INTERNATIONAL MARITIME ORGANIZATION

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MARINE ENVIRONMENT PROTECTION COMMITTEE
60th session
Agenda item 4

MEPC 60/4/23
15 January 2010
Original: ENGLISH

PREVENTION OF AIR POLLUTION FROM SHIPS

Alternative emission caps for shipping in 2020 and 2030

Submitted by Norway

SUMMARY

Executive summary:	This document presents alternative emission caps for international shipping in 2020 and 2030 based on four different ambition levels and two IPCC scenarios (A1B and B2)
Strategic direction:	7.3
High-level action:	7.3.1
Planned output:	7.3.1.2
Action to be taken:	Paragraph 26
Related documents:	MEPC 59/INF.10, MEPC 59/4/24 and MEPC 60/INF.19

Introduction

1 As a follow-up to resolution A.963(23), Norway, in document MEPC 59/4/24, presented a methodology on how to set a fair and transparent emission cap for international shipping. The agreements laid down in the Copenhagen Accord make an approach to control total emissions from international shipping even more important.

2 It is stated in the Copenhagen Accord that deep cuts in global emissions are required according to science, and as documented by the IPCC Fourth Assessment Report with a view to reduce global emissions to hold the increase in global temperature below two degrees Celsius, and take action to meet this objective consistent with science and on the basis of equity. The Norwegian support for global actions to meet the two degree Celsius objective is firm and will continue to be firm. The proposals and examples presented in this document intend to provide a methodology enabling IMO to act in support of the limitation in global temperature increase as reflected in the Copenhagen Accord.

3 In this document emission caps for shipping are calculated for a set of ambition levels and IPCC growth scenarios using the methodology outlined in MEPC 59/4/24 (Norway). Various ambition levels are used to illustrate the methodology and implications for emission caps for shipping. Various views on the ambition levels used should not distort a proper consideration of the methodology. This document has also taken into account the outcome of the United Nations Climate Change Conference 2009, and hence is submitted in accordance with the document deadline identified in document MEPC 60/1/Add.1.

Discussion

4 It should be the aim of any maritime market-based mechanism to establish a cap that is effective in terms of limiting emissions and contributing to limiting global warming, as well as being perceived as fair, in that it balances the reduction potential and abatement costs for the maritime industry, and ensures that shipping is not unfairly burdened compared to other industries.

5 In document MEPC 59/4/24 a methodology was outlined (Figure 1) where a CO_2 emission cap for international shipping can be determined based on a global emission target, using the principle of equal marginal abatement cost for sharing mitigation efforts across sectors. An example estimating the cap using the two degree Celsius target was provided. In this document a set of reduction targets or ambition levels are used, together with two growth scenarios, to evaluate a broader range of possible emission caps. In addition, updated marginal abatement cost curves (based on MEPC 60/INF.19) showing the reduction potential and cost for the world fleet in 2020 and 2030 have been used.

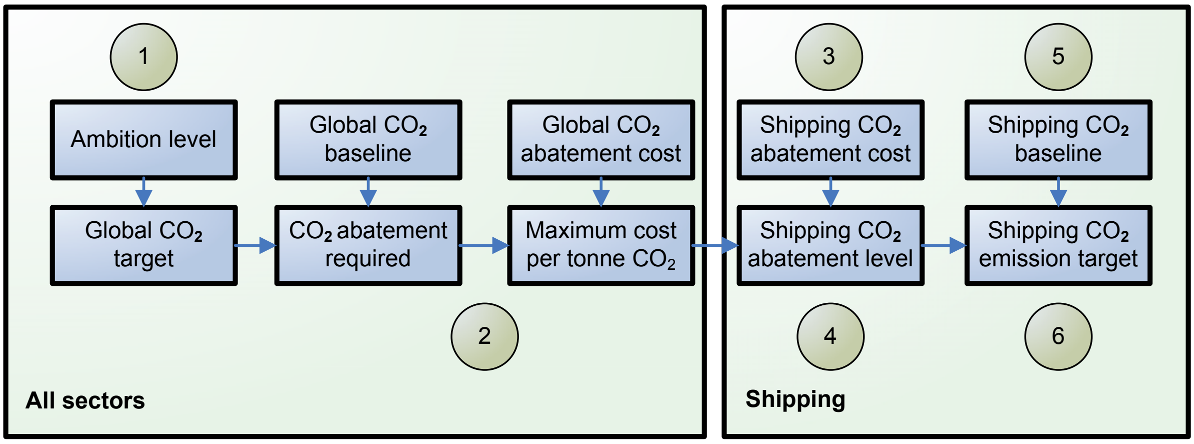

Figure 1: Outline of methodology for determining an emission cap for international shipping (circled numbers refer to steps in the process described in the headlines)

