THESIS FOR THE DEGREE OF LICENTIATE OF PHILOSOPHY

The Regulation of Global SO_x Emissions from Ships

IMO proceedings 1988-2008

ERIK SVENSSON

Department of Shipping and Marine Technology

CHALMERS UNIVERSITY OF TECHNOLOGY

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Department of Shipping and Marine Technology
Chalmers University of Technology
SE-412 96 Gothenburg
Sweden
Telephone + 46 (0)31-772 1000

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Abstract

MARPOL Annex VI regulates air pollution from international shipping. Emissions of sulphur oxides (SO_x) are regulated through a global limit for the sulphur content of bunker fuels (referred to as a *global cap*) as well as a stricter limit in particularly sensitive areas, referred to as *SO_x Emission Control Areas* (SECAs). This thesis has investigated documentation from the sulphur deliberations at the *International Maritime Organization* (IMO) for the purpose of explaining how the initial proposals for reducing sulphur emissions from ships ended with a global cap of 4.5% sulphur content in 1997, which was then revised in 2008 to 0.5% in 2020 (or 2025, subject to review in 2018).

The thesis does not provide a definitive history, but it gives an insight into how policy-making could happen at IMO. From this thesis, we can learn how IMO works as an international organization responsible for air pollution from ships and how it is reported in its documents. Moreover, it illustrates how industry interests can affect environmental policy. The results show a process that started in the 1980s when the regulation of land-based sources of acidification raised questions over the contribution of emissions from ships. The issue was raised at IMO in 1988. An early target was set to halve SO_x emissions from ships by 2000. The focus then turned to a regional approach and a supplementary global cap. This was explained by the lack of support for a stringent global solution due to high costs for the oil industry. A global cap was introduced merely to prevent a possible increase in the sulphur content. The global average sulphur content at the time was less than 3%, though a 4.5% global cap was adopted in 1997. The only motivation for this cap was that it was a first step in a global regulation that could be amended in the future.

It then took until 2005 before Annex VI entered into force, and it was decided to revise it the same year. The work started in 2006. Several different policy options were discussed intensively, including a global uniform standard. It was concluded that the health effects from particulate matter (PM) emissions were one of the main reasons for revising the sulphur requirements to stricter limits. Nevertheless, high costs for the oil industry made the IMO focus on keeping the SECA approach. A final agreement was met in 2008. It was a compromise with stringent SECA limits and a global cap that would become stringent after a review of the ability of the oil industry to supply enough quantities of distillate fuels.

It was concluded that the global cap still has no effect and should not be interpreted as an emission ceiling until the future reveals its results. Moreover, the focus of the northern hemisphere on the air pollution regime is an important factor explaining the acceptance of moderate global regulation and stringent regional regulation. This thesis opens up for further research into how air pollution is dealt with at IMO. Three frames of reference were identified that could be used to study similar processes.

Keywords: MARPOL, Annex VI, global cap, sulphur oxides, SO_x, air pollution, ships, emissions, IMO, policy-making

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It has been a privilege to be employed by the SMA and to have access to IMO documents through the International Secretariat of the Swedish Transport Agency (STA). Special gratitude is expressed for the work conducted by Camilla Gillberg, who provided me with copies of the IMO documents used in the first act. I would further like to thank the SMA and the STA for giving me the opportunity to participate in IMO and for the kind reception by the Swedish delegation.

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- Karin Andersson (Chalmers)
- Willem van Berlekom (retired from SSPA)
- Håkan Pleijel (Department of Plant and Environmental Sciences, GU)

I would also like to thank the four informants who assisted me with personal communication, advice and inspiring discussions. Furthermore, I would like to thank James J. Corbett for advising me to study the historic developments. It changed my initial detailed focus on the revision process. Finally, special thanks go to my family and friends for listening and offering advice despite difficulties understanding my spoken or written words.

Abbreviations

BCH	Sub-Committee on Bulk Chemicals Handling
BIMCO	Baltic and International Maritime Council
BLG	Sub-Committee on Bulk Liquids and Gases
CONCAWE	Oil Companies' European Organization for Environmental and Health Protection
EEA	European Economic Area
EEC	European Economic Community / European Community (EC)
EFTA	European Free Trade Association
EMEP	European Monitoring and Evaluation Programme
EU	European Union
FOEI	Friends of the Earth International
GT	Gross tonnage
HELCOM	Helsinki Commission
HFO	Heavy Fuel Oil
IACS	International Association of Classification Societies
IGOs	Inter-Governmental Organizations
IMCO	Inter-Governmental Maritime Consultative Organization
IMO	International Maritime Organization
INTERTANKO	International Association of Independent Tanker Owners
IPIECA	International Petroleum Industry Environmental Conservation Association
ISO	International Organization for Standardisation
kW-hr	Kilowatt hour (also kWh)
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
MD	Marine Distillates
MDO	Marine Diesel Oil
MEPC	Marine Environment Protection Committee
MGO	Marine Gas Oil
MSC	Maritime Safety Committee
mt	Million tonnes
NO_x	Nitrogen oxides
NGOs	Non-Governmental Organizations
NTC	NO_x Technical Code
LRTAP	1979 Convention on Long-range Transboundary Air Pollution
OCIMF	Oil Companies International Marine Forum
OECD	Organisation for Economic Co-operation and Development
PM	Particulate Matter
ICS	International Chamber of Shipping
SECA	SO_x Emission Control Area / Emission Control Area (ECA)
SO_2	Sulphur dioxide
SO_x	Sulphur oxides (SO_2+SO_3)
SOLAS	International Convention for the Safety of Life at Sea
Tg	Teragram = megaton = 10^{12} g
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNECE	United Nations Economic Commission for Europe
USD	United States dollar

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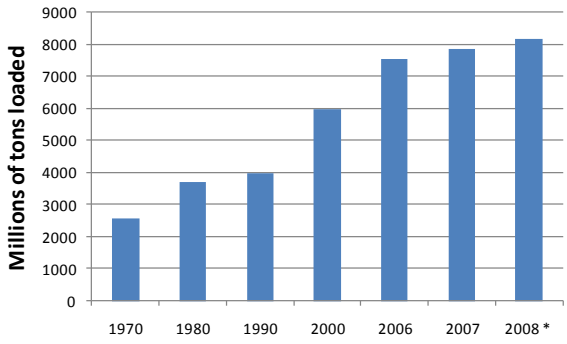
1. Introduction

1.1. International Shipping, Bunker Fuels and Sulphur

The world merchant fleet increased rapidly in the 1960s. Between 1960 and 1980 it had more than doubled in number (Eyring et al., 2009). In 2004, the world merchant fleet consisted of almost 91,000 ships of above 100 gross tonnes (GT) (Dalsøren et al., 2009). This development has gone hand in hand with global economic development (Stopford, 1997). Today, about 80% of the world trade volumes are transported by sea (UNCTAD, 2008). Figure 1.1(a) shows international seaborne trade loaded from 1970 to 2008. Figure 1.1(b) shows the world's *total seaborne trade* (TST) in billion tonne-miles[1] from 1987 to 2007.



*Preliminary.

Figure 1.1(a). International seaborne trade (millions of tonnes loaded), 1970-2008. Source: UNCTAD (2009)

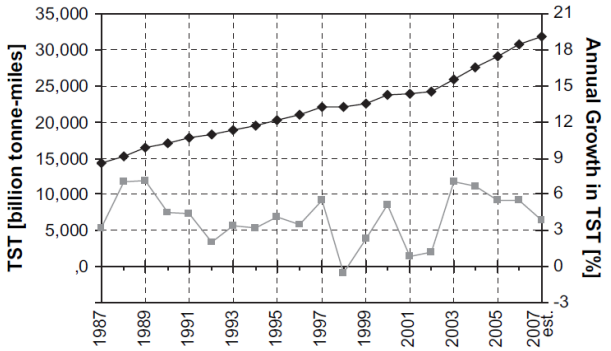


Figure 1.1(b). The world's total seaborne trade (billion tonne-miles), 1987-2007. The grey line represents the annual growth rate (from Eyring et al., 2009, their Figure 4).

The correlation between seaborne trade in tonne-miles and ships' fuel consumption has been well understood in the last 30 years, as "*the work done in global trade is proportional to the energy required*" (Eyring et al., 2009, p. 8). It has been estimated that the fuel consumption from international shipping was 277 million tonnes (mt) in 2007. Of this, 213 mt were *heavy fuel oil* (HFO) and 64 mt were *marine distillates* (MD) (Buhaug et al., 2009).

Residual fuels

The main fuel powering the international fleet is *Heavy fuel oil* (HFO). It is a mix of residues from refinery processes to produce lighter and cleaner high-quality products from crude oil. The term *residual fuel* is thus often used. It is characterized by high viscosity and requires heating for storage and combustion. In general, the sulphur content is high (<4.5% ISO standard), though the sulphur content of HFO is dependent on the sulphur content of the crude oil (CONCAWE, 1998; Winnes, 2010).

Distillate fuels

Marine distillates (MD) include *marine diesel oil* (MDO) and *marine gas oil* (MGO). They are both distillates from the refinery process and have lower viscosity and lower sulphur content than HFO. The sulphur content of MD is often below 0.5% (MDO <2.0% ISO standard; MGO <1.5% ISO standard) (Winnes, 2010; Buhaug et al., 2009).

[1] Shipping activity is generally measured in tonne-miles, i.e., the amount of transported cargo multiplied by the average transport distance (Buhaug et al., 2009).

Sulphur oxides
During the combustion of a ship's bunker fuel, about 90% of the sulphur (S) in the fuel reacts with oxygen gas (O_2) and is emitted as sulphur dioxide (SO_2). A smaller portion of the sulphur in the fuel forms SO_3. The abbreviation SO_x is thus often used ($SO_x = SO_2 + SO_3$). Due to the common absence of exhaust gas treatment on board ships, the amount of SO_x emissions from ships depends solely on the sulphur content of the fuel (Corbett and Fischbeck, 1997). The atmospheric processes and impacts of SO_x emissions are dealt with in Chapter 3. Increased shipping activity and the absence of regulation have resulted in increased SO_x emissions from international shipping. This is where this thesis comes in: the regulation of global SO_x emissions from ships.

1.2. Revised Measures on SO_x Emissions from Ships

On 10 October 2008, a decision that has caused much debate was taken at the London headquarters of the *International Maritime Organization* (IMO). The decision was an adoption of amendments to MARPOL Annex VI. The MARPOL Convention (MARPOL 73/78[2]) is the main international convention to prevent marine pollution from ships. It consists of regulations to prevent and minimize pollution originating from accidental and operational causes. The technical regulations are currently set in six annexes. States that have ratified the convention are bound to Annexes I and II, while Annexes III to VI are optional (IMO, 2009a). Annex VI (*Prevention of Air Pollution from Ships*) was adopted in 1997 and came into force in 2005. Annex VI regulates emissions of air pollutants from ships. It limits emissions of sulphur oxides (SO_x) and nitrogen oxides (NO_x) and prohibits deliberate emissions of ozone-depleting substances. The emissions of sulphur dioxide are regulated through a global limit on the sulphur content of bunker fuels (referred to as the *global cap*) as well as a stricter limit in particularly sensitive areas referred to as *SO_x Emission Control Areas* (SECAs)[3]. An alternative to reducing SO_x emissions in SECAs is to use an exhaust gas cleaning system or other on-board abatement technologies. In 1997, the global cap was set at a 4.5%[4] sulphur content and at 1.5% in SECAs (IMO, 2010a).

The 2008 amendment entered into force on the 1st of July 2010. The sulphur limits were among the main changes in the revised Annex VI. The sulphur content of bunker fuels will be reduced progressively from 2010 to 2020 as illustrated in Figure 1.2. The initial 4.5% global cap will be reduced to 3.5% from the 1st of January 2012 (Reg. 14, 1:2), followed by 0.5% from the 1st of January 2020 (Reg. 14, 1:3). A review to determine the availability of fuel oil to comply with subparagraph 1:3 will be completed by 2018. If the Parties decide after the review that it is not possible for ships to comply with the subparagraph, it shall become effective on the 1st of January 2025. In SECAs, the level will be 1.0% from the 1st of July 2010 and 0.1% from the 1st of January 2015 (Res. MEPC.176(58), Reg. 14). The Revised Annex VI applies to all ships of 400 GT and above, though exceptions are specified in the Annex, e.g., for the purpose of securing *the safety of a ship or saving life at sea* (ibid., Regulation 3:1).

[2] *International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto*. The name signifies a combination of two treaties.
[3] Today, the term *ECA* is used for the inclusion of NO_x limits, as for the North American ECA.
[4] Percentage by mass, i.e., $m_{sulphur} / m_{fuel}$.

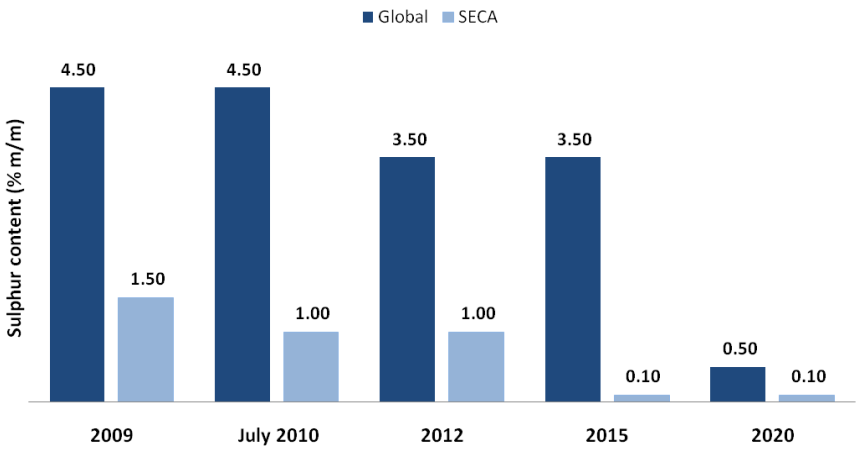


Figure 1.2. Revised MARPOL Annex VI sulphur limits for bunker fuels (based on res. MEPC.176(58))

After the adoption of the revised Annex VI, the IMO Secretary-General Efthimios Mitropoulos described it as:

"*a monumental decision in IMO's history, a decision that proves, once again, that the Organization is focused, united and relevant as the international body capable of dealing with all items on its agenda, an organization that sets global standards in a global environment"* (IMO, 2008).

The above description implies a concrete and unanimous decision made by Member States of an international organization to prevent and control air pollution from ships. Was the journey towards the final decision as concrete and undisputed for the protection of the environment as it looks at first sight however? How did the initial proposals for reducing sulphur emissions from ships end up with a global cap of 4.5% and then the stricter 0.5%? These are the questions that this licentiate thesis intends to answer.

1.3. What is IMO?

The International Maritime Organization is a *specialized agency* of the United Nations (UN). As such, it has legal and financial independence and its own management structure and budget, though these are under the specified conditions set in Article 63 under the *United Nations Charter*[5]. The total budget for the 2008-2009 biennium was £54,669,300, which is the smallest in the UN System (Boisson, 1999; IMO, 2010c). The Member States provide all the funding for IMO. The contribution from each Member State is calculated in proportion to the size of its merchant fleet. Today, IMO has 169 Member States and 3 associate members (Hong Kong and Macao in China and the Faroe Islands in Denmark). Almost all the countries in the world with maritime interests are represented. In addition, about 100 inter-governmental and non-governmental organizations with observer and consultative status are included. Its function is for its Member States to develop and maintain the regulatory framework for shipping, mainly concerned with maritime safety, environmental matters, legal issues and technical cooperation. Its main function is to develop conventions for adoption and to amend existing conventions. It also develops a variety of codes, guidelines, resolutions and recommendations that are not legally binding. Several codes have become binding after being incorporated into conventions. Some fifty conventions and hundreds of codes, guidelines and recommendations have been developed through IMO since its start (IMO, 2010b; IMO,

[5] The treaty of the United Nations signed on June 26, 1945

2009b; Tan, 2006). It is behind almost all the technical standards and legal rules for the prevention of pollution from ships and safety at sea (Boisson, 1999).

The organization was founded in 1948 under the name *Inter-Governmental Maritime Consultative Organization* (IMCO) as a consultative and advisory UN agency for international shipping. At the time, its functions were primarily concerned with maritime safety, in particular with the SOLAS Convention (*International Convention for the Safety of Life at Sea*). It took ten years before the convention to establish IMCO could enter into force in 1958. The organization started its activities in 1959. At its start, it consisted of only 28 Member States, with the majority being traditional maritime nations from the northern hemisphere (IMO, 2009b). Over the years, IMCO had to adapt to the significant changes that occurred in the world of shipping and politics with increased globalization. The Torrey Canyon oil spill disaster in 1967 became a significant factor in the development of IMCO's activities over many years to come. The Liberian-flagged oil tanker with 120,000 tonnes of crude oil grounded near the British coast and caused the single largest oil spill up to that time. Along with environmental movements in the developed world, the accident became a significant factor in IMCO taking on marine pollution and legal issues such as liability and compensation for pollution damages (Tan, 2006). The 1970s saw significant changes in IMCO's functions, *inter alia*: the establishment of a committee for environmental matters (MEPC), technical cooperation between States and the adoption of several new instruments such as MARPOL 73/78 (IMO, 2009c). The organization became so different from that of its start in 1948 that two major amendments to the IMCO Convention were made in 1975 and 1977 respectively. In 1975, the organization's name was changed to International Maritime Organization. This was done because the word "Consultative" was considered confusing and, according to IMO (1999), gave the impression "*that IMO could only talk, rather than take decisions and act*" (IMO, 1998, p. 6). The amendment entered into force in 1982. The 1977 amendment adjusted the organization's purpose to its growing commitments to environmental, administrative and legal issues. The limitation that its role should only be consultative and advisory was deleted. The 1977 amendment entered into force in 1984 (IMO, 1998). The structure of IMO today is illustrated in Figure 1.3.

The Assembly

The *Assembly* is the governing body of IMO and has representatives from all Member States. It holds regular sessions once every two years but can also hold extraordinary sessions. Its main tasks concern the functioning of the organization, such as the establishment of rules of procedure and subsidiary bodies, the election of members of the Council, voting on the budget and determining financial arrangements (Boisson, 1999; IMO, 2010c).

The Council

The *Council* is IMO's executive organ and its main task is to supervise the work of the organization. In the time between Assembly sessions, the Council has the same functions, except for the reserved right for the Assembly to make recommendations on maritime safety and pollution to its Member States. Its other functions are, *inter alia*, to coordinate the activities of the bodies and to receive reports and proposals from the organs and submit them with comments and recommendations to the Assembly and the Member States (IMO, 2010c). The Council consists of representatives from 40 Member States. Council Members are elected by the Assembly for two-year terms and are divided into three categories. Category A consists of the ten States with the greatest interests in providing international shipping services. Category B consists of the ten States with the greatest interests in international seaborne trade.

Category C consists of the remaining 20 States with special interests in maritime transport or navigation (IMO, 2010c).

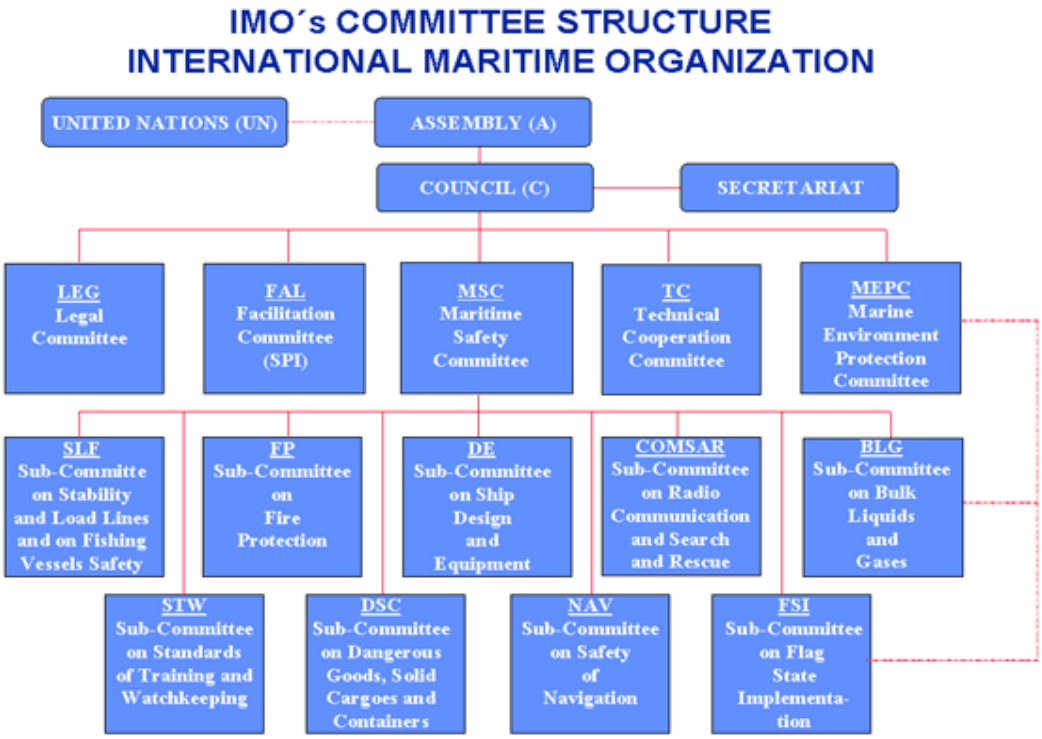


Figure 1.3. Structure of IMO (from the Swedish Maritime Administration, 2009)

The Secretariat

IMO has its headquarters in London with a *Secretariat* consisting of about 300 technical and administrative staff and the Secretary-General: currently Mr. Efthimios E. Mitropoulos of Greece (IMO, 2010c). This makes IMO the smallest agency in the UN System. The Secretariat is responsible for administration and for providing information for the work in the other bodies. It has six divisions dealing with safety at sea, the marine environment, legal affairs and external relations, conferences, technical cooperation and administrative affairs (Boisson, 1999).

The Maritime Safety Committee (MSC)

IMO's highest technical body is the *Maritime Safety Committee*. Its function is to consider all the maritime safety matters of IMO. Besides adopting amendments to conventions, such as SOLAS, the MSC considers and submits recommendations and guidelines on safety for possible adoption by the Assembly. In general, each major issue is considered in the following nine Sub-Committees (IMO, 2010c; Boisson, 1999):

- Bulk Liquids and Gases (BLG)
- Carriage of Dangerous Goods, Solid Cargoes and Containers (DSC)
- Fire Protection (FP)
- Radiocommunications and Search and Rescue (COMSAR)
- Safety of Navigation (NAV)
- Ship Design and Equipment (DE)
- Stability and Load Lines and Fishing Vessels Safety (SLF)
- Standards of Training and Watchkeeping (STW)
- Flag State Implementation (FSI)

The Legal Committee (LEG)
The *Legal Committee* was established in 1967 to deal with legal issues in the aftermath of the Torrey Canyon disaster. It reflects on any legal matters for IMO, such as liability and compensation for damage caused by ships (IMO, 2010c).

