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REVIEW OF MARPOL ANNEX VI AND THE NO_X TECHNICAL CODE

New global and regional inventories of air pollution from international shipping

Submitted by the Friends of the Earth International (FOEI)

SUMMARY

Executive summary:	This document describes new and recent information regarding global and regional inventories of emissions of air pollution from ships, as well as health impacts in California. This document was produced by a coalition of environmental NGOs.[1]
Action to be taken:	Paragraph 31
Related documents:	BLG 11/5/6, BLG 11/INF.3, BLG-WGAP 1/2/11, BLG 10/14/13, MEPC 53/4/1 and MEPC 53/4/8

Introduction

1 The BLG Sub-Committee agreed at its 10th session to further consider amendments to the regulations under MARPOL Annex VI. BLG will continue its review of potential international control of air pollution from ships at its 11th session during April 2007.

2 This document introduces and summarizes a recent report and analysis of global and regional inventories of emissions of air pollution from international shipping. The report also projects the growth of those emissions over the next several decades. The report was commissioned by the Clean Air Task Force, summarizing research led by James J. Corbett of the University of Delaware, USA. The full report is attached as annex to BLG 11/INF.3.

3 In addition, this document references a recently completed regional inventory of North American shipping emissions prepared for the California Air Resources Board (CARB).

4 Together, these inventories provide increasingly accurate evidence that shipping emissions are significant and growing rapidly. In fact, emission reductions that would result from many initial proposals before IMO would be completely offset by aggregate emissions

[1] Clean Air Task Force, Friends of the Earth-US, European Environmental Bureau, European Federation for Transport and Environment, North Sea Foundation, Seas at Risk and Swedish NGO Secretariat on Acid Rain.

increases resulting from projected growth in shipping traffic over the next decade or two. If IMO efforts to reduce air emissions from the international fleet in any meaningful way are to succeed, MARPOL Annex VI must be amended to provide substantial and early reductions. Any other course will at best only slow down a persistent upward march in shipping emissions.

5 Finally, we refer to recent analysis conducted by CARB that summarizes the health effects of shipping emissions in California waters, effects that include premature death. This analysis provides additional clear evidence that shipping emissions do impact human health, and thus must be reduced.

Updated global shipping emissions inventory

6 Attached as annex to BLG 11/INF.3 is a new report entitled "Allocation and Forecasting of Global Ship Emissions," authored by James J. Corbett, Chengfeng Wang, James J. Winebrake and Erin Green (hereafter referred to as the "Global Emissions Inventory").

7 The Global Emissions Inventory presents updated global inventories of emissions from international shipping using best practices, and projects future shipping emissions. Among other things, the report:

.1 summarizes recent work with regard to global ship emissions inventories;

.2 describes how growth in trade activity affects fleet energy and emissions trends;

.3 presents updated global ship emission inventories at high resolution (0.1 degree latitude by 0.1 degree longitude); and

.4 presents a business-as-usual (BAU) forecast of fleet energy and emissions trends consistent with the correlation between increased ocean-going trade and required power.

8 The authors believe that "this inventory represents the most complete and accurate global inventory of air emissions from international shipping prepared to date."[2]

9 The report confirms that existing inventory work "suggests that NO_x and SO_x pollution from ocean-going ships represent some 15-30% of global NO_x emissions and 5-7% of global SO_x emissions, while fuel usage ranges 2-4% of world fossil fuels."[3]

10 The final 2002 baseline inventory results are summarized as follows:[4]

Global ship emissions (Unit: metric tonnes)

NOx (N)	SOx (S)	CO_2 (C)	HC (CH4)	PM (PM10)	CO	BC
5,000,000	4,720,000	176,000,000	574,000	1,190,000	1,080,000	71,400

[2] Global Emissions Inventory, at p.2.
[3] Global Emissions Inventory, at p.5; Figure 1.
[4] Global Emissions Inventory, at p.11; Table 2.