6 The ambition levels presented in this document are based on the UNFCCC process, and are made explicit for Annex 1 and non-Annex 1 countries in order to allow exploring the consequences on shipping emission caps of different outcomes of the UNFCCC process. For shipping the target will be for the whole fleet and not separated on Annex 1 and non-Annex 1 countries.

.1 For Annex 1 countries the global targets are set as emission levels relative to the 1990 level.

.2 For non-Annex 1 countries the ambitions are described in relation to a business-as-usual scenario. The A1B and B2 IPCC scenarios are used.

7 In order to illustrate various implications for international shipping, four alternative ambition levels (characterized as “high I”, “high II”, “medium”, “low”) are studied under two IPCC growth scenarios, A1B and B2. These scenarios are also used for the business-as-usual (BAU) baselines determining the reductions for non-Annex 1 countries. The four ambition levels, which with lower and higher probabilities imply whether the two degree Celsius target can be met, are given in Table 1.

Table 1: Ambition level – emission reduction from 1990 baseline (Annex I) or deviation from business-as-usual (non-Annex I)

	Annex I (Emission reduction commitments relative to 1990-level)		non-Annex I (Policies leading to reductions relative to BAU)	
	2020	**2050**	**2020**	**2050**
Low ambition	10%	85%	5%	40%
Medium ambition	20%	85%	10%	50%
High ambition I	30%	85%	15%	60%
High ambition II	40%	85%	30%	50%

8 The ensuing paragraphs describe in detail the numbers used, assumptions made and the calculation for determining the emission caps.

Step 1: Determine global BAU baselines for future emissions and the target levels needed to achieve the ambition level

9 The first step is to determine the global emission baselines. Table 2 shows the baseline emissions in 1990 and the BAU emissions up to 2050 for the two growth scenarios, split on Annex 1 and non-Annex 1 countries.

Table 2: Global business-as-usual emission baselines for the A1B and B2 scenarios[1]

Gt CO_2-eq/year		Scenario A1B			Scenario B2		
	1990	**2020**	**2030**	**2050**	**2020**	**2030**	**2050**
Annex I	18.5	22.2	23.8	22.3	22.3	24.0	23.8
non-Annex I	12.8	40.6	44.2	54.7	27.5	29.3	34.2
Total	31.4	62.8	68.0	77.0	49.9	53.8	58.0

10 Combining the BAU emission levels in Table 2 and the reduction target under the different ambition levels in Table 1, gives the collective emission target levels for 2020, 2030 and 2050 shown in Table 3 and Figure 2 (High ambition II is not shown). The target for 2030 is determined by the average of the 2020 and 2050 targets resulting in higher levels of emission reduction per year in the first part of the period.

[1] The emission levels for Annex I and non-Annex I in 1990 and 2020 were retrieved from: van Elzen, M.; Höhne, N.: Climatic Change (2008) 91:249–274. For 2030 and 2050 the total emission level were taken from the IPCC Fourth Assessment Report (2007), while the split between Annex and non-Annex 1 were determined by the share in the projections in Bolin, B.; Kheshgi, H. S.: On strategies for reducing greenhouse gas emissions, Proceedings of the National Academy of Sciences, vol. 98 no. 9 4850-4854, April 24, 2001.

