to speed optimisation measures;
4. Safety could be compromised by further downsizing of engines or reduced engine reliability resulting from operating at high turn down ratios;
5. Engine efficiency is lower at low loads and emissions of PM, Black Carbon and $NO_x$ higher as loads are reduced beyond certain thresholds that vary by engine;
6. Operating a ship below it's design speed can reduce hull efficiency;
7. Reduction in fuel consumption may be minimal or even zero once speed reaches a point at which wave resistance is the dominant factor;
8. One of the principal reasons for uneven voyage speed profiles is port congestion. Speed measures will only be effective if applied in conjunction with measures to optimize the logistic chain and ports (see paragraphs 41 – 44), unless port capacity is expanded reducing speed will make port congestion worse;
9. Imposing speed reductions could be a barrier to innovation.
10. It could lead to modal shift; and
11. Benefits negated by need for more ships to satisfy cargo trade demand.

37. The advantages associated with speed management could be achieved by strengthening the SEEMP along with more efficient management of ports to avoid congestion. Strengthening the SEEMP would avoid the time necessary to agree separate speed measures, reduce administrative burden and avoid the negative consequences of mandatory speed restrictions.

**Reduce emissions of methane and further enhance measures to address emissions of Volatile Organic Compounds (VOCs)**

38. Using fuel with a lower carbon factor will reduce GHG emissions. One such fuel is natural gas. The carbon factor ($C_f$) of liquefied natural gas for the EEDI calculation is 2.75, compared with 3.206 for marine diesel/gas oil (MDO/MGO) and 3.114 for heavy fuel oil (HFO) (MEPC.281(70)).

39. Depending on the thermodynamic cycle of gas fuelled internal combustion engines emissions of uncombusted natural gas to atmosphere may be significant. This unburnt gas, known as methane slip, is a characteristic of Otto engines. Methane slip is not generally present in significant quantities in the exhaust of gas fuelled diesel engines because of more efficient and almost complete combustion of gas in a gas Diesel engine. Since methane is a more potent GHG than $CO_2$[1], thus even small amounts of methane slip may negate the GHG benefits arising from the lower carbon factor of natural gas.

40. Gas fuelled Otto engines offer some significant advantages relative to gas fuelled Diesel engines since they do not need the high pressure gas supply requirement of gas Diesel engines, emit less $NO_x$ and can operate without a pilot fuel such as oil.

41. Another potential source of VOC emissions is fugitive emissions during bunkering. Some early natural gas fuelled ship proposals envisaged loading fuel from road tankers with no vapour return arrangement, negating much of the claimed GHG benefit.

42. Implementing measures to reduce methane slip and fugitive emissions during bunkering would reduce fuel wastage. Measures to reduce methane slip could be addressed in a similar way to $NO_x$ via engine certification. However, attention should still be paid to methane slip when assessing the lifecycle emissions of natural gas.

**Measures to encourage port developments and activities globally to facilitate reduction of GHG emissions from shipping, including provision of ship and shoreside/onshore power supply from renewable sources, infrastructure to support supply of alternative low-carbon and zero-carbon fuels, and to further optimize the logistic chain and its planning, including ports**

43. The efficiency of shipping is limited by the efficiency of the logistic chain of which shipping forms only a part. Ship speed optimisation will only be effective if ports and the logistics associated with ports and terminals are able to manage their resources (such as berth availability, pilots, tugs, land transport) so as to avoid delays and interruptions.

44. More efficient ports would facilitate more efficient shipping. Reducing congestion could smooth out voyage speed profiles, increase vessel utilization and reduce emissions from ships at anchor waiting for berths (such ships still run their auxiliary engines). However, implementing such improvements is largely outside the control of shipowners.

45. Decarbonising the industry requires significant research and development focused on new fuels and modes of energy conversion to be developed and commercialised. It will be essential for these fuels to be available in ports.

46. Increased provision of cold ironing facilities in ports could encourage the adoption of cold ironing by ships. The co-sponsors consider that the attractiveness of cold ironing is determined by a wide range of variables, particularly the amount of power needed and the cost and technical challenges of providing the necessary infrastructure. For example, the evolution of ship designs may require frequent (and expensive) repositioning of supply points and upgrading of supplies to accommodate increased demands for power. In some cases a cost/benefit analysis may indicate that other measures are more appropriate. Whilst it is beyond the scope of the work of IMO to consider land based electricity generation the co-sponsors would note that many electricity networks are still reliant on fossil fuelled modes of

[1]Intergovernmental Panel on Climate Change (**IPCC**), Climate Change 2013: Physical Science Basis, Anthropogenic and Natural Radiative Forcing, p. 714

generation (including use of coal) and it should not be assumed that the GHG intensity of electricity supplied from shore based sources is lower than that generated onboard. This is particularly true for ship types where engines are integrated into effective energy recovery systems and operate with a heat balance which promotes very high thermal efficiency. Cold ironing will reduce emissions of local pollutants such as $SO_x$, $NO_x$ and PM however it should be noted that there are other technical measures to abate these emissions. Where cold ironing is beneficial, measures should be agreed to ensure that the cost of power provided is no higher than the cost of electricity to other industrial electrical consumers in the vicinity of ports to prevent ships facing excessively high costs. Consideration could also be given to extending the existing fuel duty exemption for marine fossil fuels to shore supplied electricity.