11 These emissions are substantial – by way of comparison, 2002 world shipping PM10 emissions were almost twice PM10 emissions from all US electric power plants in 2001 and roughly equal to NO_x emitted from such sources. Also, world shipping SO_2 emissions are about one-half of the SO_2 emitted from US power plants – and about 30% of total SO_2 emissions from *all* US sources.[5]

12 The Global Emissions Inventory also applies best practices to provide a new estimate of global shipping emissions growth over the next several decades. After considering various approaches used to forecast future growth in shipping emissions, the study based its emission projections on projected growth rates of installed power, adjusted downward for potential efficiency improvements.[6]

13 **The study projected that shipping emissions will grow at a rate of 4.1% a year through 2040, compounded annually.** See Global Emissions Inventory at page 19. This finding is essentially similar to other studies relating growth in emissions to growth in seaborne trade.

14 Future shipping emissions projected for the following scenarios:

.1 a business as usual (BAU) scenario were forecast by growing the baseline inventory by 4.1% per year, and adjusting for existing IMO Annex VI regulations that require reduced NO_x emissions for post-2000 ships and reduced sulphur emissions in the two SECAs designated to date;

.2 scenarios that assumed a 2010 global marine fuel sulphur reduction from the current average of 2.7% down to 1.5%, 1.0% and 0.5%, respectively; and

.3 a BAU scenario and a 2010 1.5% global marine fuel sulphur scenario that each assumed a lower 3% annual emissions growth rate.[7]

15 Forecasted shipping emissions from these scenarios may be summarized as follows:

[5] According to US EPA, emissions of NOx from all US electric power plants in 2001 was approximately 4.9 million tons, while SO_2 emissions from power plants was 10.9 million tons and SO_2 emissions from all US sources was 15.9 million tons. US EPA 2005, "Clean Air Interstate Rule, Emissions Inventory Technical Support Document," 4 March, 2005, at page 7, Table 2(a).

[6] Global Emissions Inventory, at pp.13-19.

[7] The 3% growth rate was used in the IMO Study on Greenhouse Gas Emissions from Ships. International Maritime Organization, *Report on the outcome of the IMO Study of greenhouse Gas Emissions from Ships,* MEPC 45/8, 2000.

Projected SOx emissions (millions of metric tons) under several BAU and global sulphur-control scenarios

	2002	2010	2015	2020	2025	2030
BAU: 4.1% Growth (This work)	4.72	6.51	7.96	9.73	11.89	14.54
1.5% Fuel-sulphur at 4.1% Growth	4.72	3.62	4.42	5.40	6.61	8.08
1.0% Fuel-sulphur at 4.1% Growth	4.72	2.41	2.95	3.60	4.40	5.39
0.5% Fuel-sulphur at 4.1% Growth	4.72	1.21	1.47	1.80	2.20	2.69
BAU: IMO GHG-study growth (3%)	4.72	5.98	6.93	8.04	9.32	10.80
1.5% Fuel-sulphur at 3% Growth	4.72	3.32	3.85	4.46	5.18	6.00

16 As has been mentioned in previous submissions to IMO,[8] while shipping emissions will increase over the next few decades, air pollution from land-based sources will decline due to increasingly stringent regulation of emissions from power plants, land-based diesels and other sources. For example, one of US EPA's recent regulations reducing air pollution from land-based sources – i.e., EPA's recent regulation to reduce interstate transport of NO_x and SO_2 throughout the central and eastern US – will reduce SO_2 emissions from all US power plants by 2015 to a level equal to less than two-thirds of 2015 global shipping emissions, and US power plant NO_x emissions will be less than half of *2002* global shipping emissions of NO_x.[9]

Recent North American shipping emissions inventory

17 Another shipping emissions inventory using best available practices is a recent study prepared for CARB and the Commission for Environmental Cooperation in North America by James J. Corbett of the University of Delaware and Chengfeng Wang of CARB. This study, entitled "Estimation, Validation and Forecasts of Regional Commercial Marine Vessel Inventories,"[10] was completed in 2006 (hereafter the "North American Emissions Inventory"). This analysis generated new shipping emissions inventories and growth projections for the United States, Canada and Mexico and compared the findings with existing models at regional and local scales.

18 This research uses a new "bottom up" methodology for estimating shipping emissions in North America. The emissions inventory and growth is derived from first order indicators: vessel activity based on load, speed and hours, installed power, fuel usage and work done. As a result, "the 2002 inventory of emissions from North American shipping represents the most accurate and complete inventory to date for inter-port activity from ocean-going commercial cargo and passenger vessels (excluding ferries)," according to the authors.[11]

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8 See, e.g, BLG-WGAP 1/2/11; BLG 10/14/13; MEPC 53/4/1.