The Technical Co-operation Committee (TC)
The *Integrated Technical Co-operation Programme* (ITCP) helps developing countries to implement international rules and standards on maritime safety and in the prevention and control of pollution from ships (IMO, 2010d). The Technical Co-operation Committee reflects on all technical co-operation matters at IMO (IMO, 2010c).

The Facilitation Committee (FAL)
The *Facilitation Committee* is intended to eliminate 'red tape' (bureaucracy) and unnecessary formalities in international shipping. It was first established to advice on the implementation of the *Convention on Facilitation of International Maritime Traffic*, 1965 (FAL Convention) (ibid.; Boisson, 1999).

The Marine Environment Protection Committee (MEPC)
The *Marine Environment Protection Committee* (MEPC) is the main body of concern in this thesis. Since 1965, the *Sub-Committee on Oil Pollution* has assisted the MSC on oil pollution matters. In 1969 it was renamed *Sub-Committee on Marine Pollution*. Until 1973, the MSC and this sub-committee handled all marine pollution matters. The MEPC was established during the eighth session of the Assembly in 1973, the same month that MARPOL was adopted. The resolution establishing the MEPC stated that it would conduct and coordinate all IMO activities concerning prevention and control of pollution of the marine environment from ships. It was an efficient solution, instead of letting the MSC deal with marine pollution in addition to its primary functions (IMO, 2009c; IMO, 2009d). Today, the MEPC considers all IMO matters concerned with prevention and control of pollution from ships. Its main task is to develop conventions for adoption and to amend existing conventions. Like the other committees, the MEPC consists of all the Member States. It is assisted by the same nine sub-committees as those that assist the MSC (IMO, 2010c).

1.4. Purpose and Research Questions

The purpose of this thesis is to describe the development of a global limit on the sulphur content of ships' bunker fuel in MARPOL Annex VI based on the documentation provided by IMO. Specifically, the purpose is to explain how the initial proposals for reducing sulphur emissions from ships ended with a global cap of 4.5%, which was then revised to the stricter 0.5%.

The following research questions will form the basis of the thesis:

1. How did the development of regulating global sulphur oxide emissions from ships end up with a global cap of 4.5% together with a regional SECA limit of 1.5%?

2. What explains the turn towards a more stringent global cap of 0.5%?

1.5. Outline of the Thesis

The following six steps constitute a framework for the work and the structure of this thesis. The results are presented in four building blocks. The studied IMO process is presented in Chapters 5 and 6. Chapters 3 and 4 provide the contexts for this process. The methodology is described in the next chapter.

1) *Chapter 3*: Describes impacts of SO_x emissions and introduces the international developments of land-based sources that preceded the story of the global cap.

2) *Chapter 4*: Briefly describes the procedures of adopting and amending conventions at IMO.

3) *Chapter 5*: Describes the development of the 4.5% global sulphur cap by studying IMO documents.

4) *Chapter 6*: Describes the development of the revised global cap by studying IMO documents.

5) *Chapter 7*: Discusses the results in relation to the research questions and supplements it with personal communication and literature where the documentation lacks explanations.

6) *Chapter 8* and *Chapter 9*: Draw conclusions and propose further research.

2. Method

This chapter describes the working procedure and methods of this licentiate thesis. It describes the methods used for data collection and analysis of data. It also shows the motivations for the choice of methods.

2.1. Frame of Reference

The work on the thesis started in December 2009 with a planning report for a licentiate thesis. The main work of the thesis then started in February 2010. The planning report was preceded by a period of working, studying and learning within the framework of shipping and environmental policy that began in June 2008. This period was a result of a joint research and employment project for the Swedish Maritime Administration and Chalmers University of Technology within the Lighthouse Maritime Competence Centre. When the work on this thesis began, I had supplemented my environmental science education with knowledge about shipping and IMO. Without this previous learning, this thesis would have been difficult to accomplish. The thesis should thus be seen within the contexts of the researcher. It is environmental science but transgresses disciplinary boundaries, mainly inspired by the fields of international law and international relations. The methodology had an inductive approach and was not directed by theory or conceptual models. The thesis provides a basis for further research, and three frames of reference were identified that could be used to study similar processes.

2.2. Contexts

- *Describe the impacts of SO_x emissions and introduce the international developments on land-based sources that preceded the story of the global cap.*
- *Briefly describe the procedures of adopting and amending conventions at IMO.*

Chapters 3 and 4 were written with the intention of helping the reader to understand the story of the two main result chapters. They further provide significant contexts that helped me analyse and draw conclusions. According to Rousseau and Fried (2001, p. 1) "*contextualizing entails linking observations to a set of relevant facts, events, or points of view that make possible research and theory that form part of a larger whole*" . This can be used in many stages of the research process, e.g., research formulation, data gathering and analysis. Johns (2006) used the context approach on organizational behaviour and emphasized that context can have both subtle and powerful effects on research results. He provided examples of how context could be used to understand studied organizational processes and events. Chapters 3 and 4 are intended to do just that. Chapter 3 gives the natural science contexts to the story as well as the regulative contexts on the land-based sources that preceded it. I started to write Chapter 3 when a base structure for the thesis had been developed. It was conducted as a literature review over a three-month period of information gathering and writing in mid-2010. It included information on SO_x emissions, international agreements on land land-based sources and the development of ship emissions. Information was sought from books, article searches in databases, international organizations and other relevant institutions. Some additional articles were found from the reference lists in the obtained articles. The section on ship emissions was later removed from the thesis because the results in Chapters 5 and 6 had covered all the aspects. Furthermore, there was no need for information on recent ship

emission inventories in this thesis as the purpose was to investigate a historical decision. Nevertheless, I learned much about ship emissions, and this knowledge worked as a guide in the investigation of the reports. Chapter 4 was written after Chapters 5 and 6 had been written. It is mainly based on experiences and knowledge obtained during the investigation of the IMO documents but also on the experience of participating at the 15th session of the Sub-Committee on Bulk Liquids and Gases (BLG) at the IMO headquarters in London, 7-11 February 2011. By merely investigating the reports of sessions at IMO, it was difficult to gain a holistic view of how it all functioned. The participation in an IMO meeting was thus a helpful tool in explaining the formal working procedures at IMO to the reader. The additional information was based on literature and the IMO website.

2.3. Main Results: A Written Story

- *Describe the development of the 4.5% global sulphur cap by studying IMO documents.*
- *Describe the development of the revised global cap by studying IMO documents.*

Chapters 5 and 6 are the main result chapters of this thesis and are based on what could be answered by the two research questions by investigating the IMO documentation. These two chapters constituted the main work of this thesis, which was conducted from October 2010 to early March 2011. As the purpose was to describe the developments leading up to two decisions made in the past, the investigations were conducted using chronological methods, i.e., a bottom-up approach. The first process studied was the historic development of a global sulphur cap from 1988 to 1997. The second was the development of the revision from 2004 to 2008. The second also included an investigation of the interim period 1997-2004. The object of study was delimited to the regulations in MARPOL Annex VI that are connected to the global sulphur cap, i.e., Regulation 14(1, 2, 5 and 8). The sulphur limits in the SECAs were not included as an object of study, though it was recognized that the SECA limits and the global limits interconnect when considering policy options to reduce SO_x and PM emissions. Hence, regional and SECA discussions were studied in order to explain the research questions. The processes studied included the historic deliberations at IMO related to the development of the global cap and also to some extent significant contextual developments outside IMO. Given the multilevel policy-making at IMO, with each Member working with the issues at a national level, the major delimitation issue in this thesis concerns the spatial extent. The spatial scope of the thesis is thus the work at IMO (the MEPC, the BCH Sub-Committee and the BLG Sub-Committee). The following sub-section describes the method for collecting and investigating 20 years of IMO documentation.

2.3.1. Method for Collecting and Investigating IMO Documents

Allison (1971) provided some useful reasoning on how to study and explain a past event.

"*In attempting to explain a particular event, the analyst cannot simply describe the full state of the world leading up to that event. The logic of explanation requires that he single out the relevant, important determinants of the occurrence. Moreover, as the logic of prediction underscores, he must summarize the various factors as they bear on the occurrence*" (Allison, 1971, p.4).

This provides an insight into what was conducted by the researcher of this thesis. The main purpose of investigating the IMO documentation was to identify significant events, positions, processes and information relevant to the outcome of both processes. Most of the documents were obtained from the International Secretariat at the Swedish Transport Agency. In general,

the same methods were used to investigate IMO documents for Chapters 5 and 6, though there was a significant difference in the way the documents were obtained. No documentation before 1998 has been digitalized at IMO, and the Swedish Transportation Agency did not start to digitalize all the relevant IMO documents until 2002. The documentation behind the first research question was thus based on prints from the archive at the International Secretariat in Norrköping. As I was writing in Gothenburg, three days were devoted to summarily reading the session reports of MEPC 26-39 and BCH 21-24 in Norrköping. This provided an overview of which parts of the reports and which submissions needed to be copied. The obtained copies were later supplemented with several additional documents. The documents for Chapter 6 were obtained from a database[6] of the Swedish Transport Agency. This database included all the documentation needed, i.e., reports, submissions and working papers.

Table 2.1 lists the investigated arenas in which the considerations and discussions of Chapters 5 and 6 took place. The investigation of IMO documents started with the MEPC session reports. In general, all MEPC reports[7] from 1988 to 2008 have been investigated, but with different approaches depending on their relevance. Sometimes there was simply nothing important in these reports, such as when the main work was conducted in Sub-Committees. Session reports by the two Sub-Committees (BCH and BLG) were investigated on equal terms as the MEPC reports. The session reports were examined with the focus on relevant agenda items considering the matter of air pollution. The agenda items were usually clear from their names, such as *Prevention of air pollution from ships*, but the relevant information could also be found in the agenda items in reports by the Sub-Committees or *Any other Business*. Within the relevant agenda item, I focused on identifying the sulphur discussions and summarizing the developments at each session. When significant discussion on sulphur emissions appeared at a session, the subject was frequently assigned to a working group for further consideration. Working group reports were thus investigated for many sessions. The opening statements were also read for each session report in order to find relevant statements by the Secretary-General that could have affected the views and positions of the delegates. The motivation for investigating his words was found in many reports; the Chairman stated that the words of the Secretary-General would be given every consideration in the work of the Committee/Sub-Committee. In addition to the session reports and working groups, there were reports by correspondence groups and intersessional meetings. These were all investigated on equal terms with the session reports.

[6] http://www.transportstyrelsen.se/IMO

[7] With the exception of MEPC 41, as the follow-up action of Annex VI started at MEPC 42. The report of MEPC 42 recalled the developments at MEPC 41.

Table 2.1. Investigated arenas considering SO_x emissions and the global cap

Body	Arena	Sessions / Meetings	Period
Chapter 5			**1988-1997**
MEPC	Plenary	MEPC 26-27, 29-39	1988-1997
	Working Group on Fuel Oil Quality	MEPC 27	March 1989
	Working Group on Prevention of Air Pollution from Ships	MEPC 30 and MEPC 39	
	Drafting Group (on a draft Assembly resolution)	MEPC 31	July 1991
	Drafting Group (on Annex VI)	MEPC 38-39	1996-1997
BCH	Plenary	BCH 21-24	1991-1994
	BCH Working Group on Air Pollution from Ships	BCH 22-23 + a second intersessional meeting	1992-1993 + February to March 1994
	BCH Correspondence Group on Air Pollution from Ships	Between BCH 21 and BCH 22	September 1991 to June 1992
	BCH Correspondence Group on Regional Control Options	Between BCH 22 and BCH 23	September 1992 to June 1993
	BCH Correspondence Group on the regional approach	Between BCH 23 and the second intersessional meeting	September 1993 to January 1994
Diplomatic Conference	Plenary	Third MARPOL Conference	September 1997
	Conference Working Group 1	Third MARPOL Conference	September 1997
	Conference Working Group 2	Third MARPOL Conference	September 1997
Informal	Informal Drafting Group	MEPC 38	July 1996
	Group of Experts	MEPC 38	July 1996
Chapter 6			**1998-2008***
MEPC	Plenary	MEPC 42-58**	1998-2008
	Working Group on Prevention of Air Pollution from Ships (MEPC 57: Working Group on Annex VI and the NO_x Technical Code)	MEPC 52-53 and MEPC 57	2004-2008
	Drafting Group on Amendments to MARPOL Annex VI and the NOx Technical Code	MEPC 58	Oct 2008
BLG	Plenary	BLG 10-12	2006-2008
	BLG Working Group on Air Pollution from Ships	BLG 10-12 + Two Intersessional Meetings: BLG-WGAP 1 and BLG-WGAP 2	2006-2008 + Nov 2006 and Oct-Nov 2007
	Correspondence Group A	Between BLG 10 and BLG-WGAP 1	April-Nov 2006
Informal	Informal Cross Government/Industry Scientific Group of Experts	Three meetings from MEPC 56. Reported to BLG 12 and MEPC 57.	2007

* Only session reports of the MEPC were studied from 1998 to early 2004. This interim period was used as a background for the studied revision process from 2004-2008.

** The follow-up action of Annex VI started at MEPC 42. The report of MEPC 42 recalled the developments at MEPC 41.

The number of submissions on the investigated agenda item varied from a few to as many as 60. Which submissions and other documents should be obtained and investigated further? How could the most significant ones for the coming development and the final outcome be sorted out? A rule of method was to investigate those submissions that where highlighted in the session reports or working group reports. A submission was investigated further if it was summarized or mentioned as "discussed, "considered" or "noted" in relation to sulphur

discussions. If the investigated report merely provided a list of documents considered, these were not investigated. In the early work of the first act, however, some submissions were investigated despite this rule in order to illustrate the basis behind the initial policy choices on how to regulate sulphur dioxide emissions from ships, e.g., emission quantities and cost assessments. This approach was not possible in the documentation of the revision process. In the first process, there were many summaries of submissions that had been discussed. In the second, the reports were not as transparent as before. It was more common that an agenda item started with a long list of documents that had been considered or discussed by the Committee/Sub-Committee. This made it difficult to select significant or relevant documents. Many submissions were thus excluded from investigation in Chapter 6.

2.3.2. A Dramaturgical Presentation

The information obtained from the investigated reports was written down in two documents, which now represent the main result chapters of this thesis. They are described as 'acts' of a story (or drama). Hunt and Benford (1997, p.106) suggested that the theatrical metaphor "*provides a means to bring together methodological insights from a variety of sources to form a consistent whole*". The thesis uses this dramaturgical perspective in the presentation of the results. The use of a dramaturgical presentation signifies that the results are of a qualitative nature in a social science framework. The results are based on secondary data and do not necessarily represent results that are as close to the reality as possible, as in natural science. Hunt and Benford (1997, p.117) emphasized that "*instead of presenting a window to 'reality', a dramaturgical method serves as a constant reminder that researches are in the business of 'reality construction*'".

The use of *intermezzos* in the text is connected to the dramaturgical approach. They were used to describe significant international or regional developments occurring outside IMO. The use of intermezzos is motivated by the context approach. Context could be applied to identify and explain missing linkages in the research, which, in the field of organizational behaviour, could explain "*how individual or team activity gets translated into larger organizational outcomes*" (Johns, 2006, p.389). Through the use of intermezzos, this thesis has a similar approach to explaining how outside developments revealed unexplained positions and outcomes at IMO. The focus of these intermezzos was on developments within the existing air pollution regime, the UN and the EU. The special focus on the EU was motivated by its development of closely related legislation and the threats of unilateral action. Another significant motive is the European focus on the air pollution consideration at IMO.

2.4. Discussion and Conclusions

- *Discuss the results in relation to the research questions and supplement them with personal communication and literature in which the documentation lacks explanations.*
- *Draw conclusions and propose further research.*

The primary method in this thesis was to study IMO documentation. The purpose was not to write a definitive history but to describe the developments of the global sulphur regulations based on what could be found in the IMO documentation. Allison (1971) analysed the Cuban Missile Crisis and based three case studies on public documents for the same reason (not to write a definitive history). The discussion on the written story did show some significant gaps, however, and further questions were raised. The reports of sessions and meetings are also categorized as secondary data, as they are written by persons at the Secretariat. These reports

represent a subjective and selective view of each meeting. Significant developments may have been excluded or described on a biased matter. According to Denscombe (1998, p.306), public minutes tend to illustrate a meeting in a way that was publicly acceptable at a given time and a given social context. The written story was supplemented with literature and a few conversations in order to provide a more holistic view from this secondary data and to fill in some major gaps in the IMO documentation that would help to answer the research questions. In social science terms, the primary method of investigating IMO documents was triangulated with a secondary method consisting of a literature review and a tertiary method consisting of personal communications. The literature used consisted of a few books and articles that focused on the development of the air pollution regulation at IMO.

The personal communications consisted of phone and e-mail conversations[8] with four Swedish informants who had participated in the air pollution considerations at IMO. A matrix with contact information for possible informants was first established. It was primarily based on the lists of participants provided in Swedish reports of IMO meetings during the investigated period. Dependent on when the contact person had participated, the first or second act was sent to nine contacts by email. The emails asked if the description was correct and if they could supplement it with their experiences by phone. Five contacts responded, and information provided by four were used in the thesis (see References). Notes were taken during the phone conversations. The conversations were summarized in Word-documents shortly afterwards so that the notes would not be difficult to interpret. Relevant information from these documents was later inserted in the discussion part of this thesis. The written information was then sent for approval and supplementation by the informants.

Allison (1971) analysed the Cuban Missile Crisis based on public documents, interviews and conversations with participants and other informants. Similarly, this thesis studied an international political process based on public documents, literature and conversations. When the data collection was complete, it was time to discuss further, draw conclusions and finalize the written thesis.

[8] One personal communication source was information retrieved during a conversation at Chalmers.

3. SO_x Emissions: Impacts and Land-based Measures

The development of international agreements on land-based emissions and the awareness of environmental impacts of sulphur dioxide emissions constitute a background for the issue making its way to IMO. This chapter first shows the environmental and health impacts of SO_x emissions and then summarizes the early developments of international agreements on land-based emissions.

3.1. Impacts of SO_x Emissions

Since the 1970s, much attention has been given to reducing sulphur dioxide emissions. For many years, the attention was directed at an environmental problem known as 'acid rain', i.e., acidification. Today, the attention is more concerned on problems associated with the emission and atmospheric formation of particles (or aerosols[9]). These particles have impacts on human health, visibility and the climate (Vestreng et al., 2007). Furthermore, SO_x emissions have significant economic costs through damage to buildings and structures (Warfvinge and Bertills, 2000). This section describes acidification and how particles affect human health and the climate.

3.1.1. Atmospheric Processes and Deposition

During the combustion of a ship's bunker fuel, about 90% of the sulphur (S) in the fuel reacts with oxygen gas (O_2) and is emitted in its gaseous state as sulphur dioxide (SO_2). Most gases that enter the atmosphere from natural and anthropogenic sources undergo oxidation, as they are in a chemically reduced state. The chemical conversions that occur in the atmosphere change the properties of the emitted substance, affecting its lifetime, transport distance and deposition rates.[10] The processes from SO_2 emissions to acidic deposition are illustrated in Figure 3.1. The atmospheric oxidation of SO_2 occurs in the gas phase as well as in cloud droplets or on aerosols by heterogeneous oxidation. In *the gas phase,* SO_2 is oxidized by hydroxyl (OH) radicals. The result is an adduct, $HOSO_2$, which in turn is oxidized to SO_3. SO_3 then reacts with water (H_2O) in the atmosphere and forms sulphuric acid (H_2SO_4). *The heterogeneous oxidation* includes both the oxidation in the aqueous phase (in clouds, fogs or aerosols) and oxidation on the surfaces of solids: either in the air or in water droplets. According to Fowler et al. (2007), the pH of water droplets has a strong influence on the reaction pathway and the oxidant that will be used. Ammonia (NH_3) is the most important base that regulates the acidity of cloud droplets over Europe. NH_3 emissions thus have the potential to regulate the pathway of SO_2 oxidation (Finlayson-Pitts and Pitts, 2000; Borell et al., 1997; Fowler et al., 2007). The deposition of acidic gases and particles can occur in two ways. Gases or particles can be transported to ground level and be absorbed or adsorbed by land surfaces, materials or water surfaces, which is called *dry deposition*. When pollutants dissolve in clouds, fog, rain or snow, they are deposited on the surface of the earth by *wet deposition*. In water, sulphuric acid is dissolved into two hydrogen ions ($2H^+$) and one sulphate ion (SO_4^{2-}) (Finlayson-Pitts and Pitts, 2000; Borell et al., 1997). It is the hydrogen ions that cause acidification, though the sulphate is as significant in the acidification process (Elvingson and Ågren, 2004). According to Lövblad et al. (2004), wet deposition dominates

[9] For definitions, see Section 3.1.3.

[10] Deposition of sulphur dioxide is thus often given simply as the quantity of sulphur. One tonne of sulphur contains the same number of sulphur atoms as two tonnes of sulphur dioxide (Elvingson and Ågren, 2004).

the total sulphur deposition in many areas, in particular in areas with low atmospheric concentrations of sulphur compounds and high precipitation. Dry deposition is significant in areas with high concentrations of air pollution. In general, dry deposition represents the local aspect of SO_2 emissions and wet deposition represents the regional and *transboundary*[11] aspect. The significance of dry deposition of sulphur decreases with the distance from the source and the significance of wet deposition increases (Lövblad et al., 2004).