47. This candidate short term measure would be better described as an ongoing measure but should nevertheless be supported.

**Encourage the development and update of national action plans to develop policies and strategies to address GHG emissions from international shipping in accordance with guidelines to be developed by the Organization, taking into account the need to avoid regional or unilateral measures**

48. IMO guidelines for the development of national action plans to address GHG emissions from international shipping could promote consistency and IMO's role as the global regulator for shipping.

49. Guidelines would need to be scaleable, recognising that each Member State faces both unique challenges and opportunities.

50. Since the plans would be based on respective national capabilities, resources and sensitivities, each plan would be different.

51. Developing such guidelines could be time consuming.

52. Industry would welcome such guidelines as reinforcing IMO's role as a global regulator and improving consistency in how national action plans are developed.

**Continue and enhance technical cooperation and capacity-building activities under the ITCP**

53. The IMO Integrated Technical Cooperation Programme (ITCP) assists countries to build their capacity to achieve compliance with IMO regulatory requirements. Using the ITCP to promote technical cooperation and build capacity for GHG emissions reduction measures, particularly in Small Island Developing States (SIDS) and Least Developed Countries (LDC) could accelerate global implementation of such measures.

54. IMO has established the Global MTCC Network (GMN) to build capacity for climate mitigation in the shipping industry. The GMN project has supported the establishment and work of regional technology centres and demonstrates how this short term measure might work in practice.

55. ITCP activities are focused on capacity building in terms of assisting maritime administrations to implement IMO instruments than technology development and capability.

56. Should this candidate measure be adopted then the co-sponsors consider that there should be a focus on building capacity to reduce GHG emissions.

**Initiate research and development activities addressing marine propulsion, alternative low-carbon and zero-carbon fuels, and innovative technologies to further enhance the energy efficiency of ships and establish an International Maritime Research Board to coordinate and oversee these R&D efforts**

57. Decarbonising the shipping industry will require new marine fuels, power and propulsion technologies, and modes of energy conversion. The diverse, globalised nature of ship design and construction and the necessity to amortise research and development (R&D) costs from limited potential sales mean that maritime R&D has tended to lag behind other sectors such as automotive and aerospace. An International Maritime Research Board to coordinate and oversee R&D efforts could be an effective mechanism to maximise the value of R&D work, reduce costs and risk and promote technology development.

58. There is a risk, however, that such a mechanism could result in governmental agencies taking decisions on future technology on behalf of industry, which is in a better position to take such decisions.

59. The principal question to be resolved for this candidate measure is how it might be funded, both in terms of collecting funds and how they are disbursed. Robust mechanisms to ensure that the disbursed funds were used efficiently and to good effect without creating market distortion would be necessary.

**Incentives for first movers to develop and take up new technologies**

60. Incentivising early adoption can accelerate the take up of new technologies, for example the take up and development of renewable energy in some European countries was accelerated by incentives.

61. If not well implemented there is a risk that such incentives might inflate costs, result in poor value for money, disincentivize efficient decision making and be market distorting.

62. Subject to careful consideration of mechanisms used, a system of incentives for early adopters could assist the industry to innovate and accelerate the adoption of new technologies.

**Develop robust lifecycle GHG/carbon intensity guidelines for all types of fuels, in order to prepare for an implementation programme for effective uptake of alternative low-carbon and zero-carbon fuels**

63. Understanding lifecycle GHG intensity of fuels will promote informed decision making. The co-sponsors consider that it is essential to understand the lifecycle GHG intensity of fuels in order to avoid adopting fuels which deliver no net GHG emissions benefit over their lifecycle.

64. Depending on how system boundaries are defined and the methodology used, results of lifecycle GHG analysis for similar fuels may differ significantly. Robust guidelines for such lifecycle analysis would provide consistency and transparency.

65. IMO guidelines for lifecycle GHG analysis would promote consistency and transparency and as such would be welcomed by industry.

**Undertake additional GHG emission studies and consider other studies to inform policy decisions, including the updating of Marginal Abatement Cost Curves and alternative low-carbon and zero-carbon fuels.**

66. IMO will be conducting further GHG studies, previous IMO GHG studies have greatly assisted informed decision making.

67. The co-sponsors would welcome additional IMO GHG studies by independent and impartial bodies.

**Actively promote the work of the Organization to the international community, in particular, to highlight that the Organization, since the 1990s, has developed and adopted technical and operational measures that have consistently provided a reduction of air emissions from ships, and that measures could support the Sustainable Development Goals, including SDG 13 on Climate Change**

68. The co-sponsors consider that it is important for IMO member states and NGOs enjoying consultative status to inform and educate other stakeholders on the IMO's role as a global regulator and its work to combat GHG emissions.