Table 3: Emission target levels based on business-as-usual baselines and ambition reduction levels

Gt CO_2-eq/year	Scenario A1B			Scenario B2		
	2020	**2030**	**2050**	**2020**	**2030**	**2050**
Low ambition	55.2	45.4	35.6	42.8	33.1	23.3
Medium ambition	51.3	40.7	30.1	39.6	29.7	19.9
High ambition I	47.5	36.1	24.6	36.4	26.4	16.5
High ambition II	39.5	34.8	30.1	30.4	25.1	19.9

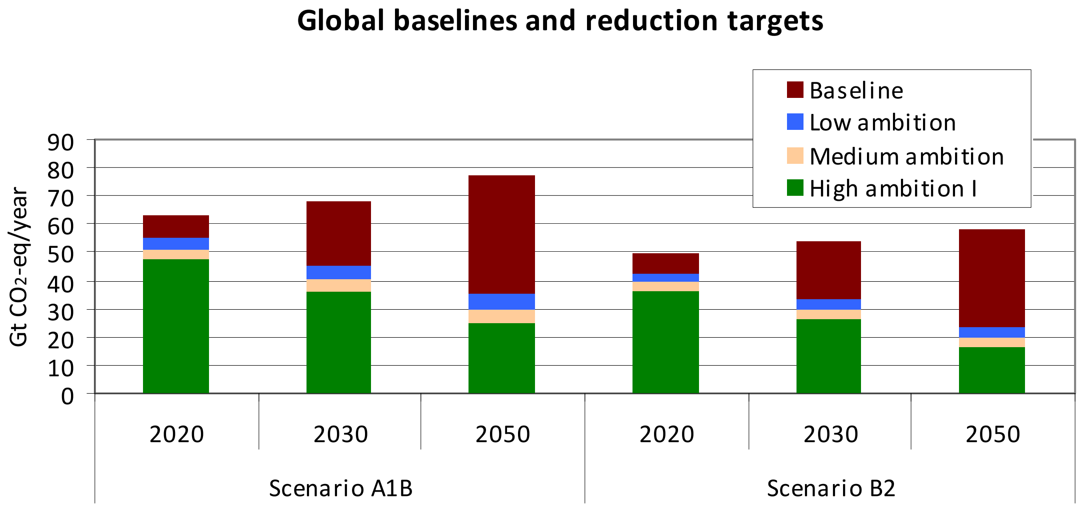

Figure 2: Global emission level baselines and reduction targets

11 Because the ambition levels for non-Annex 1 countries are given as a percentage deviation from the baseline, the emission target under a low growth scenario (B2) will be lower than under a high growth scenario (A1B).

Step 2: Determine the marginal abatement cost of bridging the gap between global BAU baseline and emission targets

12 In step 2 the reduction amount required (Table 3) is used to determine the global marginal reduction cost per tonne CO_2. This document uses the detailed background data on mitigation potential and costs in 2030 presented by WGIII in the IPCC fourth assessment report[2].

13 In the IPCC assessment many different baseline growth scenarios have be used. The reduction potential will, among other thing, be dependent on the baseline. In a high growth scenario, there will be a higher absolute reduction potential for the same mitigation options, than in a low growth scenario. To overcome this, the relative reduction has been used instead of the absolute (which was used in MEPC 59/4/24) to determine the marginal cost. Table 4 shows the relative emission reduction compared to BAU baseline required to achieve the reduction target for the different growth scenarios and ambition levels.

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2 Table 3.13 and 3.14 in Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds), 2007.

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Table 4: Relative emission reduction compared to BAU baseline needed to achieve targets ($GT\ CO_2$-eq per year)

	Scenario A1B			Scenario B2		
	2020	**2030**	**2050**	**2020**	**2030**	**2050**
Low ambition	12%	33%	54%	14%	39%	60%
Medium ambition	18%	40%	61%	21%	45%	66%
High ambition I	24%	47%	68%	27%	51%	72%
High ambition II	37%	49%	61%	39%	53%	66%

15 The reduction levels required for the high ambition level in this study are above the upper boundaries of the mitigation potential assessed in the studies reviewed by the IPCC, where there are no studies going above 40% reduction. Assessing with any accuracy the abatement costs associated with the reduction needs stated in Table 4 for the high ambition level scenarios are not possible based on the data available from the current IPCC reports. In order to avoid making any assumptions on the global cost levels above 40% reduction, the marginal cost have been capped at 200 \$/tonne CO_2.

16 It is realised that the actual cost may be higher and that the reduction amount required from international shipping should in principle be higher than this analysis shows. However, by looking a step ahead, Figure 3 shows the marginal abatement costs for shipping where the cost rises steeply when reaching about 150-200 \$ per tonne CO_2. At these cost ranges, the sensitivity of the shipping cap to the global abatement cost is low, and the potential error in the shipping emission cap will be small (<25 MT). In the following, the two high ambition level scenarios have been merged into one, showing the emission cap at the capped marginal cost of 200 \$/tonne.