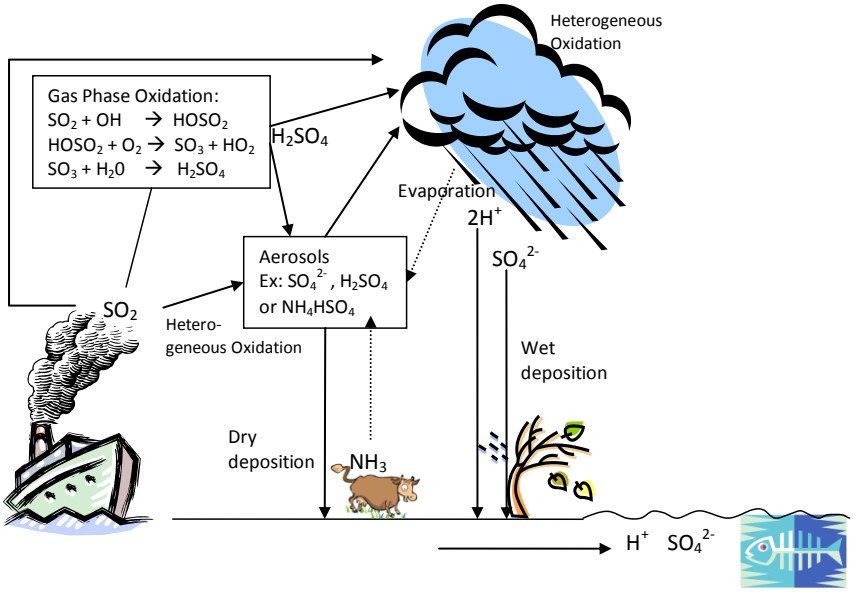


Figure 3.1. Illustration of sulphur emission, transportation and deposition (Borell et al., 1997; Finlayson-Pitts and Pitts, 2000)

3.1.2. Acidification

Sulphur dioxide is the primary air pollutant causing acidification in many areas (Smith et al., 2004). Of the mean total annual acidity of precipitation in North-West Europe, about 70% is derived from sulphuric acid. The remainder is mostly derived from nitric acid (HNO_3). The oxidation of nitrogen oxides (NO_x) in the atmosphere results in the formation of HNO_3. NO_x is formed in all combustion in which the temperature makes nitrogen in the air react with oxygen in the air. Ammonia (NH_3) also contributes to acidification. The primary anthropogenic emission source of ammonia is livestock manure and its handling in agriculture (Mason, 2002; Borell et al., 1997). So, what is acidification? A characteristic of an acid is its ability to emit hydrogen ions in a solution. Thus, by acidification we mean an increased concentration of hydrogen ions. According to Elvingson and Ågren (2004), water is generally classified as acidic at a pH level[12] below 6.2.[13] Natural buffering reactions neutralize acidic inputs in both soils and lakes. In soils, there are several different buffer systems with complex processes, which will not be described here. The chemical weathering of minerals is most important in the long term (Warfvinge and Bertills, 2000). Soils with large quantities of easily weathered minerals can receive large quantities of acidic deposition without acidification,

[11] See Section 3.2.

[12] pH is a measure of the acidity of a solution by measuring the concentration of hydrogen ions. A neutral solution has pH 7. A lower pH means a surplus of hydrogen ions and the solution is acidic. With a higher value, the solution is basic/alkaline. The scale is logarithmic and a pH of 6 is ten times more acidic than a pH of 7 (Elvingson and Ågren, 2004).

[13] The definition also includes an alkalinity level of less than 0.05-0.10 milli-equivalents of hydrogen carbonate (HCO^{3-}) (ibid.).

e.g., regions with calcareous geology. Soils with hard-weathered minerals have a low buffering capacity. Thus, acidification is likely to occur in areas with bedrock consisting of granite or gneiss. The surrounding geology and soils determine the neutralizing capacity of freshwater and thus the impacts of acidic deposition on lakes. In fact, freshwater acidification occurs mainly as a result of soil acidification. In lakes, the buffering system concerns mainly the availability of hydrogen carbonate[14] (HCO^{3-}), which originates from the surrounding soils (Mason, 2002). Note that acidification is not only anthropogenic in nature. So-called *natural acidification* has taken place since the last ice age by a slowly declining weathering rate of soil minerals. Brown water lakes are other examples of natural acidification. They contain high concentrations of humic substances that form carbon dioxide (CO_2) when decomposed. Carbon dioxide reagent with water forms carbonic acid (H_2CO_3), which acidifies lakes (Elvingson and Ågren, 2004; Warfvinge and Bertills, 2000).

The chemical effects of soil acidification are first seen when the acidic deposition has depleted the soils' buffering supply. The first effect is significant leaching of mineral nutrients. The second is decreasing pH levels, followed by rising aluminium ions (Al^{3+}) in lakes and watercourses. The aluminium levels rise sharply in lakes with a pH level below 5.5 (Warfvinge and Bertills, 2000; Mason, 2002; Elvingson and Ågren, 2004). Pleijel et al. (2001) concluded that the effects on biological diversity of acidic deposition are better known and likely to be more severe in freshwater ecosystems than in terrestrial ecosystems. Furthermore, they emphasize that there is strong evidence of big impacts on biological diversity in aquatic environments through chemical changes. Some organisms are sensitive to low pH levels while others are more resilient and benefit from the decline in other species. In particular, the presence or absence of fish controls the species composition in lakes. If the fish are eliminated, their prey increase, such as various insects (Elvingson and Ågren, 2004). The disappearance of several sensitive animal and plant species in acidified waters has been directly associated with leaching of inorganic aluminium compounds, mainly Al^{3+}. Aluminium becomes toxic to fish in the range of pH 5.0-5.5 (Mason, 2002).

According to Pleijel et al. (2001), the evidence concerning the acidification effects on biological diversity in soil flora in forest ecosystems is relatively certain, in particular for deciduous forests. The impacts of soil acidification first and foremost concern leaching of important nutrients, particularly base cations, such as magnesium, potassium and calcium. The loss of nutrients leads to reduced growth. Together with low pH levels, sensitive species could be eradicated. In addition, releases of aluminium ions and heavy metals are absorbed by plant root systems, though the most serious effects are found in decomposers. Furthermore, phosphorus binds to released aluminium and forms aluminium phosphate, thus making it difficult for the plants' uptake of the important nutrient (Elvingson and Ågren, 2004).

3.1.3. Particles: Indirect Impacts of SO_x

Finlayson-Pitts and Pitts's (2000) definition of particles, or *particulate matter* (PM), includes solids and liquids between ~0.002 and ~100 mm in diameter. The distinction between particles and aerosols is not always apparent in literature. Finlayson-Pitts and Pitts define *aerosols* as "*relatively stable suspensions of solid or liquid particles in a gas*" (p. 349). By this definition, they include "*both the particles and the gas in which they are suspended*" (ibid.). During the combustion of a ship's bunker fuel, most of the sulphur is oxidized to SO_2. Sulphur is also a major constituent of the primary particles emitted from the combustion of

[14] Also called bicarbonate

heavy fuel oil in marine engines however. The term *primary particles* refers to particles formed during combustion, and their existence in the atmosphere originates directly from emissions. A smaller portion of the sulphur in the fuel forms SO_3, which in turn forms sulphuric acid (H_2SO_4) when water is present in hot exhausts. Sulphate particles are formed when the acid nucleates (forms new particles) or condenses (attaches to existing particles) by the cooling of the exhaust. The quantity of sulphate particle emissions depends on how much SO_2 or SO_3 is formed from the fuel's sulphur and on the temperature and humidity of the gas (Winnes, 2010; Finlayson-Pitts and Pitts, 2000; Lighty et al., 2000). Research has indicated a correlation between the sulphur content in fuel and the emissions of particulate matter. Particles in the atmosphere are even more closely connected to SO_2 emissions however. As shown in Figure 3.1, SO_2 can form sulphate particles by gas-to-particle conversion. These particles are so-called *secondary particles* (or often *secondary aerosols*), meaning that they are formed by chemical reactions with their gas-phase precursors in the atmosphere (Finlayson-Pitts and Pitts, 2000; Lighty et al., 2000).[15] According to Adams et al. (2009), the contribution to the total particulate matter in the atmosphere by emitted primary particles is only about 10-15%, while the majority consists of secondary particles formed from the emissions of their precursors.

3.1.3.1. Impacts on Human Health

Increases in morbidity and mortality from extreme air pollution episodes have been well documented in the 20th century (e.g., the Meuse Valley Fog of 1930 and the London fog of 1952). In the 1970s and 1980s, the link between cardiopulmonary diseases and extraordinarily high PM concentrations was generally accepted. In the early to mid-1990s, the attention to health risks from particulate matter increased when several epidemiologic studies in the US showed health effects at low concentrations of ambient particulate matter. Similar results were reported in studies from Germany, Canada, Finland and the Czech Republic. Pope and Dockery (2006) argued that these studies together motivated much of the further research and provided "*a critical mass of evidence*" for health effects from particulate matter at low to moderate exposures (Pope and Dockery, 2006, p. 709). Several recent epidemiological studies have increased the scientific and political interest in the health effects of particulate matter. These studies indicate correlations between increased mortality and PM concentrations. Furthermore, particulate emissions have showed associations with numerous health risks: in general cardiovascular and cardiopulmonary diseases (Finlayson-Pitts and Pitts, 2000; Pope and Dockery, 2006). While the correlation between short-term exposure and increased mortality and morbidity are shown in a large number of studies, studies on long-term exposures are fewer (primarily studies in the US) (Pershagen et al., 2009). Pope and Dockery concluded, however, that estimates of mortality are higher in studies on long-term PM exposures.

Size is an important factor for the impacts on human health from particulate emissions. Figure 3.2 shows standard terms for different particle sizes. Particles originating from natural sources, such as mechanical erosion, are generally in the upper size range, e.g., terrestrial dust is generally above 10 µm. Inhaled large particles are generally removed in the upper respiratory tract by a mucus layer. Natural particles are thus of less concern for health effects. Particles from fossil fuel combustion and gas-to-particle conversion, however, are generally below 2.5 µm. These particles can reach the alveolar region of the lungs, where no protective

[15] Particles formed from SO_2 are also included in the term *secondary inorganic aerosols* (SIA), which are defined by EMEP (2009) as the sum of sulphate (SO_4), nitrate (NO_3) and ammonium (NH_4).

mucus layer exists (Finlayson-Pitts and Pitts, 2000). Ultrafine particles (<0.1 µm) can be deposited in deeper parts of the lung and can penetrate further into the body. The ultrafine particles dominate urban aerosols by number. The finest particles (nuclei or nanoparticles) are secondary particles formed by gas-to-particle conversions (Lighty et al., 2000). Winnes (2010) showed that particles below 0.1 µm generally dominate in number from marine diesel engines while coarse particles above 2.5 µm dominate in mass (Winnes, 2010). Air quality standards for particulate matter have been developed along with environmental health policy and scientific results. PM_{10} was introduced as a measurement of the mass of suspended particulate matter less than 10 µm, followed by the more recent $PM_{2.5}$, i.e., less than 2.5 µm (Pope and Dockery, 2006).

Coarse particles:
> 10 µm (or > 2.5 µm)

Fine particles:
PM_{10} < 10 µm
$PM_{2.5}$ < 2.5 µm
PM_1 < 1 µm

Ultrafine particles < 0.1 µm

Nanoparticles < 0.01 µm (10 nm)

Nuclei: nanometer-sized particles formed by gas-to-particle conversion

Figure 3.2. Standard terms for different particle sizes (aerodynamic diameter) (Lighty et al., 2000)

3.1.3.2. Radiative Forcing

Reduced visibility is an apparent factor associated with high air pollution levels. Visibility loss occurs due to the sum of scattering and absorption of light by gases and particles, together with a diversity of factors resulting in haze with different colours and densities. Aerosols are responsible for the majority of visibility loss from air pollution (Finlayson-Pitts and Pitts, 2000). The ability of atmospheric aerosols to reflect sunlight has a more significant environmental aspect. Aerosols affect the radiative balance by reflecting sunlight back into space and thereby cooling the climate. This so-called *radiative forcing* (or climate forcing) has a cooling effect corresponding to about 30% of the warming effect of CO_2. Their lifetime in the atmosphere is about one week, however, compared with about 100 years for CO_2. Furthermore, aerosols have indirect climate effects. The cloud properties are dependent on the properties of the aerosols on which the cloud droplets are formed. Aerosols may also affect cloud lifetime and precipitation. The climate effects of aerosols have considerable uncertainties, and currently no model is available that includes all aspects. Complex processes and indirect effects are involved. In short, most particles have cooling effects, and CO_2, soot and ozone have warming effects. Hansson (2009, p. 41) argued that "*the extent to which the climate will change due to increasing greenhouse gases is strongly dependent on current aerosol concentrations and the composition of aerosols, e.g. the concentration of soot*".

3.2. International Agreements on Land-based Emissions

Sweden is one of the European countries in which the ecological damage caused by acidification has been most evident and severe (Warfvinge and Bertills, 2000). In 2006, 93% of the sulphur deposition over Sweden originated from foreign emission sources (Swedish Environmental Protection Agency, 2010a). This figure gives an insight into the term *long-range transboundary air pollution*, i.e.:

"*air pollution whose physical origin is situated wholly or in part within the area under the national jurisdiction of one State and which has adverse effects in the area under the jurisdiction of another State at such a distance that it is not generally possible to distinguish the contribution of individual emission sources or groups of sources*" (LRTAP 1979, Article 1b).

Regional transboundary air pollution started a conflict between the US and Canada already in the 1920s and 1930s (Pleijel, 2007). The famous Trail Smelter[16] case was the first air pollution conflict between national borders in which a tribunal in 1941 concluded that:

"*no state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence*" (35 AJIL (1941) 716, quoted from Birnie et al., 2009, p. 144).

The international work on long-range transboundary air pollution started with the findings from decades of research on acidic lakes in Sweden and Norway. Swedish researchers had monitored acidity in freshwater since the 1940s. The measurements showed significant falls in pH levels between the 1950s and the 1960s. The contemporary understanding of these findings began in 1968 when the Swedish soil scientist Svante Odén published an article[17] on the acidification of Scandinavian lakes. He argued that precipitation over Scandinavia had become more acidic and that it was primarily due to emissions of sulphur dioxide from industries in the UK and Central Europe (Underdal and Hanf, 2000). The scientific evidence gathered in Sweden and Norway soon pushed transboundary air pollution to the international arena. The report *Air pollution across national boundaries: the impact on the environment of sulfur in air and precipitation* was presented at the first UN environmental conference in Stockholm in 1972 (*United Nations Conference on the Human Environment*). The report concluded that other European countries were strongly interrelated with the harmful effects caused by the deposition of sulphuric acid in Sweden, as it was transported on average more than 1000 km before deposition. Furthermore, international agreements, legislation and control were emphasized in the conclusions (Swedish Ministry for Foreign Affairs and Swedish Ministry of Agriculture, 1971). At the conference, delegates from other European States and developing States did not fully support the Scandinavian initiative, however, though it was declared that States have:

"*the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction*" (Declaration of the United Nations Conference on the Human Environment, 1972, Principle 21).

[16] The Trail Smelter was a zinc and lead smelter in Canada, close to the border of the United States, that caused significant pollution damage to US forests and agriculture production (Pleijel, 2007).

[17] Odén, S. 1968. *The Acidification of Air and Precipitation and Its Consequences for the Natural Environment*. Ecology Committee, Bul. 1, Nat. Sci. Res. Council of Sweden (in Swedish).

Although representatives of the USSR and allied States did not participate in the conference, it was the USSR, together with Norway, that later pushed the issue to negotiations within the *United Nations Economic Commission for Europe* (UNECE). A USSR study had shown that "*annual damage from acid rain to the agriculture of regions now known as Belarus, Lithuania, Latvia, Estonia, the northern part of Ukraine and 11 administrative regions of European Russia was estimated to be more than $150 million*" (Sliggers and Kakebeeke, 2004, p. 9). In the same period, a programme dealing with the transportation of transboundary air pollutants in Europe was initiated in 1970 under the *Organisation for Economic Co-operation and Development* (OECD). The final report of the programme was published in 1977. It was concluded that sulphur compounds travel several hundred kilometres or more in the atmosphere and that "*air quality in any European country is measurably affected by emissions from other European countries*". Furthermore, it was concluded that "*if countries find it desirable to reduce substantially the total deposition of sulphur within their borders individual national control programmes can achieve only a limited success*" (OECD, 1977, quoted by Lövblad et al., 2004, p. 9).

The pressures from the USSR and Norway, and the information from the 1977 OECD report paved the way for UNECE negotiations to adopt the *Convention on Long-range Transboundary Air Pollution* (LRTAP) (Sliggers and Kakebeeke, 2004). The convention was adopted in 1979 by 34 countries and the EC Commission (UNECE, 2010a). It was developed as a framework convention, which for the next 30 years would form the basis of the development of 8 regulatory protocols[18]. With its 51 parties, LRTAP is today the only major regional multilateral agreement on transboundary air pollution regulation and control (ibid.; Birnie et al., 2009). Birnie et al. (2009) describe it as "*one of the most successful and highly developed of the older environmental regimes*" (Birnie et al., 2009, p. 344). Furthermore, the 1977 OECD report paved the way for the *European Monitoring and Evaluation Programme*[19] (EMEP), with the purpose "*to provide governments with the information on the extent of long-range transport and deposition of airborne pollutants*" (Lövblad et al., 2004, p. 10). More than 25 countries in Europe participated in the programme. EMEP was integrated as an important part of LRTAP to develop emission reduction scenarios and as an arena for developing emission control agreements in the form of Protocols (ibid.).

While SO_2 emissions in Western Europe had declined with the 1973 oil crisis, emissions in the Eastern European countries increased with industrial growth and the exploitation of brown coal with a high sulphur content. The reports of dead forest trees in the 1980s caught the awareness of the general public and politicians. The EMEP Assessment Report from 2004 states the following: "*What had previously been regarded as a purely Scandinavian crusade about a few fish in remote lakes now became of concern also in major European countries*" (Lövblad et al., 2004, p. 10). Record-high levels of air pollutants in both East and West Germany in the winters of 1985 and 1986 brought more awareness of transboundary air pollution. This paved the way for the *Sulphur Protocol* to LRTAP (Lövblad et al., 2004). The protocol, in which 21 parties undertook binding agreements to reduce emissions of SO_2 by 30% between 1980 and 1993, was adopted in 1985 (Sliggers and Kakebeeke, 2004).

A *second sulphur protocol* was adopted in 1994. The protocol was based on the principle of critical loads, i.e., "*A quantitative estimate of an exposure to one or more pollutants below*

[18] Including regulations of the following pollutants: SO_2, NO_x, volatile organic compounds (VOC), heavy metals and persistent organic pollutants (POPs) (Lövblad et al., 2004)

[19] Also the *Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe*

which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge" (Grennfelt and Nilsson, 1988, p. 9). An agreement on avoiding exceedance of all critical loads was not fulfilled however. It was agreed to reduce at least 60% of the overall exceedance of critical loads by 2010. This included a differentiated reduction between the parties, e.g., an 80% reduction in Germany and 49% in Greece (Birnie et al., 2009; Lövblad et al., 2004). Later, the *Protocol to Abate Acidification, Eutrophication and Ground-level Ozone* (*the Gothenburg Protocol)* was adopted by 25 parties in 1999, and it entered into force in 2005. The protocol regulates SO_2, NO_x, VOCs and ammonia. Overall, SO_2 emissions should be reduced by more than 63% by 2010 compared with 1990. It is estimated that, when fully implemented, the area with excessive levels of acidification in Europe will be reduced from 93 million hectares in 1990 to 15 million hectares (UNECE, 2010b).

As a result of different abatement measures and the international agreements described above, the estimated global sulphur dioxide emissions fell significantly until the beginning of the 21th century. Smith et al. (2011) found that the global emissions increased between 2002 and 2005, however, due to increased emissions in China and from international shipping and developing countries in general.

4. Adopting and Amending Conventions through IMO

This chapter is intended to provide an understanding of the formal procedures in the story to be told in this thesis. The first section gives an overview of the working arrangements of the MEPC and its Sub-Committees based on observations from investigating the reports and participating in BLG 15, 7-11 February 2011. The second section deals with the formal procedures leading up to the adoption of a new convention through IMO. The third section briefly highlights the process of the entry into force of a convention. The fourth section deals with the process of amending existing IMO conventions.

4.1. Working Arrangements

The work of considering the global cap and air pollution at IMO took place in the following main arenas:

- *Plenary, Working Groups* and *Drafting Groups* of *MEPC sessions*
- *Plenary, Working Groups* and *Drafting Groups* of *Sub-Committees*
- *Intersessional Meetings*
- *Correspondence Groups*
- *Informal arenas*

To begin with, a rule of thumb is that the Committees take the policy-decisions and the Sub-Committees are given instructions to conduct technical work to present to the Committees. The report of a Sub-Committee ends with a list of proposed decisions to be taken by the Committee. These "action points" (*Action requested of the Committee*) include phrases such as: *the Marine Environment Protection Committee is invited to approve/agree/endorse/note* and so on. The MEPC then considers the report and its action points. Discussions could take place but the formal wordings in the session reports are similar to the above. When all the action points have been decided, the report is *approved in general*.

The sessions for the Committees or Sub-Committees are held during a normal working week. All decisions are taken in Plenary sessions in the main hall of the IMO headquarters, and all the participating delegations and observers are represented. A Chairman and a Vice Chairman are elected at the preceding session, and a decision is made on a provisional agenda and arrangements. The definitive agenda and arrangements are decided on the first day of a session. Each sub-agenda item is considered in the Plenary along with submissions that need Plenary consideration. Working groups and drafting groups are then established depending on the stage of consideration and given their terms of reference for their work during the week. All the delegations and observers present are allowed to participate in these groups. The groups are held in English, however, without interpretation. The number of participating non-English speaking countries is thus small.[20] The groups report their finalized work in the Plenary, orally and with a written report along with action points. The reports are considered in the Plenary and decisions are taken based on the action points and further discussions. Formally, a working group conducts the technical consideration of a sub-item before decisions are taken, while drafting groups are given instructions to conduct editorial work of already-decided requirements or guidelines in a draft text. A drafting group could receive

[20] Moreover, undeveloped countries often have small delegations due to lesser resources (Tan, 2006). This affects their ability to participate in all the groups and at the same time participate in the Plenary.

instructions to perform other tasks beyond an editorial nature however. If further work is needed in order to meet the deadlines, e.g., a target completion date, work could be assigned between the sessions. The intersessional work consists of *Intersessional Meetings* of a working group and so-called *Correspondence Groups*. Both are given their instructions by the MEPC (or terms of reference by a Sub-Committee followed by approval and instructions by the Committee). An intersessional meeting functions as an extended working group meeting but may include many more participants. The report of an intersessional meeting is submitted to the forthcoming session of the concerned Committee/Sub-Committee. A correspondence group is a group that considers its matters mainly by e-mail conversation. Member States and observers send their comments to a lead country, which coordinates the work and reports to a forthcoming session or intersessional meeting.

In addition to the arenas above, we will see later that informal talks have been of great importance to the development of the global cap through IMO. Much discussion and negotiation occur between the formal working hours of a session. With a two-hour lunch break, many things happen that are not accounted for in the formal reports. Another possible, significant arena is the nearby hotel bar (e.g., Shino Latino at Park Plaza Riverbank, where some delegates could be found at night). In the second act, we will also see a different form of informal arena (although very transparent): the informal Group of Experts. It should also be noted that many alignments and negotiations take place long before the sessions. For example, a joint submission by several States is a process on its own, which this thesis does not take into account (observations from IMO reports 1988-2008 and participation at BLG 15, 7-11 February 2011, IMO, London, the UK).