9 EPA has projected that US power plant emissions will be reduced to 5.1 million tons of SO_2 and 2.2 million tons of NOx by 2015. US EPA 2005, "Clean Air Interstate Rule, Emissions Inventory Technical Support Document," 4 March, 2005, at page 38, Table 15(a).

10 Tasks 1 and 2 of the North American Emissions Inventory are available on the internet at: http://www.arb.ca.gov/research/seca/jctask12.pdf. Tasks 3 and 4 are available at: http://www.arb.ca.gov/research/seca/jctask34.pdf.

11 North American Emissions Inventory, "Tasks 1 and 2: Baseline Inventory and Ports Comparison, Final Report" (3 May 2006), at page vii.

19 The North American Emissions Inventory established both a baseline 2002 emissions inventory for the North American domain and the coastal regions therein (domain areas of Canada, Mexico and the US within 200 nautical miles of the coast), as well as a forecast of future year ship emissions under a business as usual scenario and several hypothetical SECA scenarios.

20 The inventory showed that "inter-port transport of North American commerce (including global voyage transits on route segments outside the project domain) consumed more than 44.7 million tonnes of heavy fuel oil and emitted about 2.3 million tonnes of SO_2 in 2002, about 16.5% of SO_2 emissions from all sources in the US in the same year."[12] Within the North American domain, total SO_2 emissions were about 1.6 million tonnes and total NO_x emissions were about 2.7 million tonnes.[13] These inventories do not include emissions produced at port or while operating in inland waterways.

21 This regional inventory also projected high rates of shipping emissions growth, higher than the global growth rate forecast in the Global Emissions Inventory described above. **The inventory forecast an average shipping emissions growth rate for North America at 5.9% per year compounded.**

22 The report's emission growth forecast was found to be consistent with other independent forecast approaches: "using 2002 as a base year, these models agree under BAU scenarios that energy used by ships bringing global trade to and from North America will double by or before 2020; some scenarios predict doubling before 2015."[14]

23 Based on the 5.9% annual rate of growth, the North American Emissions Inventory then forecast emissions patterns within hypothetical SECAs with 15,000 ppm and 5,000 ppm marine fuel sulphur caps in place.

24 The report found that emissions reductions and associated "health effects and/or other impacts that may be offset from the 2002 base year by implementing a 15,000 ppm North American SECA will return to 2002 levels within one or two decades." In fact the projected emissions would outpace reductions from the lower sulphur fuel as early as 2012. Using lower growth rates from other studies, SO_x emissions within a North American 1.5% sulphur SECA would return to 2002 levels by 2019.[15]

25 A lower sulphur cap of 5,000 ppm would produce deeper and longer-lasting emission reductions:

> "A North American SECA requiring 0.5 percent fuel-sulphur or control technologies achieving these reductions would offset trade growth continuing to the early 2030s under a 5.9 percent Compounded Annual Growth Rate or to about 2050 under a 3.7 percent CAGR, respectively."[16]

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[12] North American Emissions Inventory, "Tasks 1 and 2: Baseline Inventory and Ports Comparison, Final Report," at page 18.

[13] North American Emissions Inventory, "Tasks 1 and 2: Baseline Inventory and Ports Comparison, Final Report," at page 19, Table 6.

[14] North American Emissions Inventory, "Tasks 3 and 4: Forecast Inventories for 2010 and 2020, Final Report" (8 December 2006), at page vii.

[15] North American Emissions Inventory, "Tasks 3 and 4: Forecast Inventories for 2010 and 2020, Final Report," at page 20.

[16] North American Emissions Inventory, "Tasks 3 and 4: Forecast Inventories for 2010 and 2020, Final Report," at page 20.