69. This could mitigate the risk of national or regional measures being developed by bodies who are not familiar with the already impressive achievements of IMO in this field and its ongoing work.

**Discussion - Consideration of candidate mid-term measures to reduce GHG emissions from ships**

**Implementation programme for the effective uptake of alternative low-carbon and zero-carbon fuels, including update of national actions plans to specifically consider such fuels**

70. An implementation programme for the effective uptake of alternative fuels could accelerate the adoption of new technologies.

71. It is considered that paragraphs 48 – 52 addressing the development of national action plans, as well as paragraphs 60 – 62 on initiating research and development activities addressing marine propulsion, low-carbon and zero-carbon fuels in the discussion of candidate short term measures also address this candidate mid-term measure.

**Operational energy efficiency measures for both new and existing ships including indicators in line with the three-step approach that can be utilized to indicate and enhance the energy efficiency performance of ships**

72. Please refer to paragraphs 10 – 20 which are also considered to address this candidate mid-term measure

**New/innovative emission reduction mechanism(s), possibly including Market-based Measures (MBMs), to incentivize GHG emission reduction**

73. The industry is open to discussion about new/innovative emission reduction measures, particularly measures that will promote the development of zero $CO_2$ fuels, but suggests this should be deferred until a future session of the ISWG following MEPC 73, after progress has been made with regard to developing short term measures that will deliver immediate additional $CO_2$ reductions before 2023 .

74. The industry is currently considering ideas about possible new/innovative measures and – subject to achieving consensus – may be ready to come forward with detailed ideas at a future session.  In the meantime, the industry does not think it will be productive for IMO to have

further discussions about Market Based Measures (MBMs). The MEPC has previously had extensive discussion about MBMs. It will be recalled that Member States were unable to reach consensus, and discussion about MBMs was suspended in 2013 (MEPC 65/22, paragraph 5.1).

75. Having considered the levels of ambition now agreed as part of the initial IMO strategy, the co-sponsors consider that the GHG reduction goals can in fact be met through technical and operational measures alone, without the need to develop an MBM which would be politically very complex and potentially controversial, especially given the IMO strategy's requirement to be cognizant of the CBDR-RC principle.

76. The development of an MBM would almost certainly require the negotiation of substantial amendments to MARPOL, especially if a new body is required for the collection of payments and to administer their use. Such negotiations would divert limited administrative resources within Member States that are available for the development of additional technical GHG reduction measures that could deliver genuine environmental benefit quickly.

77. The co-sponsors are sceptical of the argument that MBMs might significantly incentivise further CO2 emission reduction. Marine fuel is already, by far, a shipowner's greatest cost and it is already in the commercial interest of ship operators to do everything possible to minimise fuel consumption. Moreover, fuel costs are expected to increase significantly following the introduction of the global 0.50% sulphur in fuel cap in 2020, perhaps by more than 50% (although the quantum of this increase will not become clear until after 1 January 2020).

78. If despite the industry's doubts there is a still a desire among Member States to test the idea that carbon pricing measures might further incentivise the reduction of fuel consumption, the impacts of the implementation of the global sulphur cap will provide the Organization with an obvious case study to test this theory. The co-sponsors therefore suggest that the Organization should undertake some proper in depth research after the global sulphur cap has been implemented, before giving any further consideration to the possibility of developing of an MBM.

**Further continue and enhance technical cooperation and capacity-building activities such as under the ITCP**

79. Please refer to paragraphs 53 – 56 which are considered to address this candidate mid-term measure.

**Development of a feedback mechanism to enable lessons learned on implementation of measures to be collated and shared through a possible information exchange on best practice.**

80. A feedback mechanism to assess the effectiveness of measures would demonstrate the success (or otherwise) of such measures.

81. Sharing best practices would assist those who are less advanced in their energy transition than early movers and technology leaders and is supported by the co-sponsors.

82. Utilising feedback and lessons learned should underpin all IMO activities and is fully supported by the co-sponsors.

**Discussion - Consideration of candidate long-term measures to reduce GHG emissions from ships**

**Pursue the development and provision of zero-carbon or fossil-free fuels to enable the shipping sector to assess and consider decarbonization in the second half of the century**

83. Please refer to paragraphs 57 – 59 which are considered to address this candidate long-term measure. The co-sponsors would, however, note that the potential for innovation is not the same for all type of vessels and all sectors.

**Encourage and facilitate the general adoption of other possible new/innovative emission reduction mechanism(s).**

84. Please refer to paragraphs 43 – 47, 57 – 59 and 73 - 79 which are also considered to address this candidate long-term measure

**Action requested by the Committee.**

86. The Committee is invited to consider the comments contained in this submission and to take action as appropriate.