4.2. Adopting IMO Conventions

As an international organization, IMO should not be confused with having regulative powers of its own. Its role is primarily to provide an arena in which States can discuss, negotiate and take common decisions on maritime issues. Like other international agreements, the responsibility for the outcome of the work in IMO is up to each Member State. Shaw (2008) described international law (i.e., *public international law*) as a separate system outside the national legal systems that only exists between States. Common principles and norms are recognized between the States and are mainly formulated in the form of international treaties and agreements, e.g., conventions. A Party to an international treaty is bound to follow the rules that have been set in the treaty. There is no institution above the States, however, with powers to set rules and to enforce them (Shaw, 2008). The general procedures at IMO follow the *Vienna Convention on the Law of Treaties*[21] and formal procedures under the UN. Unlike other UN organizations, however, IMO does not have the mandate to adopt international conventions. Adoption has to be made through a diplomatic conference (Boisson 1999; IMO, 2011).

The preparatory work of adopting a convention at the MEPC begins with an initial proposal to include a new item in the work programme. Only Member States can submit such a proposal. Organizations with observer status at IMO can merely submit background information and recommend or advise the Member States to take action (ibid.).[22] With the current guidelines for the work of the MEPC (MSC-MEPC.1/Circ.2), a proposal should include, *inter alia*, the

[21] The *Vienna Convention on the Law of Treaties* (1969) and the *Vienna Convention on the Law of Treaties between States and International Organizations or between International Organizations* (1986)

[22] Note that follow-up action could also be requested from the Assembly, diplomatic conferences, UN conferences/bodies and other international or inter-governmental conferences/bodies.

need for the proposed measures and an analysis of the benefits and costs to the shipping industry, and legislative and administrative burdens. The Committee then discusses and considers the proposal and decides if it should be part of the work programme. If it is decided that an item should be included in the work programme of a Sub-Committee, the MEPC considers the technical aspects and gives detailed instructions. The Committee also considers priorities and decides on a target date for completing the new item (MSC-MEPC.1/Circ.2). If the Committee agrees on a proposal for a new convention, it is sent to the Council and to the Assembly when necessary. After authorization to proceed, the Committee begins a detailed consideration or assigns a Sub-Committee to carry out the main technical work. The aim is to develop a draft convention on a specific target date. When agreement on a final draft convention has been reached by the Committee, it is sent to the Council and the Assembly with a recommendation to hold a diplomatic conference for adoption. The work of the MEPC is now complete. A resolution is then adopted by the Council or the Assembly if agreement is met on the draft convention. The resolution calls for a diplomatic conference and invites all IMO Member States and all Member States of the UN. The draft convention is circulated before the Conference for comment. This is the stage at which the powers of IMO end. The time needed to reach this stage varies but it could take several years (Boisson 1999; IMO, 2011). According to Okamura (1995, p. 183), the IMO process "*is by nature a slow negotiating process*". Boisson (1999) emphasized that the extent of this work at IMO should not be underestimated and that any excessive haste could result in an inadequately prepared draft convention, which could result in failure at the diplomatic conference. Boisson further stated the following:

"*IMO plays a vital role at this preliminary stage in lawmaking. Its duty is to define the guiding principles of the debate, and also to encourage the emergence of a consensus*" (Boisson (1997, p. 139).

Once the conference is held, it becomes an international body in itself with its own arrangements, rules and election of a chairman and vice-chairmen, even if it is held at the IMO headquarters. All States (not just IMO Members) have equal rights at a conference. When adopting a new protocol under the MARPOL Convention, however, only the Parties can adopt it. Today, MARPOL 73 can be seen as a framework convention with its main requirements existing in the Annexes of two Protocols. By adding a new annex to a framework convention, a protocol has to be adopted by the Parties to the Convention. The Protocol of 78 merged with the 73 Convention and added Annex I to V. Subsequently, the Protocol of 97 added Annex VI. Observer organizations also participate at diplomatic conferences but can merely give advice and provide background information. The draft convention and comments from invited Member Governments and organizations are considered in detail at the conference. The work could be conducted in plenary sessions and in established working groups. Unlike the deliberations at IMO, voting takes place at diplomatic conferences. A convention is adopted when a majority of the Governments present and voting agree (IMO, 2011; Boisson, 1999; observations from investigated IMO documents). In regard to the adoption of Annex VI, each represented Party to MARPOL 73/78 had the right to vote. In general, decisions were taken by a two-thirds majority of representatives for the Parties present and voting. Decisions on procedures were taken by a simple majority (MP/CONF.3/2).

4.3. Process of Entry into Force

The adoption of a convention is merely a first stage of a long process. A convention has to become legally binding to the Parties before the standards can take effect. This stage is called *entry into force* (IMO, 2011; Boisson, 1999). Generally, a number of States representing a specific percentage of the world tonnage (merchant fleet) have to formally "*express its consent to be boun*d" by an IMO convention (IMO, 2011). There are different methods for Governments to do so. A convention is often open for *signature* within 12 months of the adoption. For most multilateral treaties, the signature alone is not binding. It has to be followed by *ratification*, *acceptance* or *approval*. These three procedures all have the same basic meaning: that a State expresses its consent to be bound by the treaty. *Ratification* is the most commonly used. *Acceptance* and *approval* have less formal and technical procedures. Another option is *definitive signature*, by which a State can express its consent to be bound directly without ratification, acceptance or approval. This is only optional when it is allowed under the treaty. After the period for signature, the convention is open for *accession*. A State that has not signed the convention can become a Party by accession, which also has the same legal effect as ratification (IMO, 2011; UN, 2011).

When the conditions required for a convention to enter into force are met, it usually takes an additional period before it enters into force in order to enable *implementation* by Governments. The Governments have to ensure that the standards of an international convention are applied nationally. As such, the standards are implemented in national law. The Governments of Member Parties have a responsibility to ensure compliance with the treaty. The enforcement of maritime conventions has traditionally been the obligation of the Flag State (IMO, 2011; Boisson, 1999). Flag States set their own provisions, and penalties are set for their ships and operators. A system of certificates and inspections are used in addition to the national requirements, however, such as Port State control under the Memorandum of Understandings between Parties and class certificates by classification societies (IMO, 2011; Boisson, 1999). Further information on enforcement measures is excluded from this thesis.

4.4. Amending IMO Conventions

The 'old way' of adopting amendments of IMO conventions that had entered into force could be adoption by a two-thirds majority of the Parties present and voting at IMO or at least one-third at a diplomatic conference. These procedures were so slow that some amendments never entered into force. The *tacit acceptance procedure* was therefore introduced. It sets a specific date for entry into force that will apply if no objections are received from "a specified number of Parties" before that date (IMO, 2011). The preparatory work on amendments follows, in principle, the work of a new convention. The guidelines for the work by the MEPC, however, states that "a compelling need" for an amendment and an analysis of implications should be demonstrated in the proposal (MSC-MEPC.1/Circ. 2, para. 2.11.2). With regard to the second act of this thesis, amendments to MARPOL are provisioned under Article 16(2) of the MARPOL Convention (MARPOL 73). It states, *inter alia*, that: a submission that proposes an amendment shall be circulated to all Members and Parties. The Secretary-General shall then communicate the adopted amendments to all Parties for acceptance (MARPOL 73, Article 16(2)). This differs from the revision of Annex VI. Agreement first had to be met for an *approval* of amendments. The approved text was then circulated to the Parties, after which a final adoption could be made. No explanation was found on this procedure.

5. *Act 1*. The Development of a 4.5% Global Cap

This chapter describes the historic development of a 4.5% global sulphur cap in MARPOL Annex VI. The story starts at the time when acidification was a 'hot topic' in 1970s and 1980s (as described in Section 3.2) and ends with the adoption of Annex VI in 1997.

5.1. *Overture*: The 1970s and 1980s

Marine pollution from ships was given international attention in the aftermath of the Torrey Canyon disaster and with increased environmental awareness in the 1970s, particularly in the Western world. The first conference on marine pollution, *International Conference on Marine Pollution*, was held a year after the Stockholm Conference (Tan, 2006). Seventy-one States participated and the result was the adoption of the *International Convention for the Prevention of Pollution from Ships 1973* (MARPOL 1973). The ratification process for its entry into force was slow however. As a reaction to a series of tanker accidents in 1976-1977, a new protocol was adopted in 1978. It was incorporated into the protocol of 1978 as MARPOL 73/78. MARPOL 73/78 entered into force on 2 October 1983 (IMO, 2009a). According to IMO (1998a), air pollution from ships was discussed already in the lead-up to the adoption of the 1973 MARPOL Convention, though it was decided not to include air pollution at the time.[23] Nevertheless, the international agreements on land-based air pollution drew the Governments' attention to ship emissions and influenced the coming work at IMO. As fuels with high sulphur contents were regulated on land, these fuels were sold for use on board ships. In the 1980s, questions thus arose over the contribution of shipping to problems associated with air pollution and acid rain (Tan, 2006; Okamura, 1995). The issue found its way to the MEPC in the mid-1980s when a review of fuel oil quality was conducted in relation to the discharge requirements in Annex I (IMO, 1998a). At the same time, growing concern over irreversible ecosystem damage to the North Sea and dissatisfaction with "*the lack of progress made by the competent international organizations charged with protecting the marine environment*" made the North Sea countries turn to a regional initiative (CONSSO, 2002, p. 3). The first *International Conference on the Protection of the North Sea* was held in Bremen in 1984 (ibid.). At the second conference in London 1987, the issue of air pollution from ships was raised by Norway. A Norwegian study had indicated that emissions from coastal marine activities were a major cause of acidification in Norway and contributed to about 40% of the Norwegian deposition of NO_x and about 14% of the Norwegian SO_x deposition (CONCAWE, 1993). The issue of regulating the sulphur content of bunker fuels was also raised. According to Tan (2006), at the time, the combustion of sulphur-containing fuel was considered a major cause of acidification (Tan, 2006). In the Ministerial Declaration to the Conference, the ministers of the North Sea States agreed to:

"*initiate actions, within the appropriate international bodies concerned such as the International Maritime Organization and the International Standards Organization as may be appropriate, leading to improved quality standards of heavy fuels, and actively support this work aimed at reducing marine and atmospheric pollution*" (the London Declaration, 1987, para. 31).

[23] Further information on this statement was asked for through the Maritime Knowledge Centre at IMO, but no further information was obtained before the finalization of this thesis.

5.2. MEPC 1988-1989

The issue of air pollution was raised at IMO as a direct result of the London Declaration (Tan, 2006; CONSSO, 2002). A communication from the Secretary of the North Sea Conference to the Secretary-General of IMO was submitted from the IMO Secretariat to the upcoming 26th session of the MEPC. The communication was intended to draw attention to those parts of the declaration that had particular relevance to IMO. The declaration was also submitted in full text[24]. During MEPC 26 in September 1988, this led to particular focus on paragraph 31 of the declaration. A proposal to include air pollution from ships in the future work programme of MEPC was submitted by Norway (MEPC 26/22) together with an information paper presenting estimations on the scale of air pollution problems from ships. The paper dealt with sulphur emissions from ships emanating from high sulphur contents in bunker fuels but also problems associated with emissions of NO_x and VOC. With a 5% sulphur content in HFO, it was estimated that global SO_2 emissions from ships would correspond to 10% of the total global emissions (MEPC 26/INF.3O). The Norwegian initiatives were supported by the Baltic Sea States, environmental NGOs and European parties to LRTAP (primarily other Scandinavian and Northern European States) (Tan, 2006; CONCAWE, 1993). As a result, it was agreed to include air pollution from ships in the future work programme of MEPC (MEPC 26/25). Furthermore, issues associated with the quality of fuel oil were raised by a representative of the Helsinki Commission (HELCOM). The *Declaration on the Protection of the Marine Environment of the Baltic Sea Area* was adopted on 15 February the same year and included in a submission[25] (MEPC 26/25). The declaration stated that ministers responsible for environmental protection in the Baltic Sea States were determined to "*cooperate within appropriate international bodies to promote the development of environmentally sound standards of marine fuels*" (Declaration on the Protection of the Marine Environment of the Baltic Sea Area, 1988, p. 5). The MEPC later agreed that the issue of improving quality standards for heavy fuel oils should be dealt with at MEPC 27 (MEPC 26/25).

At MEPC 27 in March 1989, documents submitted by Norway and the Baltic Sea States were considered. The Norwegian submission estimated that the annual global SO_2 emissions from shipping were about 10 million tonnes. Two options for reducing emissions from ships were given: reducing the sulphur content or using on-board abatement technology. The first option was preferred and an upper limit for the sulphur content of 1% was proposed (MEPC 27/6/2). The submission by the Baltic Sea States provided the same options but also explained that the technology involved in on-shore installations for reducing SO_x emissions is complex, causes disposal problems and tends to have substantial costs in small-scale applications (MEPC 27/6/3). A working group was established to consider fuel oil quality and the submitted information. It was agreed that SO_x emissions were one of the main items for consideration when analysing environmental problems caused by fuel oil quality. A proposed action plan for fuel oil standards was developed that included, *inter alia*, "*identification of SO_x emissions in relation to all other sources*", cost impacts, environmental impacts and alternative options (MEPC 27/16, Annex 8). Member States where urged to submit studies to Norway, which agreed to submit a progress report to MEPC 29. The MEPC further agreed to include prevention of air pollution from ships and fuel oil quality in the long-term work plan of MEPC up to 1996. The work would start at MEPC 29 in March 1990 (ibid., Annex 12; Annex 13).

[24] MEPC 26/INF.2
[25] MEPC 26/INF.19

5.3. *Intermezzo*: Development within the Air Pollution Regime

In June 1990, an EMEP Workshop on Emissions from Ships was held in accordance with the work plan for the implementation of LRTAP. The contribution from shipping to deposition of air pollutants in coastal areas within the ECE region was considered significant. Earlier inconsistency between the results of models and measurements could be partly explained by the emissions from shipping. The total contribution of emissions from the English Channel and the North Sea could be equal to or exceed the contribution from some small countries. SO_2 emissions from ships were estimated to contribute to about 5% of the total global anthropogenic emissions. Furthermore, the average sulphur content of bunker fuels used in shipping was found to be 2.8% for HFO and 0.97% for MDO. The highest sulphur content of HFO was about 5%. It was agreed that further measurements should be conducted and regulatory measures considered, such as a potential shift to cleaner fuels (MEPC 30/INF.17).

5.4. MEPC 1990

The 29th session of the MEPC was held in March 1990. Air pollution from ships, including fuel oil quality, was now an agenda item for the first time. The submissions included an information document by the Secretariat with texts of protocols to LRTAP. Norway continued to drive the issue at the MEPC with five submissions (MEPC 29/22; IMO, 1998a). Submission MEPC 29/18/4 summarized two Norwegian studies[26] that estimated the annual global SO_x emissions from international shipping at between 4.5 and 6.5 million tonnes, which corresponded to about 4-5% of the total global emissions. While the effects of the emissions over open seas were considered moderate because of dispersion, the emissions from shipping contributed significantly to environmental problems along certain routes. It was concluded that the relative contribution to global emissions was likely to increase, with a growing number of States regulating most of the land-based sources. It was proposed that the next step for MEPC was to "*discuss the target for reductions, and proposals for regulations*" (MEPC 29/18/4, p. 4). Another Norwegian submission[27] represented Bremnes (1990), a study to quantify the global exhaust gases from ships in international trade and to chart NO_x and $S0_2$ emissions geographically. NO_x and SO_2 emissions in the North Sea, the English Channel and the Baltic Sea were charted on EMEP maps. The global SO_2 emissions from international shipping were estimated at about 4.6 million metric tonnes (Bremnes, 1990). A document was submitted by the Baltic Sea States within the framework of HELCOM. The submission emphasized that there were "*already facts available to support in general the need to introduce requirements*" and that only the levels needed consideration (MEPC 29/18/1, p. 1). An annex to the submission suggested a sulphur content near 0.8% for ships designed for HFO, as residual fuels with a sulphur content below 0.8% often cause the pour point to increase[28] (ibid., Annex).

Later, a cost impact study contained in a submission from the State of Kuwait was presented. It recommended keeping the current sulphur content limits of 4-5% to avoid a substantial price increase in fuel oil. A 1% limit was expected to increase the price by 20% (MEPC 29/18/5). The delegation of Venezuela stated that as the sulphur level in fuel oil is dependent on the sulphur content of the crude oil, it would be impractical with a uniform level of 1%. A submission from *Friends of the Earth International* (FOEI) made a first proposal to develop a

[26] MEPC 29/18 and MEPC 29/18/6
[27] MEPC 29/INF.7
[28] Pour point = "*the temperature below which crude oil becomes plastic and will not flow*" (Britannica Online Encyclopedia, 2010)

new Annex to MARPOL on air pollution, which would include all sources of air pollution from ships. It was suggested that the regulation of CFCs and halons should be prioritized, as the development of a complete annex "*would require considerable time*" (MEPC 29/18/2, p. 4) and other pollutants could be added through amendments later on. The proposal was discussed and some delegations announced that it was too early to decide on the forms of regulations at MEPC 29. It was thus agreed as a first step to prepare recommendations, which could be transformed into regulations later. The Committee recognized that air pollution from ships "*constitutes a significant problem of a global nature which requires international action by the Organization*" (MEPC 29/22, para. 18.2). It was thus agreed to deal with the issue with high priority from the next session onwards. A working group was scheduled at the next session and Member States where urged to investigate all aspects of the issue thoroughly and to present their views and ideas well in advance (MEPC, 29/22).

The third North Sea Conference was held in The Hague in March 1990. The North Sea States agreed to take concerted action within IMO "*to establish effective measures to minimize air pollution from ships*" (The Hague Declaration, 1990, para. 25.1(iii)). This would be achieved by submitting proposals with reduction objectives and target dates to IMO (ibid., Annex 2D). As a result, recommendations on air pollution regulations were submitted by the North Sea States and the Commission of the EEC to MEPC 30 in November 1990. The submission (MEPC 30/14/2) recommended reducing the present level of SO_2 emissions by 50% at the latest in the year 2000. Quality standards for HFO should be developed in consultation with the *International Organization for Standardisation* (ISO) and the oil industry, with a maximum sulphur content of 1.5%. For ships sailing in areas where the SO_2 emissions are likely to affect the air quality adversely (such as inland waters, harbours, territorial waters and near coastal zones) the sulphur content should be less than 1% (MEPC 30/14/2). A submission from the Baltic States provided the exact same recommendation as the North Sea States, though it was clarified that a 50% reduction could be achieved using a maximum sulphur content of 1.5% (MEPC 30/14/6).

Intensive discussions on air pollution from ships emerged for the first time at MEPC 30 (MEPC 36/22). A working group on air pollution was established to deal with, *inter alia*, reduction targets and the establishment of a draft Assembly resolution. Target levels and dates were set by the working group based on MEPC 30/14/2[29]. With regard to sulphur emissions, the recommendation in MEPC 30/14/2 was agreed in the working group and later by the Committee. A target level of 50% of the present emission level of SO_2 was thus agreed to be achieved by the target date of 2000. The MEPC was unable to agree on which year the definition of the "present level" was to be set however. The Japanese delegation reserved its position on the targets of SO_2 and NO_x. It was expressed that any decision on targets "*should not be taken before and unless scientific justification for setting such targets had been developed*" (MEPC 30/24, para. 14.10). A strategy for exhaust gas was considered in the working group and the Committee based primarily on the recommendations in 30/14/2. The economic and technical implications of the recommendations were then considered.[30] A lack of information made it impossible to proceed with detailed consideration of these aspects however. Several Member States emphasized that more information was needed. Furthermore, full account was taken of the views presented by the Netherlands (MEPC 30/WP.3), which proposed steps to be taken in order to achieve the objectives of halving SO_2 emissions to 1.5% of the sulphur content and 1% in certain regions. It was proposed, *inter*

[29] Also the Norwegian proposal (MEPC 30/14/4), which did not include anything on SO_x emissions

[30] The delegation of Venezuela had suggested earlier including the consideration of financial implications for oil-producing developing countries

alia, to collect information, assess target dates and sulphur reduction costs, and to take actions on target dates and implementation. The *Sub-Committee on Bulk Chemicals Handling* (BCH) was then instructed to deal with information gathering and impact assessment of the proposed measures. It was further instructed to deal with potential alternative measures on SO_2 reductions. Member States and industry were requested to conduct research on these matters and submit the results to the 21th session of the BCH Sub-Committee (BCH 21). Furthermore, an action plan on developing a new annex to MARPOL 73/78 was developed. The action plan gives certain goals and dates for the future work up to the time of entry into force of the proposed Annex. The MEPC then designated the BCH as the co-ordinating Sub-Committee with assistance from other Sub-Committees for consideration of all air pollution aspects in general and to conduct the work as described in the action plan, i.e., to develop a new annex (MEPC 30/24).

5.5. 1990-1991: Work towards an Assembly Resolution

The working group at MEPC 30 developed a draft text of an Assembly Resolution to cover all the aspects of air pollution. The Draft Assembly Resolution was agreed by the Committee, and it was decided to consider the draft text at MEPC 31, with the aim of adoption by the Assembly's 17th session in November 1991. The *Maritime Safety Committee* (MSC) was requested to consider and comment on the text in the meantime. The draft Assembly Resolution was approved with amendments at the 59th session of MSC. The amendments were based on a US proposal that a technical study would be conducted by the BCH and that no decision on target dates for SO_x or NO_x would be taken before the outcome of this study.