17 Table 5 shows the marginal abatement cost per tonne CO_2 needed to achieve the three ambition levels under the two growth scenarios in 2020 and 2030. There are few global mitigation cost studies published for 2020, but the 2020 emission caps are determined by using the same marginal abatement cost level for 2020 as for 2030.

Table 5: Cost of reaching reduction targets in 2030[3]. The same values are used for determining the 2020 emission caps

2008 US\$/tonne CO_2-eq	**Scenario A1B**	**Scenario B2**
Low ambition	71	114
Medium ambition	132	200
High ambition (I and II)	>200	>200

[3] All costs in this document are given in 2008 US\$, while the IPCC reports and MEPC 59/4/24 uses 2000 US\$. These numbers have been converted using the US consumer price index: Bureau of Labor Statistics, U.S. Department Of Labor, ftp://ftp.bls.gov/pub/special.requests/cpi/cpiai.txt, retrieved 23.11.2009.

Steps 3 and 4: Determine the marginal abatement cost and emission reduction potential for shipping

18 In step 3 the marginal costs are used to find the emission reduction potential for shipping. This study uses the marginal abatement cost curve model and data presented in document MEPC 60/INF.19. In the BAU baselines for shipping, no efficiency gains are assumed and all reduction measures and efficiency gains are put into the marginal abatement cost curve. Figure 3 shows the reduction potential for different marginal abatement costs.

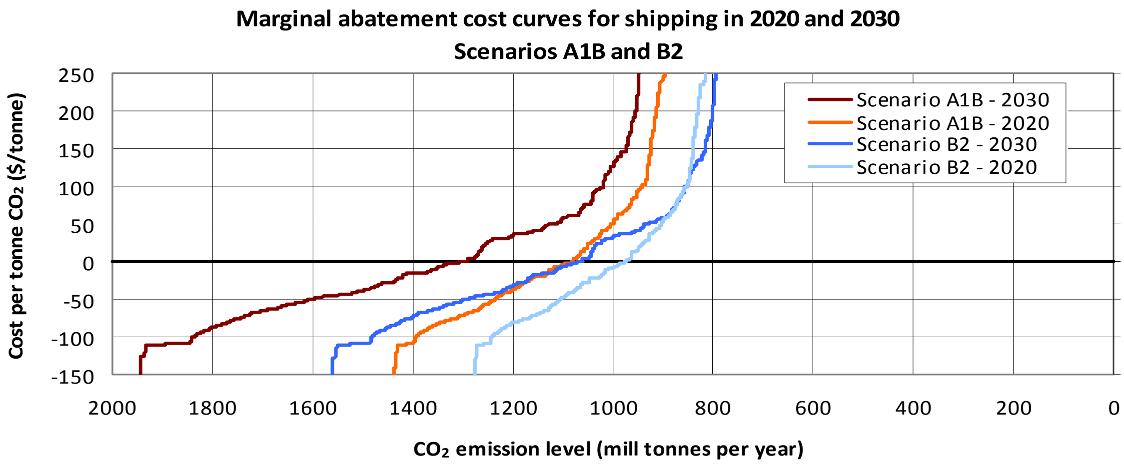

Figure 3: Marginal abatement cost curves for 2020 and 2030 under the A1B and B2 growth scenarios. The curves show the marginal cost (y-axis) for reaching a certain emission level (x-axis). The lines will move to the right with higher reduction potentials. The left ends of the curves indicate the baseline emissions for the different years and growth scenarios.

Step 5: Determine a BAU baselines for future shipping emissions

19 The BAU baselines for shipping for which the marginal abatement costs have been estimated are given in Table 6. In the second IMO GHG Study 2009 (MEPC 59/INF.10), the baselines for 2007 were estimated to 870 MT for international shipping and 1046 MT for total shipping.

Table 6: Shipping emission level baselines

Mt CO_2-eq/year		**Scenario A1B**		**Scenario B2**	
	2007	**2020**	**2030**	**2020**	**2030**
International shipping	870	1200	1632	1067	1309
Total shipping	1046	1443	1962	1283	1574

Step 6: Determine a cap for shipping emissions

20 By subtracting the reduction potential from the BAU baseline level in Table 6, the emission level for shipping can be determined as shown in Table 7 and Figure 4.