26 The new global inventory and North American inventory of ocean-going shipping emissions cited in this document provide the best available information on global and regional scale shipping emissions to date. Together, we believe that these reports ("Allocation and Forecasting of Global Ship Emissions" (annex to BLG 11/INF.3) and the "North American Emission Inventory") compel a number of conclusions:

.1 shipping emissions are substantial and growing;

.2 anticipated growth in shipping emissions will outpace fleet wide reductions of 60% or less by about 2020 or earlier, depending on the level of reduction;

.3 emission reductions limited to new ships will not be sufficient to produce needed reductions on a fleet wide basis; rather reductions from existing ships will also be required;

.4 prompt and steep emission reductions from the entire global shipping fleet are necessary to prevent a continued rise in such emissions over the next several decades.

27 We urge the IMO BLG Sub-Committee to consider the findings in these reports when considering sulphur fuel caps and NO_x and PM emissions standards during BLG 11.

Public health impacts from ships in California

28 The correlation between ship emissions and impacts to human health is also becoming more defined with the publication of new modelling and research. In its work to quantify the public health impacts from goods movement in California, CARB projected health risks for each of the goods movement sectors, including ships. In its report entitled "Quantification of the Health Impacts and Economic Valuation of Air Pollution from Ports and Goods Movement in California,"[17] CARB determined that: "ships, railroads, diesel trucks, and cargo handling equipment are the most important port and goods movement-related emission categories. At the ports, ship emissions dominate and will continue to dominate in terms of the tonnage of emissions for diesel PM and NO_X. This is largely due to the cleaner diesel engines that will be required over time for the other source categories."[18]

29 The State of California utilized several updated inventories and a numerous health studies and risk assessment models to estimate ocean going vessel emissions and impacts.[19] The detailed methodology is described in the above-mentioned report.

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17 The health impacts report is Appendix A to CARB's goods movement report entitled "Emission Reduction Plan for Ports and Goods Movement (March 22, 2006)," which is available on the internet at: http://www.arb.ca.gov/planning/gmerp/gmerp.htm (hereinafter the "Goods Movement Report"). Appendix A is also available on the internet at: http://www.arb.ca.gov/planning/gmerp/march21plan/appendix_a.pdf.

18 Goods Movement Report, at Appendix A-11.

19 The general approach to calculating ship emissions was as follows:
"Emissions are calculated on a statewide basis for each port in California. Emissions are also calculated for hoteling and manoeuvring operating modes that occur within ports and transit emissions as ships move up and down the California coastline. Emissions calculated within 24 nautical miles of the shore are included in this emissions inventory. For emissions inventory tracking purposes, emissions are allocated to a port when they occur within three miles of shore. Emissions outside of three miles are allocated to the outer continental shelf air basin."

30 The estimated mortality effects from air pollution from ocean-going vessels ranked third in 2005 for contributing to premature deaths; by 2020 ship emissions impacts moved to second in ranking. More startling, the number of premature deaths from exposure to shipping emissions is predicted to more than double from 210 to 540 per year by 2020 while most other sources show reductions or incremental increases. See Table A-14 below from CARB's report:[20]

Table A-14 Mortality Effects Associated with Ports and Goods Movement: Contributions of Source Categories[a] (Uncertainty range in parentheses)

Source Category	2005 Number of deaths	2010 Number of deaths	2020 Number of deaths
Commercial Harbor Craft	140 (41- 240)	120 (35-200)	85 (25-150)
Cargo Handling Equipment	43 (13-73)	38 (11-64)	16 (5-28)
Ocean-Going Ships	**210** (63-360)	**290** (86-490)	**540** (160-910)
Rail (Locomotives)	270 (84-460)	230 (69-380)	290 (89-490)
SoCAB Ports (modelled)	67 (18-120)	75 (20-130)	96 26-170
Truck	1,500 (460-2,600)	1,200 (360-2,000)	580 (180-990)
Transport Refrigeration Units	130 (36-220)	99 (29-170)	48 (15-81)
STATEWIDE TOTAL	2,400 (720-4,100)	2,000 (610-3,400)	1,700 (500-2,800)

[a] Does not include the contributions from particle sulphate formed from SO_X emissions, which is being addressed with several ongoing emissions, measurement, and modelling studies. Range reflects uncertainty in health concentration-response functions, but not in emissions or exposure estimates.

Action requested of the Sub-Committee

31 The Sub-Committee is invited to consider the above information and to recommend to the MEPC stringent limitations for air emissions from ships.

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[20] Goods Movement Report, at Appendix A-74.