At MEPC 31 in July 1991, the delegation of the US further suggested that the target levels should be deleted from the Assembly Resolution and that further technical study on these elements should be undertaken by the BCH. The US proposal was even welcomed by Norway and the Netherlands, as well as Germany, which maintained its preference that target dates and levels should be set in the draft resolution. It was agreed to revise the draft Assembly resolution based on the US proposal, and a drafting group was established. The revised draft Assembly resolution was presented to the Committee in the report of the Drafting Group. All the target levels and target dates were removed and the only specific text on the issue of SO_2 emissions from ships was an added subparagraph to the paragraph on exhaust gas, "*Reduce emissions of sulphur oxides and nitrogen oxides in exhaust gases*" (MEPC 31/21, Annex 14, para. 2.3.2). The draft Assembly resolution was then approved by MEPC along with a recommendation to adopt the resolution by the Assembly at its 17th session. Furthermore, the action plan was revised. Almost the same target levels and dates, which were deleted in the draft Assembly resolution, were included in the action plan.[31] The 50% reduction target thus still remained at the MEPC. The Committee noted that available documents could be regarded as a base for developing reference levels and years, but it was recognized that further technical consideration was needed. The reference levels and reference years would be considered at BCH 21. The revision of the draft Assembly resolution and the action plan should be seen in light of earlier consideration of submissions. The decision to postpone the consideration of reference years for SO_x was based on a Norwegian proposal[32]. Moreover, a submission from France[33] presented results from a study of economic implications of possible refining operations. The costs of sulphur reduction were estimated to be identical to the

[31] The only differences concerned CFCs (reference levels and one target date)
[32] MEPC 31/13/2
[33] MEPC 31/INF.6

figures presented by Kuwait, i.e., MEPC 29/18/5. It was stressed that careful consideration of the cost of reducing the sulphur content in residual fuels (hereafter desulphurization) was necessary. The concern was shared by Japan and Venezuela, which reaffirmed their earlier position (MEPC 31/21; BCH 24/7/7).

Resolution A.719(17) on Prevention of Air Pollution from Ships was adopted unanimously by the Assembly on 6 November 1991. The resolution was a non-binding interim measure that requested that the MEPC in co-operation with the MSC prepare a draft Annex to MARPOL 73/78 on the prevention of air pollution from ships (Resolution A.719(17); Okamura, 1995). It recognized "*the urgent necessity of establishment of a policy on prevention of air pollution from ships, and development of reduction objectives and measures to achieve the objectives for control of emissions of all the elements of air pollution*" (Resolution A.719(17), 326).

5.6. Drafting 1991: BCH 21

The work on drafting a new Annex to MARPOL on air pollution requirements was about to persist at the MEPC and the BCH Sub-Committee for a period of seven years, 1991-1997. The 21st session of the BCH was held before the adoption of the Assembly resolution, though in this section it is treated as the first step of the drafting process. The BCH had been instructed to deal with, *inter alia*, the reference level for sulphur oxides and the economical/technical implications, as well as to coordinate the development of requirements on air pollution and a new annex to MARPOL. The main issue on SO_x emissions was how to achieve emission reductions. Norway had submitted information on a number of different methods and concluded that the following two options were technically possible: (1) to control the sulphur content in bunker fuels and (2) to use exhaust gas treatment (BCH 21/11/2). The first alternative was preferred by the delegations of Germany, Sweden and France, which all preferred international fuel oil standards as the solution. The delegation of France pointed out that the submitted papers on industry implications did not address the advantages of using low-sulphur fuels, e.g., less tear on engines and potentially less maintenance and energy savings. According to the delegation of the Netherlands, the benefits amounted to about USD 5 per tonne of fuel. The costs, however, would be of the magnitude reported in submission MEPC 29/18/5 by the State of Kuwait (see Section 5.4 above) or much higher, as indicated by the submission by Japan (BCH 21/11/6). The Japanese submission showed results of an ongoing study on the feasibility of low-sulphur fuels, including possible economical implications for the oil market and bunker fuel prices. The submission indicated increased costs of about USD 60 per tonne with a reduction to a 1% sulphur content and about USD 30 per tonne for a reduction to 2%. It was estimated that the bunker fuel price would rise to about 1.5 times the present level (BCH 21/11/6). The delegation of Japan concluded that a global reduction of the sulphur content would result in increased freight costs and also an "*excessive burden on refining industry*" (BCH 21/15, para. 11.10). The delegation of Japan further expressed that it would take some time before exhaust gas equipment would be available on the market and that it should be developed through international co-operation. The delegation of Norway stated that it was premature to decide which measure to use and that Member States should encourage research and development to find a practical solution. This view was supported by the Netherlands. The BCH further noted a communication from the *International Energy Agency* (IEA) of the OECD. The communication emphasized that no decisions were to be taken before the results of various studies, e.g., by CONCAWE (the Oil Companies' European Organization for Environmental and Health Protection) and the *International Petroleum Industry Environmental Conservation Association* (IPIECA).The document expressed that the scientific knowledge on the contribution of shipping to SO_x

emissions was highly uncertain and that the relative cost-effectiveness was unknown (BCH 21/11/5).

The BCH then noted that the issue of reducing sulphur emissions needed further considerations, in particular on costs and benefits of desulphurization and its scope of application, i.e., global or restricted to certain areas. It was agreed that the BCH should not take any decisions on this controversial issue. The BCH concurred with the view of Japan and the Netherlands on encouraging the Member Governments to put further effort into research and development. Furthermore, the BCH requested that Members submit further information to the next session. The framework for a new annex was then considered with the aim of agreeing on elements of requirements and methods of enforcement for each pollutant. A list of elements was developed based on a Norwegian proposal. After a suggestion by the delegation of Japan, it was agreed that this list would only be preliminary for further consideration. A correspondence group was then established to prepare a draft annex to MARPOL as a submission to BCH 22. It was further agreed to draw the attention of the MEPC to "*the impracticability of completing its work in 1992*" and to recommend that the target date be extended to 1994 (BCH 21/15, para. 11.60).

5.7. *Intermezzo*: Earth Summit 1992

The *United Nations Conference on Environment and Development* (UNCED) (also known as the Earth Summit) was held in Rio de Janeiro, 3-14 June 1992. It was the first UN environmental conference since the Stockholm Conference in 1972. It was highlighted at MEPC 33 as a major development. One of its major results, *Agenda 21*, was referred to as becoming a focal point within IMO (MEPC 33/20, para. 1.5 and 3.25). Agenda 21 is a comprehensive global action programme for sustainable development, containing proposals for action in areas such as poverty reduction and for protecting the atmosphere, oceans and biodiversity. Another agreement adopted at the Earth Summit was the *Rio Declaration on Environment and Development*, which contains principles defining the rights and responsibilities of States (UN, 2010). Principle 15 is of particular importance to the development of the global cap and the reader will find several references to this principle as we move on. The principle is given below.

"*In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*" (Rio Declaration, Principle 15).

5.8. Drafting 1992

5.8.1. MEPC 32

At MEPC 32 in March 1992, two submissions were discussed by the Committee on the issue of SO_x and NO_x emissions. The first was from The *Oil Companies International Marine Forum* (OCIMF). It included an interim report from CONCAWE, which at the time was conducting a study to assess the costs and environmental benefits of reducing sulphur emissions from ships. The report concerned the contribution of ship emission to the overall sulphur burdens in Scandinavia and North-West Europe. The study was based on EMEP data and the results indicated that the contribution was less than 2%, which was reported as minimal by both CONCAWE and OCIMF. It was further concluded that "*land based*

emission reductions provide a much more significant means to reduce overall sulphur burdens than reductions in ships" (MEPC 32/12/1, p. 2). OCIMF further expressed the view that "*targeting ship-sourced emissions for global control cannot be justified on the basis of either environmental benefit or cost*" (ibid., p. 1). The delegation of Germany expressed that it could not share the view of OCIMF. The observer from OCIMF further raised the question of whether the guidance was needed from the Committee on the matter of cost and benefits of desulphurization, though the Committee decided that BCH was responsible for this consideration (MEPC 32/20). The second submission was from the *International Association of Independent Tanker Owners* (INTERTANKO). It emphasized that the quantities of SO_x emissions were unknown at the time. According to INTERTANKO, data gathering on present emission levels should be given the highest priority, and a percentage reduction should be established thereafter. It was further highlighted that the costs of reductions would fall on both the oil industry and oil tanker owners. It was explained that the costs of reducing the sulphur content from an average of 3.5% has an exponential variation. A limit of 1% would cost 70% more than a limit of 2%. This was due to the requirement of new technology when reducing the sulphur content by more than 2.5%. The option of using exhaust gas cleaning was considered to have a great disadvantage as the waste disposal could result in an additional marine pollution problem. It was stated that INTERTANKO would support IMO's decisions if "*measures would be feasible for all parties from both economical and technological point of views*" (MEPC 32/12/2, p. 2). The Committee noted both submissions and referred these to the BCH for further consideration. With regard to the BCH request to extend the target date to 1994, the MEPC decided to wait for the result of the correspondence group and to revert the issue to the next session of the MEPC (MEPC 32/20).

5.8.2. BCH Correspondence Group on Air Pollution from Ships

The BCH Correspondence Group on Air Pollution from Ships started its work directly after BCH 21 and finalized the report in June 1992. The question of regional vs. global regulation appeared for the first time in the SO_x discussions. "Some Members" preferred the regional solution, as the problem of acid deposition was restricted to coastal areas. The transboundary aspects of SO_2 emissions made "some Members" prefer a global solution however. It was further emphasized that control of different regulations in different areas was difficult or even impossible. Three options were presented: (1) Global approach, (2) Regional approach and (3) to postpone a difficult decision. The global approach was considered to be the only viable and controllable option to achieve the target of reducing emissions by 50% before the year 2000. It was reported that "a slight majority" favoured a global approach (BCH 22/7/3, p. 4). Various proposals on a global sulphur content limit was presented, though the largest number of Members in the group supported 1.5%. The question of global vs. regional approaches was left for consideration at BCH 22. The work of the correspondence group resulted in a draft text of the new Annex to MARPOL, though it was considered to still be at an early stage of development. As the group's task was to develop controllable regulations, a global approach remained, as did the 1.5% limit on the sulphur content in bunker fuels. The proposed Regulation 13 on SO_x emissions is presented in Figure 5.1.

REGULATION 13

Sulphur oxides

(1) The total emission of sulphur oxides from a ship shall be [..... g SO_x/KWh] or less.

(2) At least one of the following condition shall be fulfilled:

a) The sulphur content of fuels used onboard ships, including solid fuels and any other fuels, shall not exceed [1.5%].

The quality of fuel shall be documented by the supplier and provided to the ship at the time of delivery in a bunker delivery note on a format as given in Appendix 1.

b) An exhaust gas cleaning system approved by the Administration, in accordance with guidelines developed by the Organization, is applied to reduce SOx emissions onboard.

c) Any other method to limit SOx emissions, approved by the Administration in accordance with guidelines developed by the Organization, is applied.

Figure 5.1. Proposed Regulation 13 of the Correspondence Group 1992 (BCH 22/7/3, Annex 1, para. 13)

5.8.3. BCH 22

The 22nd session of the BCH was held in September 1992. It was first considered that the draft text developed by the Correspondence Group could be the basis for further development of international requirements. A submission by Japan (BCH 22/7/8[34]) showed the results of continued investigations into the supply and potential volumes of bunker oil, and the effects of desulphurization. The results of the new investigations indicated that the character of bunker oil varied by region and country. It was thus concluded that if the present crude oil production structure were used, it would be impossible to desulphurize bunker oil to a 1.5% sulphur content in half of the world's regions (Central and South America, Asia, Europe and Africa). Regional shortages of supply could be expected as could negative effects on the global relationship between the demand and supply of crude oil. It was emphasized that these aspects should be considered in the discussions on SO_2 emissions and not only environmental aspects (BCH 22/7/8; BCH 22/INF.12). A general discussion on the proposed Annex was held early on in the agenda item. The majority was in favour of developing a new annex on the prevention of air pollution from ships, though the majority also thought that the development of the draft had been too fast. "A number of members" had the view that more research was necessary before the Annex could be finalized. The SO_x discussions that followed were characterized by a presentation of several documents and different views. The report informs that the BCH was unable to reach consensus on the main items. These included data on the necessity of regulating air pollution, cost-benefit considerations and alternative options to desulphurization. It was of particular significance to this thesis that the question of global uniform regulation vs. regional special area regulation was discussed. The report does not mention any thing on this Plenary discussion, though the working group was instructed "*to develop a possible framework of regional requirements for SO_x emission*" (BCH 22/14, para. 7.18.2).

With regard to exhaust gases in general (SO_x, NO_x and VOCs), the working group first discussed the basic question of the necessity of measures. "A number of members" of the working group had the view that shipping's contribution to total global emissions was too small to take action, while another group of members ("a number of members") had the view that the necessity of action was clear. Although the contribution was relatively small, the

[34] Together with BCH 22/INF.10-13

proportion would increase in the future while emissions from other sectors would be reduced. Hence, shipping must share the burden of taking necessary measures. Another group of members ("a number of members") could not share these opposite views but expressed concern over the fast development and necessity for further study. The group could not take a majority decision on the necessity of measures but agreed that such a basic question could only be taken by the BCH or the MEPC (BCH 22/WP.4; BCH 22/14). The BCH noted the general discussion by the working group and agreed to request that the MEPC consider the question on necessity for action on SO_x, NO_x and VOCs at its 34th session, with the aim of providing guidance to the BCH (BCH 22/14).

The specific SO_x discussion at the working group concerned the question of a regional approach. "A number of members" supported the view of Norway that a regional approach would result in different regional or national rules. This would complicate international shipping, distort the competiveness within the industry, affect the freedom of shipping and result in a heavy burden on national administrations. These effects would be avoided with a global approach of international standards for all flags. The observer of FOEI further stressed that the costs of enforcement in Port States and Coastal States should be taken into account in cost-benefit studies with a regional approach. The response to Norway's statement was expressed by the delegation of the Netherlands, which acted as Chairman of a group of volunteers that was requested to prepare a framework on the regional concept[35]. It was stated that the risk of unilateralism[36] could be addressed through uniformly applied regional standards agreed upon through IMO. Moreover, emission standards within a specific region would apply to all flags entering that region. A "number of members" agreed with the statement of the delegation of the Netherlands, i.e., they favoured a regional approach. The Working Group recognized the importance of a unified international standard but also that a regional approach should not be confused with unilateral action without international regulations (BCH 22/WP.4; BCH 22/WP.4/Corr.1; BCH 22/14). The concept of "capping" that emerged at BCH 22 is a particularly significant issue for this thesis. It was introduced under consideration of the regional approach at the working group by the group of volunteers. The general idea was to form a world-wide barrier (or ceiling) of possible rising sulphur levels as a result of more stringent land-based measures to reduce SO_x emissions. It was suggested to "cap" (or limit) the sulphur content in bunker fuels to 3.5%. It was noted that the ISO standards at the time included a limit on the sulphur content up to 5%. Together with regional control, a global cap could be helpful in resolving the availability problem of low-sulphur fuels. The delegation of the Bahamas expressed that a relatively high cap of 3.5% must be considered for any meaningful effect on global SO_2 emissions levels and on the economic implications for industry. The working group could not proceed with further discussion and it was decided to deal with the issue at its next session (BCH 22/WP.4; BCH 22/14). Later on in the session, it was agreed to re-invite the MEPC to postpone the target completion date to 1994. In order to finalize the work, a correspondence group on regional control options for NO_X and SO_x was established (BCH 22/14).

5.8.4. MEPC 33

MEPC 33 was held in October 1992. The agenda item on air pollution mainly concerned the outcome of BCH 22. With regard to the request from BCH that the MEPC should give guidance on the necessity for action, several delegations expressed that the necessity had

[35] The report of the group of volunteers is found in Annex 2 to BCH 22/WP.4.
[36] Unilateralism = one-sided requirements taken by any single state or union, as opposed to bilateral agreements between two parties and multilateral agreements between several parties.

already been justified at previous sessions of the MEPC and that there was no further need to discuss this issue at the MEPC or the BCH. It was thus agreed to instruct the BCH to continue its work on the new annex in accordance with the request made by the Assembly resolution. Moreover, the Committee decided to instruct the BCH to incorporate fuel oil standards into the new annex after the delegation of Germany had expressed that it was an important element of air pollution and should not be dealt with separately. Furthermore, it was agreed to extend the target date for the BCH preparation of the draft annex to 1994 (MEPC, 33/20).

5.9. Drafting 1993

5.9.1. MEPC 34

MEPC 34 was held in July 1993. At this session, there was no agenda item on air pollution, though the report of BCH 22 was considered. Matters at BCH 22 that required decisions by the MEPC were dealt with at the previous session. The only decisions made were formal procedures. Some submitted documents were referred to the BCH for consideration however (MEPC 34/23). One of these documents was MEPC 34/3/1, submitted by OCIMF. Although it was referred to later in the report of MEPC 37, it is presented here. The submission contained a report of a study on the costs and benefits of a 3.5% global sulphur cap undertaken by IPIECA. OCIMF briefly highlighted the results and concluded that a global cap was not considered to be a cost-effective method to control SO_x emissions. The results indicated that a global cap of 3.5% would only reduce the SO_x emissions from ships by less than 5%. By only using a global 3.5% cap, the net reduction in SO_x pollution in Northern Europe and Scandinavia was estimated to be 0.1%. The global investment costs of a 3.5% cap were estimated to be between USD 1.4 billion and USD 2.0 billion (MEPC 34/3/1).

5.9.2. BCH Correspondence Group on Regional Control Options

A report on the Correspondence Group on Regional Control Options for NO_x and SO_2 was submitted by the Netherlands at BCH 23. The report gives an insight into the reasoning behind choosing a regional approach before a global approach, the concept of capping and the advantages and disadvantages of possible measures. It was first reasoned that reducing the sulphur content was the easiest method to reduce SO_2 emissions from ships compared with the difficulties of enforcement, technology and the costs of using on-board equipment. A stringent global standard was considered "overkill" however, as air pollution was a regional problem. It was considered unlikely that there would be enough support for a stringent global sulphur content limit as this would involve high costs and the risk of disrupting the market for residual fuel. Early in the report, it was stated that the apparent lack of support for a global solution was a main reason for developing a regional concept. The concept of critical loads was used to justify the use of a regional approach. In certain coastal regions, it would be impossible to prevent exceedance of critical loads unless emissions from shipping were reduced along with land-based sources. The regional approach was considered to result in major reductions in the most sensitive areas, which were neither considered achievable nor necessary, with far-reaching global measures. It was concluded that the regional approach would have to include global characteristics with uniform standards for all designated regions and apply to all ships covered by MARPOL. It was further argued that an integrated approach with regional measures and a global cap of about 3% would *"provide for a generally applicable protective measure, although of a moderate nature, associated with gradual measures for a higher level or protection of certain regions and at acceptable cost levels*" (BCH 23/7/4, p. 6). The reduction target set by the MEPC may not be reached by this

approach, however, and "may have to be reviewed" (ibid.). It would "*nevertheless still achieve some of benefits for the environment that the proponents of the reduction targets and dates had in mind*" (ibid.). It was further noted that the cap limit was open to discussion, though a 3.5% cap would still lead to an increase of about USD14 per tonne of fuel. It was also stated that such a cap "*will not lead to any reductions of sulphur oxides worth mentioning*" (ibid.). The point of capping was not to reduce global emissions but to prevent a possible increase in the sulphur content of fuels. The cap would be supplemented with a regulation to monitor the sulphur levels and to facilitate a review if necessary. It was further argued early in the report that combining the regional concept with a cap of 3-3.5% implied that regional reductions would have to be very high in order to reach the initial target level of a 50% reduction by the year 2000.

The justification for measures in general included a clear reference to the precautionary principle of the Rio Declaration, which was considered to be of particular importance as the contribution and consequences of SO_x emissions from ships were not clear. Although further research was needed, it was concluded that a lack of scientific certainty was no reason for postponement. Figure 5.2 shows the proposed redraft of Regulation 13 by the Correspondence Group. In addition, Regulation 13(A) included a 1.5% limit in certain sensitive areas and Regulation 17 stated that the oil used on board should meet the latest ISO quality standards (BCH 23/7/4).

REGULATION 13

Sulphur oxides

(1) The sulphur content of fuels used on board ships, including solid fuels, or fuels based on solid fuels, shall not exceed [3%] by weight.

(2) Notwithstanding the provisions of regulation 17, the sulphur content of residual and blended oil fuels used on board ships, shall not exceed [3 %] by weight.

(3) Notwithstanding the provisions of regulation 17, the sulphur content of destillate oil fuels used on board ships, shall not exceed [0.2%] by weight.

(4) The emission of sulphur oxides shall not exceed [.. g SO_x/kWh]

(5) The quality of the fuel shall be documented by the supplier an provided to the ship at the time of delivery in a bunker delivery note on a format as given in Appendix 1. The bunker delivery note shall be retained on board and shall be available for inspection by the Competent Authority of the Government of a Party to the Convention for a period of [three] years after the date it was issued.

Figure 5.2. Proposed redraft of Regulation 13 by the correspondence group 1993 (BCH 23/7/4, Attachment 2)

5.9.3. BCH 23

BCH 23 was held in September 1993.[37] The key statements in the report of the correspondence group were first discussed. The working group on air pollution was then instructed to consider a reduction of SO_x emissions and to formulate a proposal for further consideration and finalization at BCH 24. Three possible approaches to SO_x emission reduction were identified after exchanging views in the working group: (1) global stringent measures, (2) global capping in conjunction with regional measures and (3) regional measures. There was little support to proceed with the first approach. The working group thus focused on detailed consideration of the second and third approaches. Special attention was

[37] The first intersessional meeting of the BCH Working Group on Air Pollution had been held before BCH 23 (July 1993), though nothing relevant was found in the report of the meeting.

given to a proposal from Japan that the global cap should not be too stringent, "*A maximum value of the sulphur content of fuel shall be [3.5]%*" (BCH 23/WP.3, Annex 2, para. 1). The opinion on whether global capping should be used was evenly divided within the group. The delegations that were in favour of a global cap had the following arguments:

1. Avoidance of a future rise in the sulphur content of fuel oil
2. It could be regarded as a first step in a step-by-step approach to achieve the target level.
3. Only regional measures could result in high sulphur oil distribution in other areas.
4. As recognized by UNECE, SO_2 is a long-range transboundary air pollutant.
5. In the context of the precautionary principle, global measures could be justified by the status of acidification at the time.
6. "*IMO should act as the global organization to address this matter*" (BCH 23/WP.3, para. 18.6).

The delegations that did not support a global cap (at the time) had the following arguments:

1. The environmental benefits gained from global capping were negligible and the costs were high.
2. The regional approach would deal with the pollution caused by ships in designated areas and there was no reason for global capping.
3. The sulphur content in fuel oil showed no indication of an increase. Thus, it was not considered necessary with a global ceiling.
4. Another Assembly resolution (A.500(XII)) required that a compelling need, as well as the costs on the maritime industry and trade, could be demonstrated.