Table 7: Emission caps for shipping in 2020 and 2030. For the high ambition target the emission caps are close to the maximum potential

Mt CO_2-eq/year	Scenario A1B		Scenario B2	
	2020	**2030**	**2020**	**2030**
Low ambition	972	1063	847	849
Medium ambition	928	997	831	800
High ambition (I and II)	~913	~954	~831	~800

21 The resulting emission caps (Table 7 and Figure 4) are between about 830 and 970 MT (33-37% reduction) in 2020 and between about 800 and 1060 MT (46-51% reduction) in 2030. For the high ambition targets the levels are close to the maximum mitigation potential and lower targets will lead to significantly higher marginal costs.

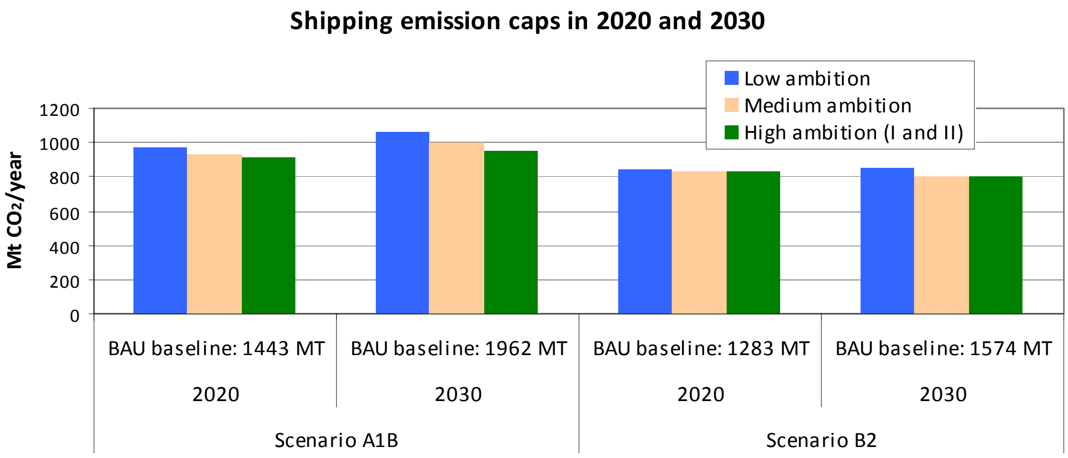

Figure 4: Emission caps in 2020 and 2030 under three ambition levels scenarios and two growth scenarios

Uncertainty

22 There are uncertainties connected to each of the steps in this methodology, and the ensuing paragraphs summarize the most important ones.

23 The global BAU baselines split between Annex 1 and non-Annex 1 countries is taken from a paper published in 2001 (see reference in paragraph 9, Table 2). The growth in recent years has exceeded these projections making any target more difficult to achieve. There is also inherent uncertainty in emission projections or baselines in general.

24 As commented on in paragraph 14, the IPCC has not reviewed studies with reduction potential above 40% compared to BAU. This makes it more difficult to estimate an accurate global marginal abatement cost. However, as the mitigation potential for shipping is very low at costs above 150 \$/tonne CO_2, the cap has been set to the same level for all global marginal abatement costs above 200 \$/tonne. Further research on global mitigation cost for more ambitious reduction levels is needed to improve the accuracy. This is also the case for the shipping analysis where more research is needed on emerging technologies and structural measures. Further studies and technology development within the shipping sector may show more abatement potential at medium to high cost (>50 \$/tonne).

25 Other notable studies which have estimated the future carbon cost include a study by McKinsey: “Pathways to a low-carbon economy”. This study does not report on any mitigation option with costs above 60 €/tonne, but at this cost level it reports emission reductions of 38 GT or 55% relative to a baseline similar to the A1B scenario. Applying 60 €/tonne (90 $/tonne) would give an emission cap of 1039 MT for shipping in 2030.

Action requested of the Committee

26 The Committee is invited to consider this input in its debate on the development of a market-based GHG reduction mechanism and take action as appropriate.

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