Furthermore, the delegations of the US and the Netherlands suggested that the sulphur content of fuel oil should be monitored. If a threshold value of a 3.2% sulphur content was exceeded, a 3.5% global cap could be applied (BCH 23/WP.3). The Group concluded that it was unable to develop a single text of requirements for SO_x emissions due to the divided opinions on the necessity of a global cap (BCH 23/WP.3). The discussions then continued in the Plenary. The delegation of Venezuela expressed that a global maximum ceiling would result in a change to the production process for petroleum and its derivatives, which would have "a far-reaching impact" on Venezuela's economy and on consumers worldwide (BCH 23/14, para. 7.40). The observer of FOEI underlined that the costs of acidification were already high. It was considered very difficult to estimate the costs of the damage caused by sulphur emissions on human health, crop production, water supplies, fisheries, forests and cultural heritage. Nonetheless, the World Watch Institute has estimated that USD 30.4 billion of annual losses were associated with forest damage in Europe from sulphur deposition alone (BCH 24/7/7). The delegation of the Bahamas supported FOEI and emphasized that these costs should be taken into account in cost-benefit discussions at IMO. Furthermore, it was noted that the *International Chamber of Shipping* (ICS) accepted a global cap together with regional measures. The Norwegian delegation then expressed that decisions on global capping should be taken by the MEPC. It was confirmed, however, that no delegation had opposed the inclusion of regional measures in the new Annex to MARPOL. The BCH decided that the issue should be further considered at the second intersessional meeting in 1994. In addition, an intersessional correspondence group on the regional approach to SO_x emissions was established to consider items that needed to be dealt with before the second intersessional meeting of the working group.

At the end of the agenda item, a statement was made by the delegation of Sweden. It emphasized that the sensitive issues of global capping and a regional approach should be decided by the MEPC. The delegation "*had experienced a distinct feeling that many efforts had been made to turn the development away from the objectives to be achieved stipulated by the MEPC*" (BCH 23/14, para. 7.62.5). It expressed hope of co-operation to find a solution without unilateral action however. Several delegations supported the views of Sweden. The US delegation then explained that the role of a Sub-Committee was to technically evaluate those areas that the Committee requested it to consider. Thus, the target levels for SO_x and NO_x should not be seen as rigid MEPC tasking without further technical review. The delegation also provided an explanation for the controversial development of the SO_x emission regulation at BCH 22; the target levels and dates were not included in the Assembly resolution. This made the US delegation 'comfortable' with a combined global and regional approach that did not strictly hold on to the target levels set by MEPC. The views of the US were supported by "other delegations" (ibid., 7.64).

5.10. Drafting 1994

5.10.1. BCH Correspondence Group on the Regional Approach

The US was the coordinator of the Correspondence Group on the Regional Approach for controlling SO_x emissions and considered the views presented by the Members during the intersessional period. Consensus was not reached on global capping and it was reported that a polarization of views occurred throughout the intersessional period. The support from Members was divided between proposal (A) [3.5%] global cap and (B) "delayed trigger method", which meant that the global average sulphur content should be monitored and if it exceeded 3.2% after two years, a 3.5% global cap should be applied. Other Members favoured not including a global cap at all (AP/WG 2/3).

5.10.2. Second Intersessional Meeting of the BCH Working Group

The second intersessional meeting of the BCH Working Group on Air Pollution was held from 28 February to 4 March 1994. The goals of the meeting were to finalize the draft annex to the extent possible. The issue of global capping was discussed intensively and based on proposals A and B in the report of the correspondence group. For proposal A, the delegation of Spain proposed a global cap of 4.0% and the delegation of the Bahamas proposed 5.0%, though it was stated that the Bahamas could accept 4.0% if the group could not agree on 5.0%. The group could not agree on any single proposal for a global cap. It was thus decided to present the alternative proposals together with an indication of the number of supporters for each alternative. The results of this indication are given in Table 5.1. Note that the number of supporters in the report represented the preferences of the participants to the working group, which also included NGOs and IGOs with observer status. The number of delegations is thus reported in the table with quotation marks. At the meeting, there were representatives for 21 Member States, 1 Associate Member, 10 NGOs and 1 IGO. It could thus be concluded from the table that the preference for proposal A was in a majority, in particular the 4.0% alternative. Furthermore, the table indicates a clear majority for a possible compromise of 4.0%. A draft Annex to MARPOL was prepared by the group, though a number of issues needed further consideration by the BCH, such as global capping. The group could thus not recommend the BCH to approve the draft text. Draft Regulation 13 is given in Figure 5.3. Of further relevance is that the representative for the EC informed of a proposed directive that may possibly include a maximum sulphur limit of 3% in the EU and 1.5% in special areas. A

whish for coordination of this legislative process with IMO was expressed, though if no IMO legislation with acceptable sulphur limits were in place by 1995, the EU could take its own measures (BCH 24/7/6).

Table 5.1. Support for global capping options at the second intersessional meeting of the Working Group

PROPOSAL A			
Global Cap	**Number of "delegations"**	**Members**	**Observers**
5.0%	13	Australia, the Bahamas, Bahrain, Belgium, China, Egypt, Greece, Italy, Liberia, Vanuatu and Venezuela = 11	OCIMF and INTERCARGO
4.0%	18	The Bahamas, Bahrain, Belgium, Canada, China, Egypt, France, Italy, Liberia, Mexico, the Netherlands, Spain, the UK, the US, Venezuela and Hong Kong* = 16	OCIMF and IACS
3.5%	11	Argentina, Denmark, Finland, Germany, Japan, the Netherlands, Norway, Poland, the Republic of Korea and Sweden = 10	EC
POPOSAL B			
Delayed trigger method	**Number of "delegations"**	**Members**	**Observers**
4.0% / 3.7%	4	Mexico, Saudi Arabia, the UK, Hong Kong*	-
3.5% / 3.2%	3	The Netherlands, the Republic of Korea and the US	-
POSSIBLE COMPROMISE			
Global Cap	**Number of "delegations"**	**Members**	**Observers**
4.0%	24	Argentina, Australia, the Bahamas, Bahrain, Belgium, Canada, China, Egypt, France, Italy, Liberia, Mexico, the Republic of Korea, Saudi Arabia, Spain, the UK, the US, Vanuatu, Venezuela and Hong Kong* = 20	ICS, INTERCARGO, OCIMF and IACS
NO SUPPORT FOR ANY OF THE ABOVE ALTERATIVES			FOEI

*Associate Member

REGULATION 13

Sulphur oxides

Proposal a

General Requirements

(1) The sulphur content of fuels used on board ships, [including solid fuels], shall not exceed [3.5%] [4.0%] [5.0%].

Proposal b

General Requirements

(1) (a) The sulphur content of fuels used on board ships, [including solid fuels], shall not exceed [3.5%] [4.0%], [twelve] months after the Marine Environment Protection Committee of the Organization takes a decision to that effect.

(b) The Marine Environment Protection Committee shall take such a decision on the basis of evidence that the sulphur content of fuel measured over the last two consecutive calendar years exceeds a threshold value of [3.2%] [3.7%].

(c) The procedure to monitor the sulphur content of fuels shall be based on the guidelines developed by the Organization.

Figure 5.3. Draft Regulation 13 by the second intersessional meeting of the BCH Working Group 1994 (BCH 24/7/6, Annex 2, para. 13)

5.10.3. BCH 24

BCH 24 was held in September 1994.[38] This was the target session for BCH to finalize its task. A different work method was used in order to finalize the work effectively, and no working group was established. The draft text from the second intersessional meeting was used as a base document. Documents submitted before the intersessional meeting were not considered. A special heading in the report was devoted to the OCIMF presentation of the CONCAWE (1993) report, as referred to at MEPC 32 (BCH 24/15). The delegation of Japan presented the results of a study carried out on Tokyo Bay in response to the findings presented by CONCAWE. It was concluded that it was not sufficient with emission control only in port areas. The BCH agreed that the findings of both reports should be brought to the attention of MEPC 36 (BCH 24/15).

The two proposals made at the intersessional meeting were discussed. As no delegation supported proposal "b", it was decided not to include it for further consideration. The following proposed capping values were discussed with the aim of recommending a single compromised value to MEPC 36:

- 5.0% – proposal by Singapore (BCH 24/7/14)
- 4.0% – proposal by Spain (BCH 24/7/8)
- 3.5% – proposal by Denmark (BCH 24/7/10)

Many delegations participated in the discussion. The majority (22 delegations) supported 5%. Five of these delegations gave indications that they could accept a compromise solution of 4.0-4.5%. Twelve delegations supported 3.5% or 4.0%. The report noted that these numbers were counted from the Secretariat's record of discussions and were not the results of voting. The Chairman postponed the discussions to the following morning in the hope that a

[38] MEPC 35 was held in March 1994, but no relevant information was found in the report.

compromise would be found in the meantime. Hence, the Chairman conducted individual consultations with Members. The result of these consultations was a compromise proposal of 4.5% presented by the Chairman the next day. The Chairman urged the Members to reach consensus so that a single value could be presented to the MEPC. The majority of delegations (15) accepted the Chairman's proposal of 4.5%. Eight delegations stated that they could not accept a figure higher than 4%, however, and six delegations proposed to put alternative figures in square brackets in the draft text. In addition, several delegations that supported 4.5% stated that they would turn to their initial position of 5.0% if consensus could not been reached on 4.5%. The report of BCH 24 informs that "*it became obvious that the Chairman's proposal could not be accepted as a compromise solution by consensus*" (BCH 24/15, para. 7.20). The Chairman thus suggested that Regulation 13(1) in the draft text should only include 5.0% in square brackets. This was accepted by the BCH, although some delegations preferred to include 3.5%, 4.5% and 5.0%, and other delegations preferred not to include any value (BCH 24/15). Table 5.2 summarizes the support given to the global cap discussions.

Table 5.2. Global cap discussions at BCH 24

FIRST DAY		
Global Cap	**Support (delegations)**	**Reported as**
5%	22	majority
3.5-4.0%	12	significant number
SECOND DAY		
Global Cap	**Support (delegations)**	**Reported as**
Compromise 4.5%	15	majority
<4.0%	8	significant number
[3.5%] [4.5%] [5.0%]	6	several
[5.0%]	Accepted by the BCH	no consensus

Due to the lack of consensus, the BCH agreed to include the above discussion in the report to MEPC 36 and a recommendation of further discussion by the MEPC. A drafting group then revised the draft text of Regulation 13. The result of the four years of work on air pollution at BCH thus ended with the global regulation shown in Figure 5.4. Regulation 17(2) states that the bunker delivery note shall at least contain the information in Appendix [2] of the Annex. With regard to the special area Regulation 13(2-4), a 1.5% limit on sulphur content was put in square brackets, as well the designation of the Baltic Sea as a Special Area.

REGULATION 13

Sulphur oxides

General Requirements

(1) The sulphur content in any fuel oil used on board ships, [including solid fuels], shall not exceed [5.0%].

(5) The sulphur content of fuel referred to in paragraphs (1) and (4)(a) of this regulation shall be documented by the supplier and provided to the ship at the time of delivery in a bunker delivery note referred to in regulation 17 of this Annex.

Figure 5.4. Draft Regulation 13 (1 and 5) of BCH 24 (BCH 24/15, Annex 9, para. 13.1; 13.4)

At the end of the agenda item, the delegation of Norway held a statement on the development of a SO_x emission reduction at IMO:

…"the delegation of Norway expressed deep regret for the lack of progress made during the sessions and the eventual deferral of an agreement on requirements for the global reduction of SO_x emissions.

They were gravely concerned that there would be a real possibility that steps leading to unilateral legislations might now be taken, in particular with respect to requirements on the level of sulphur content in fuel oil. Such an approach might greatly affect the role of IMO in this particular area."

..."it considered the oil industry's contribution on the discussion on fuel oil sulphur reduction not satisfactory and not in line with the usual IMO spirit of compromise. In this context, it mentioned that it might reconsider its present positive position towards accepting participation of non-governmental organizations in discussions at IMO meetings." (BCH 24/15, para. 7.57)

The Norwegian view was shared by the delegations of Denmark, Germany, the Netherlands, Poland and Sweden. The observer of OCIMF responded that its attendance in the air pollution debate was *"to provide Member Governments with realistic comprehensive scientific data and relevant cost information to assist them in the development of the new annex*" (ibid., para. 7.58).

5.10.4. MEPC 36

MEPC 36 was held in October-November 1994. At the welcoming of the session, the Secretary-General pointed out the need for the shipping community to deal with air pollution and that the MEPC had a responsibility to develop justifiable air pollution regulations under a new Annex to MARPOL. The Annex could be adopted by a Conference of the Parties at the end of 1996 or early 1997 in conjunction with MEPC 39. The draft regulations had to be finalized at MEPC 37. As BCH 24 was held after the deadline for submission to MEPC 36, submissions would be sent to MEPC 37 instead. The focus at MEPC 36 was put on the outcome of BCH 24 and the draft text of the new Annex to MARPOL. The following views expressed by several delegations were highlighted in the report of MEPC 36:

- The global average sulphur content at the time was about 3% and a capping of 5% would have "very little effect, if any" (MEPC 36/22, para. 9.5.3). This would send the wrong signal from IMO.
- Further consideration should be taken of the figures 3.0%, 4.0% and 5.0%.
- The Committee should continue with the figure 5% as a majority of the BCH supported it.
- The 50% reduction target could not be reached with the proposed requirements.

Furthermore, the UK and the Netherlands presented the results of research that had quantified emissions from ships for 1990 in the North-Eastern Atlantic and developed emission reduction scenarios for SO_x. The UK had submitted the main findings in document MEPC 36/9/6. The average sulphur content in 1990 was 2.7% and the emissions from ships in the area were quantified to be 1.09 million tonnes. The results showed that reducing the sulphur content to 1.5% would lead to a 44% reduction of emissions in the whole area surveyed and a 29% reduction 350 km from land.[39] It was concluded that only a marginal reduction would be gained by using low sulphur fuel within the 12-mile territorial limit. The reductions gained using a 200 mile zone "*would still be substantially below the 50% reduction target*" (MEPC 36/9/6, p. 3). The findings indicated that the target level of a 50% reduction of SO_x emissions in 2000 could not be achieved with a sulphur content of 1.5%, "*even if it were to be applied on a global basis*" (ibid.). It was noted, however, that the North Atlantic was one of the areas with the densest traffic. The results should thus be regarded as a worst-case scenario. It was requested that these scenarios were taken into account at MEPC 37 (MEPC 36/22).

[39] Represents a 200-mile coastal zone on a 50 kilometre grid square

The Committee could not endorse the draft text at this session as further work was necessary *"to resolve key issues which were still outstanding and for editorial improvement of the text*" (MEPC 36/22, para. 9.4). A correspondence group was established to work before MEPC 37, though it would only consider editorial improvement to the draft text and not sulphur capping. It was also agreed that it was essential to take policy decisions on the outstanding issues, such as global capping, at MEPC 37. A work programme aimed at an adoption of the new annex at a one-week conference in 1996-1997 was agreed in principle (MEPC 36/22).

5.11. Drafting 1995: MEPC 37

MEPC 37 was held in September 1995. The draft text had to be finalized at this session, but there were still some substantial issues left to decide in the Plenary. With regard to the legal framework, it was decided that the new Annex (now named Annex VI) should be adopted as a protocol to MARPOL. The draft text was then reviewed paragraph by paragraph. Only a few sentences were found on global capping in the agenda item in the report, though Annex 15 to the report provides statements from delegations and observers. The few sentences inform that a large number of delegations had expressed views on global capping. A majority supported a 5% cap, though numerous delegations favoured a figure of 3-4%. It was decided to keep "[5%]" in the draft text, though a footnote was added, which mentioned the support of numerous delegations for a cap between 3-4%. The Secretariat was instructed to issue a consolidated text on the draft Protocol, which would act as a basic paper for consideration at MEPC 38. Draft Regulations 15(1) and 15(4) from the consolidated draft text are given in Figure 5.5. The footnote described above is represented by the 17th note. Note number 18 explains the m/m measurement.

REGULATION 15

Sulphur Oxides (SOx)

General Requirements

(1) The sulphur content of any fuel oil used on board ships shall not exceed [5.0% m/m][17&18]

(4) The sulphur content of fuel oil referred to in paragraph (1) and sub-paragraph (3)(a) of this regulation shall be documented by the supplier. Such documentation shall be provided to the ship at the time of delivery in a bunker delivery note referred to in Regulation 19 of this Annex.

Figure 5.5. Regulation 15(1 and 4) in the consolidated draft text by MEPC 37 (MEPC 38/9, Annex, para. 15)

5.11.1. Statements

The delegation of the Bahamas presented a joint submission with Liberia and Panama (MEPC 37/13/3) in which reference was made to the CONCAWE findings. Based on these findings, a 1.5% global cap would only reduce the sulphur deposition in Northern Europe by about 1% and at "prohibitive" costs. With a cap of 3.5%, the deposition reduction would correspond to about 1/10 of 1% and the costs could be up to USD 2 billion (MEPC 37/22/Add.1). The delegation of the Bahamas stated that a compromised cap of 4% would have "*essentially no global environmental benefit*" but "*severe financial burden on some Member States*" (MEPC 37/22/Add.1, Annex 15, p. 1). It was stated that the Bahamas, Liberia and Panama "*do not believe some Members should be penalized when **no** benefit is achieved*" (ibid.). Support was expressed for Special Area regulations together with a global cap of 5% (ibid.).

The delegation of Germany expressed different views. As the global average sulphur content at the time was about 2.8%, a 5% global cap could not be justified. A 3% cap was proposed but with an interim cap of 3.5-4% for a suggested period of 5 years, to deal with the "*temporally practical and financial problems to some refineries or countries*" (ibid., p. 2). It was stressed that regional and unilateral actions could not be stopped if acceptable standards were not established through IMO. The delegation of Norway stated that it first supported the initiative of introducing a global cap, as it was feared that the stricter regulations on land-based industry would result in high-sulphur fuel oil being sold to the shipping industry. It was considered obvious, however, that to legalize a 5% global cap would send the wrong signal to a concerned public. This signal could result in regional and unilateral actions.

The delegation of the UK had the view that consensus would be unlikely to be reached at the MEPC unless a major revision of Regulation 13(1) was conducted. It was thus proposed to include a 4.5% global cap together with a future 4.0% cap if the average sulphur content measured over two years exceeded 3.7%. Monitoring of the sulphur content should be based on guidelines developed by IMO. Furthermore, FOEI expressed concern over the enforcement of Regulation 13 and, in particular, the enforcement within Special Areas. It was argued that the lack of enforcing regulations in Special Areas could result in the global cap being the main restricting factor for SO_x emissions in Special Areas. It was thus believed that "*the only sulphur regime that makes sense is one based on a single global fuel oil sulphur cap that is strict enough to protect Special Areas*" (ibid., p. 6).

5.12. *Intermezzo*: Development within the Air Pollution Regime

In November 1995, the Executive Body of LRTAP expressed concern over air pollution from growing shipping traffic. It was decided to approach IMO "*to explore the possibilities of harmonizing approaches*" in order to achieve the emission reduction targets set in the ECE region (MEPC 38/9/2, p. 2). A submission by Norway (MEPC 38/9/2) presented a written communication from the Chairman addressed to the Secretary-General of IMO. It was highlighted that emissions from land-based sources would be reduced by up to 87% compared with those in 1980. It was stressed that without measures on shipping, its relative contribution would be at least doubled by 2010. Critical loads would be exceeded despite the land-based reductions, and shipping could even become one of the main contributors of sulphur depositions in some areas. It was argued that it was more cost-effective to reduce the emissions from ships close to a sensitive area than to reduce the land-based sources. The sulphur limits in the draft Annex to MARPOL were thus considered too high (MEPC 38/9/2).

5.13. Drafting 1996: MEPC 38

MEPC 38 was held in July 1996. At the welcoming of the session, it was stressed that the preparatory work for a new annex had to be completed at this session in order for the Conference to be held in conjunction with the next session. The session was thus extended by three extra days. In the early discussion on the global cap, the Chairman of the Executive Body to LRTAP addressed the MEPC. The importance of the Annex results to the true reduction of air pollution was highlighted. A general discussion on the global cap revealed that numerous Members maintained their previous positions. Two proposals were then set up by an informal drafting group (MEPC 38/WP.4) and the delegation of the Netherlands (MEPC 38/WP.5). MEPC 38/WP.4 provided three additional requirements in Regulation 15(1), as briefly outlined below:

a) Maximum sulphur content of [5%] from entry into force.
b) The worldwide average sulphur content shall be monitored. An initial value should be established [two] years after entry into force.
c) [4%] if the initial value has increased by [0.2%] with 12 months of evidence.
d) [3%] if 12 months of evidence shows that the initial value is exceeded after an additional [two-] year period.

MEPC 38/WP.5 consisted of two different paragraphs of Regulation 15(1):

a) The sulphur content shall not increase compared to the average sulphur content in the reference year [1996].
b) Assessment and evaluation will be made every two years. If the sulphur content has increased by more than [0.2] compared with the reference year, IMO shall take appropriate action.

The Committee was unable to agree on these alternative solutions, though they were later merged into a new proposal by a Group of Experts[40] in MEPC 38/WP.11:

(1) The worldwide average sulphur content shall be monitored.

(2) (a) The maximum sulphur content shall not exceed [4.5% m/m].
(b) The reference value for average sulphur content shall be determined by IMO.
(c) The maximum sulphur content shall be reduced to [4.0% m/m] [twelve] months after evidence shows exceedance of the reference value by [0.2% m/m].

The content of MEPC 38/WP.11 was not discussed, though it was later annexed to the consolidated text of the draft Protocol for further consideration at MEPC 39. A vote was taken merely to give indications on who supported 5% or a lower figure. It was found that these two groups were evenly divided. It was thus decided to keep the 5% figure in square brackets in the draft. The Chairman of BCH 24 informed the MEPC that agreement was almost reached on a global cap of 4.5%. It was emphasized that various proposals had been made since then and that agreement on a common value at the Conference seemed realistic. The Drafting Group presented its report with a revised text of the Protocol of 1997 (MEPC 38/WP.17), though the report was not considered due to a lack of time. The Secretariat was instructed to issue a consolidated text of the draft Protocol. It was also concluded that a number of outstanding issues still remained for consideration, such as the proposed designation of the Baltic Sea and North Sea as SECAs (MEPC 38/20). Due to the lack of time, it was decided to use one more session for the finalization of the draft Annex VI. It was also decided to postpone the Conference to September 1997, in conjunction with MEPC 40 (MEPC 39/13). Draft Regulations 14(1) and 14(4) from the consolidated draft text are given in Figure 5.6. Regulation 18 requires, *inter alia*, a bunker delivery note.

REGULATION 14

Sulphur Oxides (SOx)

General Requirements

(1) The sulphur content of any fuel oil used on board ships shall not exceed [5.0% m/m].

(4) The sulphur content of fuel oil referred to in paragraph (1) and sub-paragraph (3)(a) of this regulation shall be documented by the supplier as required by regulation 18 of this Annex.

Figure 5.6. Regulation 14(1 and 4) in the consolidated draft text by MEPC 38 (MEPC 39/6, Annex 1, para 14)

[40] The working paper and the report did not specify what kind of experts they were.

5.14. Final Drafting 1997: MEPC 39

MEPC 37 was held in March 1997. At the welcoming of the session, it was stated that the consideration of Annex VI was top priority. At the 77th session of the Council, several delegations had expressed that the conference must have a fair prospect of success before a decision to convene it would be taken. Going ahead with a diplomatic conference if it was unlikely to achieve the declared objectives was not considered in IMO's best interests. The consolidated draft text acted as a basic document for consideration. When considering the global cap, a proposal by *the Baltic and International Maritime Council* (BIMCO) was considered. The proposal (MEPC 39/6/21) consisted only of including a 3% global cap without any SECA regulation. The Committee did not agree with the proposal. Instead, a proposal from Australia, Singapore and Vanuatu (MEPC 29/6/9), and the State of Bahrain (MEPC 29/6/17) gained significant support. The submissions proposed not introducing a global cap that was different from the ISO Standard of 5%, though a 1.5% sulphur content limit in SECAs should be established. It was reported that "other delegations" supported a global cap lower than 5%. After a lengthy discussion, it was agreed to maintain "[5%]" in the final draft Regulation 14(1).

It was agreed to monitor the global average sulphur content, as suggested by the UK and the Netherlands in MEPC 39/6/7, which contained draft guidelines for monitoring procedures and setting of the reference value. It was not agreed, however, to include a "trigger mechanism" for a reduction of the global cap if the global average increased above a certain level, which was proposed by the Group of Experts in MEPC 38 (MEPC 39/6/7; MEPC 39/13). It was agreed that "*there should be no linkage between the results of monitoring and reduction of the global cap*" (MEPC 39/13, para. 6.52). An additional paragraph 14(2) was prepared by the Working Group to deal with the monitoring mechanism agreed on as well as an alternative to adopt a Conference resolution on the monitoring mechanism. As a number of delegations had expressed concern about the financial and administrative implications of monitoring, both the draft Regulation 14(2) and the draft Conference resolution were placed in square brackets. The Secretariat was instructed to issue a consolidated text of the draft Protocol of 1997, which would act as a basic document for the Conference (MEPC 39/13). Draft Regulation 14(1, 2 and 5) from the consolidated draft text is given in Figure 5.7. Regulation 18 requires, *inter alia*, a bunker delivery note.

REGULATION 14

Sulphur Oxides (SOx)

General requirements

(1) The sulphur content of any fuel oil used on board ships shall not exceed [5.0% m/m].

[(2) The worldwide average sulphur content of residual fuel oil supplied for use on board ships shall be monitored in accordance with guidelines to be developed by the Organization.]

(5) The sulphur content of fuel oil referred to in paragraph (1) and sub-paragraph (4)(a) of this regulation shall be documented by the supplier as required by regulation 18 of this Annex.

Figure 5.7. Regulation 14(1, 2 and 5) in the consolidated draft text from MEPC 39 (MP/CONF.3/3, Annex 1, para. 14)

5.15. *Intermezzo*: Development within the European Union

In March 1997, the European Commission adopted a proposal on a strategy for combating acidification within the EU, COM(97)88. The strategy included the development of a directive on national emission ceilings (NEC directive) in 1998, ratification of the 1994 protocol to LRTAP and amendment to Directive 93/12/EEC relating to the sulphur content of certain liquid fuels. Moreover, it supported a designation of the Baltic and North Seas as SECAs through IMO (European Commission, 1997). This strategy had further significance for the developments later on as we move to the second act.

5.16. Adoption at the Third Conference on Marine Pollution, 1997

The 1997 Conference of Parties to MARPOL 73/78[41], i.e., the third Conference on Marine Pollution, was held in London from 15-26 September in conjunction with MEPC 40. Representatives of 74 Parties participated, along with Hong Kong as an Associate Member. In addition, representatives from 7 IMO bodies plus the Secretariat, UNECE, the *United Nations Industrial Development Organization* (UNIDO) and observers from 4 IGOs and 26 NGOs participated (Swedish Maritime Administration, 1997; MP/CONF.3/5; MP/CONF.3/INF.1). As no official report was produced, the information in this section is primarily based on the records of decisions of the Plenary, the report of the Swedish delegation and two working group reports. The Secretary-General stressed the importance of IMO taking responsibility for the prevention of air pollution from ships with the new annex to MARPOL. A President and Vice-Presidents for the Conference were elected and the agenda, conference arrangements and rules of procedure were approved. Two working groups were established. Working Group 1 would consider the Draft Protocol of 1997 and the Conference resolutions, and Working Group 2 would consider Draft Annex VI to MARPOL and the Draft NO_x Technical Code (MP/CONF.3/RD/1; Swedish Maritime Administration, 1997).

5.16.1. Adoption of Regulation 14 in Annex VI

5.16.1.1. Plenary 15-17 September

The regulations in Annex VI were considered one by one during 15-17 September (MP/CONF.3/RD/1-4). The discussions on Regulation 14 began on 16 September. It was first reported that the Conference noted two submissions by ICS and BIMCO. Like the submission at MEPC 39, BIMCO proposed a 3% global cap. The arguments included that a 5% cap would have little effect, if any. It was considered to be the wrong signal to be sent from IMO. BIMCO preferred to see an internationally agreed solution instead of a development with more regional standards that would cause difficult operational problems (MP/CONF.3/10). The submission by ICS listed a number of difficulties for the shipping industry and operators associated with using the SECA regulation instead of a single global standard. It was considered to place a significant burden on operators occasionally entering the SECAs. These ships would have to carry a supply of fuel oil with the required sulphur limit in SECAs in addition to their bunker fuel. Besides the costs for a more expensive fuel to carry as supply, the burden on the shipowner was related to the technical aspects of holding, treating and handling two different grades of bunker fuel. The changeover from one grade to another could lead to increased engine breakdowns. Another technical aspect was that the extra supply would mean a loss of deadweight capacity. The effective timing of changeovers between fuels

[41] *Conference of Parties to the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto* (MP/CONF.3)

was considered to pose serious difficulties, which would also increase the burdens of enforcing the regulations. Another aspect presented was that SO_x emissions generated outside the SECAs would inevitably drift in. Furthermore, there was also a possibility that ships would skirt the edges of SECAs with conventional fuel and then take the shortest route across the SECA to its destination. It was stated that "*the majority of the ship owners feel that the problems created by setting up Sulphur oxide emission control areas could be avoided by a single radical step*" (MP/CONF.3/17, para. 10). By establishing a global standard that was "*workable, enforceable and sustainable, at a threshold value sufficiently low enough to take immediate effect*", the objectives of the Assembly resolution would be achieved (ibid.). It was proposed that the global cap be set at 3.5% with a stepwise reduction, starting with 3%. With this approach, SECAs were considered unnecessary (MP/CONF.3/17). The Swedish report notes that the delegation of Lithuania supported the proposal from BIMCO and ICS. The opinion of the other Baltic Sea States, the North Sea States and most of the EU States, however, was that such a solution would not help the acidification situation in Europe. Instead, they had been working towards the assignment of the Baltic Sea and the North Sea as SECAs, which was also consistent with the EU's acidification strategy (Swedish Maritime Administration, 1997).

It was then agreed to instruct Conference Working Group 2 to consider and review Regulation 14(1-3a). The instructions included consideration of the possibility of agreeing on a lower global cap than 5.0%. The remaining consideration on 16 September consisted of the SECA regulations (MP/CONF.3/RD/3). The consideration of Regulation 14 continued on the next day, on which Regulation 14(5) was agreed in principle, i.e., documentation of the sulphur content by the supplier as stipulated in Regulation 18 (MP/CONF.3/RD/4).

5.16.1.2. Working Group 2, 18-23 September

Working Group 2 met on 18, 19, 22 and 23 September and was instructed to prepare final drafts of Annex VI and the NO_x Technical Code, which included comments and decisions at the Plenary. Figure 5.8 shows Regulation 14(1, 2 and 5) in Draft Annex VI by Conference Working Group 2. Note that it was exactly the same as the consolidated draft text of MEPC 39, i.e., the basic document MP/CONF.3/3.

REGULATION 14

Sulphur Oxides (SOx)

General requirements

(1) The sulphur content of any fuel oil used on board ships shall not exceed [5.0% m/m].

[(2) The worldwide average sulphur content of residual fuel oil supplied for use on board ships shall be monitored in accordance with guidelines to be developed by the Organization.]

(5) The sulphur content of fuel oil referred to in paragraph (1) and sub-paragraph (4)(a) of this regulation shall be documented by the supplier as required by regulation 18 of this Annex.

Figure 5.8. Regulation 14(1, 2 and 5) in Draft Annex VI by Conference Working Group 2 (MP/CONF.3/WP.4, Annex 1, para. 14)

5.16.1.3. Plenary 22-25 September

An interim report by Working Group 2 was considered at the Plenary on 22 September, though it only covered Regulation 14(7) on the exception for ships entering a SECA

(MP/CONF.3/RD/4). The final report was considered at the Plenary on 24 September and the regulations of Annex VI were considered one by one. On Regulation 14, decisions were only taken on the SECA regulations: 14(7) and 14(3)(b). It was agreed to postpone further decisions on Regulation 14 to the next day (MP/CONF.3/RD/6). On the next day (25 September), the records of the decisions report that the Conference unanimously adopted all the remaining paragraphs of Regulation 14. The adopted Regulation 14(1) now reads: "*The sulphur content of any fuel used on board ships shall not exceed* ***4.5% m/m***" (MP/CONF.3/RD/7, para. 4.1). The records of the decisions further reported that the square brackets around Regulation 14(2) had been removed and that the regulation had been unanimously adopted (MP/CONF.3/RD/7). As such, the Conference agreed that the global average sulphur content of residual fuel oil should be monitored. Figure 5.9 presents the adopted Regulation 14(1, 2 and 5).

REGULATION 14

Sulphur Oxides (SOx)

General requirements

(1) The sulphur content of any fuel oil used on board ships shall not exceed 4.5% m/m.

(2) The worldwide average sulphur content of residual fuel oil supplied for use on board ships shall be monitored taking into account guidelines to be developed by the Organization.

(5) The sulphur content of fuel oil referred to in paragraph (1) and sub-paragraph (4)(a) of this regulation shall be documented by the supplier as required by regulation 18 of this Annex.

Figure 5.9. Regulation 14(1, 2 and 5) of Annex VI as adopted by the Conference of 1997 (MP/CONF. 3/34)

5.16.2. Adoption of the Protocol

The consideration and adoption of the Protocol of 1997 began at the Plenary on 15 September. It was agreed to refer to the precautionary principle in the preamble of the Protocol. Working Group 1 was instructed to prepare a text on this reference. The articles of the Protocol (such as procedures for signature and ratifications, entry into force and amendment procedure) were then considered one by one. Many were approved in general, though consideration of the article on entry into force was postponed to later Plenary sessions without instructing Working Group 1. Working Group 1 met on 19 and 22 September and reviewed the proposed draft text of articles of the Protocol and prepared a revised draft text to include comments and decisions at the Plenary (MP/CONF.3/WP.3). The report of Working Group 1 was considered at the Plenary on 24 September, and the preamble and all the articles of the Protocol, except Article 6 on the entry into force, were unanimously adopted (MP/CONF.3/RD/6). Article 6 was unanimously adopted on the next day. (MP/CONF.3/RD/7)

5.16.3. Adopted Resolutions

In total, eight resolutions were adopted by the Conference, of which the following are of significance to the subsequent development of the global cap:

- Resolution 1. *Review of the 1997 Protocol*
- Resolution 4. *Monitoring the World Wide Average Sulphur Content of Residual Fuel Oil Supplied for Use on Board Ships*

Resolution 1 expresses a desire to achieve the conditions for entry into force by 31 December 2002 and urges Member States to take the necessary steps to be bound by the Protocol not later than 31 December 2002. If the conditions for entry into force have not been met by 31 December 2002, the MEPC is invited to initiate a review at its first meeting thereafter, as a matter of urgency. The review would identify the obstacles of entry into force and measures to alleviate them (IMO, 1998b). Resolution 4 invites the MEPC, "*in co-operation with interested organizations, to develop guidelines for monitoring the world-wide average sulphur content of residual fuel oil supplied for use on board ships*" (ibid., p. 141). It further urges Member States and interested organizations to make the necessary resources and expertise available for developing and implementing the guidelines (ibid.).

5.16.4. Adoption and Signature of the Final Act of the Conference

A *Final Act* of a conference contains all the agreed texts during a diplomatic conference. It also contains a summary of the proceedings *and describes the work and structure of the Conference*. No commitment is involved by signing a Final Act (USLegal, 2011; MP/CONF.3/RD/8). The Final Act of the Conference was unanimously adopted on 25 September (MP/CONF.3/RD/7) and was then signed by all delegations participating in the Conference on 26 September (MP/CONF.3/RD/8). The Swedish report informs that the UK and Ireland expressed deep disappointment at a coordination meeting of the EU States the day before the signature of the Final Act however. The disappointment concerned the North Sea not having been designated a SECA at the Conference. It was suggested that the Final Act not be signed in order to make a strong political statement on how important this issue was to the North Sea States. In response, Sweden and the Netherlands emphasized the importance of establishing an international regulatory framework on air pollution from ships and that nothing would be gained by disapproving the results of the Conference. The EU States later agreed that it was better to have a not entirely satisfied Annex VI than none at all (Swedish Maritime Administration, 1997). The records of the decisions noted the following statement by the European Commission:

"*The European Commission appreciates the well established IMO spirit and the use thereof during this Conference, the outcome of which will be taken note of and assessed in view of possible initiatives*" (MP/CONF.3/RD/8, p. 2).

This is where the story of the first act ends. It would take until 2005 before the Protocol of 1997 would enter into force, but it was decided to revise it the same year. The story thus continues with a second act in the next chapter.

6. *Act 2*. The Revision

After exploring the historical IMO deliberations on reducing sulphur emissions, which ended with the adoption of a 4.5% global sulphur cap in 1997, we have now arrived at the second act. It describes the developments towards a revised global cap. The story starts with an overture, briefly describing the developments from the interim period 1997 to 2004. The story of the revision starts thereafter from MEPC 52 in October 2004.

6.1. *Overture*: Interim Developments 1997-2004

6.1.1. Follow-up Actions within IMO

As reported to the *UN Commission on Sustainable Development* (CSD) in 1998, "*the adoption of the 1997 Protocol and the new Annex VI to MARPOL 73/78 was not an end in itself*" (MEPC 42/22, Annex 10, para. 2.5).[42] Conference Resolution 1 resulted in follow-up actions within the MEPC to facilitate entry into force. At the same time, Conference Resolution 4 resulted in the development of guidelines for monitoring the average sulphur content (ibid.).

6.1.1.1. Entry into Force

The Protocol of 1997 was about to enter into force 12 months after ratifications[43] by not fewer than 15 States, representing not less than 50% of the gross tonnage of the world's merchant fleet. The Protocol was open for signature at the IMO headquarters from 1 January 1998 until 31 December 1998. After that, it would remain open for accession. The entry into force of the 1997 Protocol took eight years from adoption however. The slow entry into force of Annex VI is explained by Birnie et al. (2009) as a result of more flagging out to open registries in developing countries, which made the 50% tonnage requirement more difficult to achieve. Tan (2006) has another explanation: many developed States had political difficulties accepting the Protocol in the early years after the adoption as the 4.5% global cap "*was meaningless to them*" (Tan, 2006, p. 161).

At MEPC 44 in March 2000, it was noted that only two Parties to MARPOL 73/78 (Sweden and Norway) had acceded the Protocol of 1997, which corresponded to about 5% of the gross tonnage of the world's merchant fleet. The Committee thus urged Member States to ratify the Protocol as soon as possible (MEPC 44/20; Elvingson, 2000). The slow development persisted and at the 22nd session of the Assembly in November 2001, Resolution A.929(22) on *Entry into force of Annex VI of MARPOL 73/78* was adopted. The resolution noted that only four States had ratified the Protocol, representing about 14.28% of the gross tonnage. It recognized the urgent need to implement the requirements under Annex VI and that the shipping industry was prepared for the implementation. It thus urged Governments to ratify the Protocol as soon as possible. It further requested the MEPC to conduct a review at its first meeting in 2003 if the terms of entry into force had not been met and to consider measures to alleviate any obstacles (Resolution A.929(22)). At MEPC 48 in October 2002, it was

[42] Reported under *Major Achievement Since UNCED* in the *Report of the International Maritime Organization to the Commission on Sustainable Development (CSD)*

[43] The term *ratification* is used here to simplify matters for the reader. Acceptance, approval and accession have the same legal results in the process towards entry into force. See Chapter 4.

concluded that the conditions for entry into force could be met in mid-2003. As they could not be met by 31 December 2002, it was agreed to start a review of the entry into force at MEPC 49 in accordance with the Conference resolution (MEPC 48/21). At MEPC 49 in July 2003, it was concluded that only four more ratifications were needed (MEPC 49/22). At the time of MEPC 51 in March-April 2004, 13 States had ratified the Protocol, representing over 54% of the gross tonnage. Three more ratifications were required however. Four States announced that they could ratify the Protocol by the end of 2004. It was thus concluded that it would enter into force in 2005 (MEPC 51/22). On 18 May 2004, Samoa acceded to the Protocol and the criteria for entry into force were met. The Protocol of 1997 and Annex VI of MARPOL 73/78 entered into force 12 month later on 19 May 2005 (MEPC 52/24).

6.1.1.2. Global Sulphur Content Monitoring

The process of monitoring the global average sulphur content of residual fuels in ships started with the development of draft guidelines at MEPC 41-43. Resolution MEPC.82(43), *Guidelines for monitoring the worldwide average sulphur content of residual fuel oils supplied for use on board ships*, was adopted at MEPC 43. It stated that the results of measurements were to be presented as a *rolling average* over a three-year period. A *reference value* would then be established. According to paragraph 6, if the rolling average exceeded the reference value by 0.2%, the MEPC "*shall consider the need for further measures to reduce SOx emissions from ships, so as to decide whether it should be considered a high priority item for the Committee. MEPC shall continually review this excess value, (now 0.2%) once the reference value has been set*" (MEPC.82(43), Annex, para. 6). The Netherlands was the lead country of the monitoring work and it shared the financial burden for a five-year period with Denmark, Finland, Norway, Sweden and the UK. It was concluded that by starting in 1999, it would only be possible to establish a reference value during 2002. A comparison between the rolling average and the reference value was concluded as possible during 2003 (MEPC 43/21). At MEPC 48 in October 2002, the Netherlands submitted the results of the monitoring of the sulphur content, and it had calculated that the three-year rolling average for 1999-2001 was 2.7%. It was agreed that this figure would also represent the reference value. At MEPC 49 in July 2003, the Netherlands reported in a submission that a new three-year rolling average for 2000-2002 had been calculated at 2.67% (MEPC 49/22).

6.1.2. FOEI Proposal to Amend Regulation 14

At MEPC 47 in March 2002, FOEI submitted a proposal to amend Regulation 14(1) of Annex VI. The results from several studies were presented and they included that global emissions from ships corresponded to 43% of the sulphur emitted by the US and 53% of emissions in the European OECD States.[44] Moreover, SO_2 emissions from international shipping in the North and Baltic Seas and the North-Eastern Atlantic would contribute to 11% of the total European sulphur emissions in 2010 compared with 4% at the time. As a result of the increased demand for low-sulphur fuels for land-based transportation, larger volumes were being produced in the refineries. Availability was thus increasing and costs decreasing. As the least expensive measures had already been used on land-based sources, it was now more cost-effective to reduce ship emissions than to reduce land-based emissions. It was also stated that FOEI had difficulties convincing the general public that ratification of Annex VI was beneficial "*as it falls far short of providing the limitations on sulphur content in fuel necessary to reduce sulphur emissions from ships*" (MEPC 47/4/4, p. 2). It was also stated

[44] Figures from Corbett and Fischbeck (1997)

that "*it is with great difficulty that Member States can garner the necessary political support at the national level to convince decision makers to endorse the backward looking provisions on sulphur content of bunkers as they currently exist in Annex VI* (ibid., p. 3). FOEI thus encouraged that Member States to consider an amendment to Annex VI with a global standard of a 1.5% sulphur content without SECAs (MEPC 47/4/4). There was no support for the FOEI proposal at MEPC and it was agreed that "*there was no need to consider the proposal further*" (MEPC 47/20, para. 4.24). The US stated, however, that consideration for the sulphur content would be in place at MEPC 49 in 2003, i.e., the target date for a potential review of the entry into force (ibid., para. 4.25).

6.1.3. Developments within the European Union

The European States and the North Sea States, in particular, did not sit and wait for MARPOL Annex VI to enter into force when the emissions from shipping in Europe increased and no SECA regulation had been established in the areas with the heaviest emissions in Europe (i.e., the North Sea and the English Channel). Already in 1996, the Swedish Maritime Administration, the Swedish Shipowners' Association and the Swedish port authorities agreed to reduce the emissions of SO_2 and NO_x from ships by 75% in the year 2000. A system of fairway dues was introduced in 1998. The so-called differentiated fairway dues meant that every ship entering Swedish ports would have to pay a sulphur charge per gross tonne if it used fuel with a sulphur content above 1% (0.5% for passenger and railway ferries) (Elvingson, 1998).

Within the EU, the results of studies and EMEP reports showing increased emissions from shipping made the European Commission take action[45]. Already in March 1997 (before the adoption of Annex VI), the European Commission presented a Strategy to Combat Acidification, which was accompanied by a proposal to revise Directive 93/12/EC (on the sulphur content of certain liquid fuels), including establishing legally binding, stricter standards for the maximum sulphur content of various fuel oils. The analysis leading up to the Acidification Strategy included alternative computer model scenarios estimating the cost-effectiveness of international ships' emission abatement. It showed that a 1.5% SECA limit in the Baltic Sea and the North Sea/English Channel would significantly reduce the overall costs for the EU to achieve the set interim environmental objectives, i.e., by EUR 1-2 billion/year in 2010. The European Commission thus considered that all EU Member States would support the designation of SECAs in these areas and that they should move towards ratifying and implementing MARPOL Annex VI as soon as possible (COM(97) 88 final). Directive 93/12/EC was amended in 1999 with the adoption of Directive 1999/32/EC. It now included limits on the sulphur content in MDO and MGO used on board ships in EU territorial waters and inland waterways. No limit was set for marine HFO however (Ågren, 2003a). As a result of the Acidification Strategy, the European Commission also initiated several studies on ship emissions, including new ship emission inventories. In 2002, the European Commission presented a communication to the European Parliament and the Council with a proposal for "*A European Union strategy to reduce atmospheric emissions from seagoing ships"* (COM 2002, 595). It was presented as a communication, which was followed by debates in the European Parliament and the Council. The strategy consisted of two volumes. The first volume presented objectives and actions for reducing emissions of various air pollutants from ships. One of the objectives was to reduce SO_2 emissions from ships in areas where these

[45] Conclusion drawn from reading all the articles related to shipping in the newsletter *Acid News* from 1997 to 2004

emissions contributed significantly to the exceedance of the critical loads for acidification and where local air quality was affected. The actions to achieve the objectives included, *inter alia*, coordination of Member States' positions in IMO for stricter emission levels from international shipping (EUROPA, 2010a; Ågren, 2003b).

The second volume was a proposal to amend Directive 1999/32/EC. In 2003, the European Parliament proposed several amendments aimed at more far-reaching emission reductions. The sulphur content of marine fuels for all ships in the Baltic and North Seas and the English Channel was proposed to be set at 1.5% in a first step, followed by 0.5% in a second step from December 31, 2008. The second step would also apply to ferries in all EU sea areas. Moreover, as from December 31, 2012, it would apply to all ships in the remaining European waters. The Council of Ministers did not share this view, however, and emphasized the importance of pursuing solutions through IMO. The Council of Ministers thus urged its Member States to submit proposals for stricter standards to IMO in a forthcoming revision of Annex VI, such as a stricter global cap (Ågren, 2003c; Ågren 2004). A compromise was later agreed by the European Parliament and the Council in April 2004. Instead of including a second step at this stage, the compromise was to conduct a review in 2008 (Ågren, 2005a). The compromise was formally adopted as Directive 2005/33/EC. It includes the following:

- All marine gasoil sold in the EU shall contain a maximum of 0.1% sulphur and 1.5% for marine diesel oil respectively.
- The 1.5% limit applies to passenger ships in regular service to or from EU ports in all EU waters, independent of fuel type.
- The 1.5% limit applies to all vessels and marine fuels within the SECAs.
- As of January 1, 2010, the sulphur content of all marine fuels shall not exceed 0.1% for ships in port (within the EU) (Swedish Transport Agency, 2010; EUROPA, 2010b).

6.2. 2004: An Opportunity to Amend

Several amendments to Annex VI had been developed and approved since its adoption in 1997, including a designation of the North Sea as a SECA. Any amendments to Annex VI had to be adopted after its entry into force however. At MEPC 52 in October 2004, it was reported that the conditions for entry into force had been met. The Working Group on Air Pollution was thus instructed to conduct a final review of the amendments, which were scheduled for adoption at the next MEPC in July 2005 (MEPC 52/24). A special topic on the implementation of Regulation 14 in Annex VI emerged at MEPC 52. The Islamic Republic of Iran had submitted document MEPC 52/4/12, highlighting technical limitations for compliance with Regulation 14(4) (i.e., a 1.5% sulphur content in SECAs). Examples of technical and operational limitations were presented, including the restricted availability of low-sulphur fuels and problems associated with the changeover procedures and the extra carrying of fuel on board. In addition, the required guidelines on Regulation 14(4) had not yet been developed by IMO. It highlighted that one of the most important objectives of the MEPC was to avoid excessive regulation. A globally uniform standard of sulphur content was considered more appropriate than regional requirements. It was thus proposed that a timetable should be developed for a global sulphur content level without SECAs and without the need for additional stringent measures (MEPC 52/4/12). Submission MEPC 52/4/4 by FOEI also proposed amendments to Regulation 14. The submission focused on the health risks of sulphate and nitrate particles derived from SO_2 and NO_x emissions. The *World Health Organization* (WHO) had estimated that long-term exposure to PM_{10} in Europe could be

associated with 95,000 to 380,000 premature deaths annually. In connection to this, the submission highlighted that about 20-30% of secondary inorganic particle concentrations in coastal areas within the EU could be related to emissions from shipping. FOEI suggested an amendment of the global cap to a 1.5% sulphur content or the adoption of more SECAs (MEPC 52/4/4). After consideration of the submission by Iran and noting the submission by FOEI, the Committee invited Member States to submit proposals for amendments to Annex VI to MEPC 53. It further noted that only Parties to Annex VI could decide on amendments (MEPC 52/24; Swedish Maritime Administration, 2004).

6.3. 2005: Decision to Revise at MEPC 53

At the time of MEPC 53 in July 2005, MARPOL Annex VI had finally entered into force. At the opening of the session, the Secretary-General expressed that the proposal to review Annex VI "*merited the Committee's special attention*" (MEPC 53/24, para. 1.10). A special heading under the agenda item on air pollution dealt with the *Review of proposed amendments to MARPOL Annex V*I. It first presented the arguments that preceded the decision to initiate a revision. To start with, *Conference Resolution 3*[46] in 1997 had invited the MEPC to review the NO_x limits after the entry into force at five-year intervals (as a matter of urgency). Amendments to Regulation 13(3) and the NO_x Technical Code (hereafter NTC) could be necessary depending on the results. It was further recalled that ships' contributions to air quality problems had increased in many areas and that Governments were considering addressing the issue locally, nationally and at international levels. Moreover, technical improvements had made reductions possible beyond the standards in Annex VI. An additional aspect was that over 70 proposals on *Unified Interpretations*[47] to Annex VI were presented at MEPC 52. This indicated that the text of Annex VI was "*unclear and difficult to transform into practical implementation on board ships*" (MEPC 53/24, para. 4.46).

Seven documents on a complete review or specific amendments to Annex VI and the NTC were submitted to MEPC 53. Several concerned amendments related to NO_x emissions. One submission had significant impact in the Plenary and resulted in the decision to initiate a revision (Swedish Maritime Administration, 2005). The joint submission MEPC 53/4/4 by Finland, Germany, Italy, the Netherlands, Norway, Sweden and the UK included some parts of the arguments presented above. It was further emphasized that the regulations of land-based sources had been tightened since 1997 and that the impacts on human health from PM emissions was an area of increasing concern. The main arguments and facts presented concerned NO_x emissions and technological developments. Engine manufacturers had been complying with Regulation 13 since January 2000 and five years had now passed since this compliance. There was also considered to be a major gap between the requirements in Annex VI, and known impacts and available technology. The submission called for instant discussions at IMO in order to secure international standards and not unilateral or regional ones. It was thus proposed to initiate a process to update Annex VI. An annex to the submission provided information on the contribution and impacts of ship emissions. Several new studies since the adoption in 1997 were presented. Corbett and Fischbeck (1997) estimated that ships emitted 8.48 Tg (million tonnes) of SO_2 per year, corresponding to 5%[48] of sulphur emissions from all fuel combustion sources. In 2003, another study by Corbett revealed significantly higher emissions than earlier estimates. The fuel consumption of marine

[46] *Review of nitrogen oxides emission limitations*
[47] Resolutions on matters that have arisen in connection with the implementation of requirements
[48] The submission reports 6.5% "*of all sulphur emitted by all fuel combustion sources including coal*" (MEPC 53/4/4, para. 19)

bunkers was found to be more than twice as high as reported in the international statistics. The sulphur emissions were found to be 12.98 Tg SO_2[49] per year (corresponding to about 9% of the total global emissions according to BLG 11/5/15). This figure was about 53% higher than the previous estimate (Corbett and Koehler, 2003). It was further underlined that the emissions from ships in EU waters were expected to be equal to the land-based emissions in 2010. Moreover, a connection between the sulphur content in fuel and PM emissions was noted when describing PM reduction technology (MEPC 53/4/4).

FOEI submitted document MEPC 53/4/1, which presented a background paper by a coalition of NGOs[50]. Early in the paper, it was reported that Corbett et al. (1999) had found that 70% of the global emissions from ships occurred within 400 km of land, thus enabling transport to land. FOEI stressed that, even with the implementation of Annex VI and SECAs in the North Sea, the Baltic Sea and the English Channel, SO_2 emissions from international shipping in European waters were expected to increase by over 42% in 2020. As such, ship emissions would exceed land-based emissions in the EU25. A reduction of the sulphur content of marine fuels was considered an important initial action. By reducing the sulphur content from the current average of 2.7% to 0.5%, an 80% reduction of SO_2 emissions from ships would be achieved. It would also reduce PM emissions by up to 40%. Ågren (2005b) had found that reducing the sulphur content from 2.7% to 0.5% would result in benefits from reduced health damage alone exceeding the costs by 2.2-7.5 times in 2020. A reduction of the sulphur content was also considered a first step in reducing PM emissions (MEPC 53/4/1).

After considering the submissions and a general discussion, the Committee decided to "*initiate a general review of MARPOL Annex VI and the NO_x Technical Code*" (MEPC 53/24, para 4.50). The work was estimated to take two or three years. Due to the workload at the MEPC, it was decided that the major work on the revision would be conducted by the Sub-Committee *Bulk Liquids and Gases* (BLG), starting at its next session in April 2006. The Working Group on Air Pollution then developed draft terms of reference for BLG in the review. Figure 6.1 shows the terms of reference related to SO_x and PM emissions. The Working Group based the consideration on MEPC 53/4/4 and the earlier submission by Iran (MEPC 52/4/12). The target date for finalizing the revision was set to 2007 (MEPC 53/24; MEPC 53/WP.11).

- Examine available and developing techniques for reduction of emission of air pollutants.
- Review technology and the need for reduction of SOx, justify and recommend future limits of SOx emission.
- With a view to controlling emissions of particulate matter (PM), study current emission levels of PM from marine engines, including their size distribution, quantity, and recommend actions to be taken for the reduction of PM from ships. Since reduction of NOx and SOx emission is expected to also reduce PM emission, estimate the level of PM emission reduction through this route.
- Review the texts of Annex VI, NOx Technical Code and related guidelines and recommend necessary amendments.

Figure 6.1. Terms of reference for the BLG on the Revision of MARPOL Annex VI (SO_x and PM) (MEPC 53/24/Add.1, Annex 14)

[49] Reported as 6.49 Tg S, which equals 12.98 Tg SO_2

[50] The Clean Air Task Force, the Bluewater Network, the European Environmental Bureau, the North Sea Foundation, the Seas at Risk, the European Federation for Transport and Environment and the Swedish NGO Secretariat on Acid Rain

6.4. 2006: The First Year of the Revision

6.4.1. MEPC 54

MEPC 54 was held in March 2006. At the opening of the session, the Secretary-General expressed that the revision of Annex VI was a major task for the MEPC, requiring expert advice from all industry sectors. He thus invited Member States and Observers to ensure that expertise would be available at the BLG. The complexity and technical nature of the revision was later acknowledged by the Chairman, with large numbers of documents being submitted to BLG 10. In order to meet the timetable, the Committee decided to hold an intersessional meeting between BLG 10 and BLG 11 (MEPC 54/21).

6.4.2. BLG 10: The Start of the Revision

The tenth session of the BLG Sub-Committee was held in April 2006. Under the agenda item on the review, it was agreed that the revision should be based on scientific grounds and also on the best available technology. "*A common basis and understanding*" of different emission types was also considered essential to progress (BLG 10/19, para. 14.13). A Working Group on Air Pollution was established and instructed, *inter alia*, to consider the terms of reference in Figure 6.1 and the submitted documents. The Working Group agreed that the essential purpose at this session was to begin a dialogue on the basic facts of emissions and techniques (BLG 10/WP.3; BLG 10/19). In relation to SO_x emissions, the basic question of whether the global cap or SECA limits should be lowered was discussed. The discussion was held in light of the health and environmental risks from sulphate and particulate emissions related to the sulphur content in bunker fuels. It was noted that the availability of low-sulphur residual fuel was limited. Moreover, it was considered unrealistic to expect the refineries to convert high-sulphur fuel into low-sulphur fuel, due to the high costs and lack of available technology. Further lowering of the sulphur content or designation of additional SECAs would thus require the use of distillate fuels or exhaust gas cleaning. On-board blending of the HFO bunker with distillates was considered a potential option, though technical and safety concerns were raised. In relation to PM emissions, growing concern for the effects on human health was reported. It was concluded that reducing the sulphur content was "*one of the most direct means of achieving particulate reduction*" (BLG 10/WP.3, para. 14). Significant reductions could also be achieved through exhaust gas cleaning. Japan submitted document BLG 10/14/11 containing information on the general characteristics of different forms of PM emissions from diesel engines. It informed that there were limited data on PM emissions from marine engines. It presented some factors that needed to be identified, *inter alia*, emission levels, mass and number distribution, a common sampling method, transportation and health effects (BLG 10/14/11). The Working Group noted that the question of which forms of PM the revision should focus on needed further discussion (BLG 10/WP.3). After consideration of the report of the Working Group, it was agreed that an intersessional meeting of the Working Group would be held in November 2006. The outcome would be reported to BLG 11, at which a final draft revision of Annex VI and the NTC should be agreed. In addition, two intersessional correspondence groups were established to be held before the intersessional meeting:

- Correspondence Group A – dealing with Annex VI and PM emissions
- Correspondence Group B – dealing with NTC, VOCs and implementation issues

6.4.2.1. A Norwegian Submission and Comments

Submission BLG 10/14/2 by Norway was not fully considered by the Group. It started a chain of comments and discussion later on however. Only reducing the global cap to 3% was considered to have a marginal effect and no effect within SECAs. The option to establish additional SECAs with the present levels was considered to result in emission reductions in the most vulnerable areas, although this may not be sufficient in some areas. It was further noted that experiences of PM emission abatement from ships were limited. It was stated that Norway had the view that the focus on reducing SO_x emissions should be put on SECAs and not the global cap. It was explained that "*the global sulphur cap may not be amended*" (BLG 10/14/2, p. 7). Document BLG 10/14/5 was submitted by ICS, BIMCO, the *International Association of Dry Cargo Shipowners* (INTERCARGO), the *International Council of Cruise Lines* (ICCL) and INTERTANKO. It provided a shipping industry perspective on the Norwegian submission, which was supported in principle, but a few items were viewed with concern. It was emphasized that impacts on global bunker fuel supply needed consideration in order for an agreement to be reached on a reduced sulphur limit in SECAs. The global cap should also be considered. It also highlighted a high level of concern about the emergence of regional measures for international shipping. It was emphasized that the revision should have a scientific basis and environmental needs, and the cost-benefit analysis should be taken into account (BLG 10/14/5).

6.4.3. Report of Correspondence Group A

The report of Correspondence Group A was submitted to the intersessional meeting. No reference to this group was found in the report of the meeting however. A brief summary of the different views expressed on Regulation 14 is presented in Table 6.1. For more details on each view given by the Members of the Group, the reader is referred to the annex of BLG-WGAP 1/2/1.

Table 6.1. Views on SO_x and PM reductions from Correspondence Group A (BLG-WGAP 1/2/1, para. 6)

Members	Views
"Some members"	Both the global cap on and the SECAs should be reduced
"Others"	Unchanged global cap
"At least one"	A modest lowering of the global cap "to show IMO is doing all it can"
"Some"	Evaluation of the present SECAs was needed before any changes
"Some"	Consideration of fuel oil availability and supply/demand was needed

6.4.4. First Intersessional Meeting of the BLG Working Group

The first intersessional meeting of the BLG Working Group on Air Pollution (BLG-WGAP 1) was held in November 2006[51] in Oslo, Norway (due to the renovation of the IMO headquarters). More than 100 Member States and observers participated (BLG 11/5). They had been invited to send experts on all aspects of air pollution from ships (IMO Circular letter, No. 2710). The Group had been instructed to consider submissions, the instructions given in Figure 6.1 and further intersessional work. At the opening, the Secretary-General underlined that the work at this meeting was:

[51] MEPC 55 was held in October 2006. As most of the work on the revision was put on the BLG Sub-Committee, other issues on air pollution were considered, e.g., contamination of the oceans from seawater scrubbing and on-shore power supply at birth (MEPC 55/23).

"*…of the utmost importance, not only for IMO but also for the entire shipping industry and our joint efforts to show unequivocally that the maritime sector takes environmental problems seriously and does so responsibly and as proactively as is practicably possible. And your deliberations, here in Oslo, present you with an opportunity to take a* ***precautionary approach*** *to our challenges – as is expected of us by Governments and the public at large – and to demonstrate that the shipping industry embraces fully its* ***corporate responsibilities***" (BLG 11/5, Annex 2, p. 2).

It was further mentioned that the Group would consider a proposal to replace the use of residual fuel as bunker with a clean distillate. The Secretary-General emphasized that the proposal was obtainable in principle, "*although much would depend on the refining industry*" (ibid., p. 3). The consideration of this proposal had to be holistic with involvement by engine manufacturers and oil producers.

6.4.4.1. Submissions on SO_x Emissions

Several submissions were considered under the SO_x discussions. ICS had submitted a document (BLG-WGAP 1/2/10) providing comments on the submission by shipping industry representatives to BLG 10 (BLG 10/14/5). It was explained that ICS had always advocated a holistic approach to reducing air emissions from ships. ISC noted that the current Annex VI merely recognized SO_x emissions from ships as a regional problem and not a global one. The SECA concept was considered "a reasonable solution", however, as both local environmental vulnerability and the availability of low-sulphur fuel were addressed (BLG-WGAP 1/2/10, p. 2). Nevertheless, there were operative and safety problems related to the carrying of different fuels. If the global cap was to be lowered, further applications for SECAs and the availability of low-sulphur fuels had to be taken into account (ibid.).

IPIECA and OCIMF had submitted document BLG-WGAP 1/2/13. It included a reproduced report by CONCAWE that focused on the European situation and the non-cost-effectiveness of establishing further SECAs. One assessment of EMEP data showed that land-based measures in eight EU States would be more cost-effective than the use of low-sulphur fuels on board ships. The report also showed that refinery desulphurization of residual fuel would result in significant increases in CO_2 emissions. IPIECA and OCIMF ended by stressing that an overall analysis was needed to consider "*net environmental benefits, cost-effectiveness, supply/demand impact and potential modal shift to land based freight*" (BLG-WGAP 1/2/13, p. 2). FOEI submitted document BLG-WGAP 1/2/11, produced by a coalition of NGOs[52]. Contradictory to the submission by IPIECA and OCIMF, an Entec report to the European Commission showed that the costs of reducing SO_x emissions from ships were lower than abatement measures at almost all land-based sources. Furthermore, a table showed that HFO with a 0.5% sulphur content would result in an 80% reduction of SO_x emissions and 20% for PM. In addition, the US *Environmental Protection Agency* (EPA) had estimated a reduction of about 63% in PM emissions by switching from HFO with a 2.7% sulphur content to distillate fuel with 0.5%. FOEI proposed 70-90% reductions from shipping in 2015. The global cap should be successively lowered to 1% by 2010 and 0.5% by 2015. The SECA limits would also need to be lowered (BLG-WGAP 1/2/11).

[52] The Clean Air Task Force, the Bluewater Network, the European Environmental Bureau, the European Federation for Transport and Environment, the North Sea Foundation, the Seas at Risk and the Swedish NGO Secretariat on Acid Rain

6.4.4.2. The INTERTANKO Report and Subsequent Discussions

Although a future 0.5% global cap had been proposed by FOEI, another submission brought about the hottest debate and had a big impact at the meeting: BLG-WGAP 1/2/5 submitted by INTERTANKO (BLG 11/5; Swedish Maritime Administration, 2006). INTERTANKO proposed that Regulation 18 be amended to require the use of distillate fuels for all ships. Regulation 14 would be amended to include only a global cap, which would be lowered in two steps: (1) 1% maximum sulphur content from [2010] and (2) 0.5% maximum sulphur content for engines installed/built on and after [2015]. The submission included the following reasons for switching to distillate fuels:

- Large reductions in SO_x and PM emissions (also CO_2 and NO_x)
- The only investment is a higher fuel price
- No changeovers
- Improved safety
- The use of a single fuel on all ships simplifies monitoring and compliance and no competitive problems arise

Several reasons were also given for the proposed amendment to Regulation 14, *inter alia*:

- The connection between the sulphur content and PM emissions
- Desulphurization of residual fuels requires large amounts of energy and increased CO_2 emissions
- Emissions outside the SECAs can drift in
- The problems associated with changeovers from and to SECAs
- Expected additional SECAs would increase the demand for low-sulphur fuel and complicate shipping (BLG-WGAP 1/2/5)

The introduction of the INTERTANKO submission resulted in "considerable discussion" with comments by "numerous delegations" (BLG 11/5, para. 6.24). According to the Swedish report of the meeting, the INTERTANKO proposal was supported by, *inter alia*, Sweden, Norway, Germany, the USA, the Netherlands, Japan, FOEI and informally the EC (Swedish Maritime Administration, 2006). The early discussion of the Group was divided into the views presented in Table 6.2.

Table 6.2. Views on the INTERTANKO proposal (BLG 11/5, para. 6.24)

Delegations	Views
"Several delegations"	Concern over the oil industry's availability to provide the necessary supply of distillate fuels on the proposed dates
"Several delegations"	The proposal was expressed as "a simple and uniform global approach to marine fuels" with multiple benefits.
"Others"	The change to distillate fuels was questioned.

As a result of the INTERTANKO proposal, the Group identified the following policy options for ways to further address the sulphur content in bunker fuels:

A. Leave Regulation 14 unchanged.
B. Lower the SECA limits to 1.00% by [2010] and 0.50% by [2015]. The global cap would be left unchanged (or lowered).
C. Require the use of distillate fuels and lower the global cap to 1.00% by [2012] and 0.50% by [2015].[53]
    - C2: Use the same requirements as Option C, but allow "*alternative mechanisms (such as an exhaust gas cleaning system) in combination with residual fuel oil with a higher sulphur content"* (Ibid., Annex 8).

The first date in Option C was modified to 2012 and not 2010 as proposed by INTERTANKO. The date was modified due to the concern for the supply capacity as expressed in Table 6.2. This date was also questioned by some delegations however. It was not seen as "*adequate time for the necessary investments*" (ibid., para. 6.27). Moreover, IPIECA expressed that "*a complete switch to distillate fuel is so far-reaching for the refinery industry that it was very difficult at that stage to provide even an indication of what implementation date would be possible*" (ibid., para. 6.26). It was noted that the dates in Option C would require further consideration. The discussion continued and Singapore stated that an evaluation of the necessity for further measures was needed before proposals would be made on SO_x limits. The evaluation should include the costs of producing the fuel oil. This view was supported by several delegations. With regard to PM emissions, a few documents were considered along with information from presentations given on the first day. It was agreed that the INTERTANKO proposal would lead to significant reductions in PM emissions, though it was also agreed to discuss specific measures at BLG 11. Further discussions should also include the assessment of the fate and transport of PM emissions from ships. Member States and observers were encouraged to submit specific proposals to BLG 11 on these matters (BLG 11/5).

6.5. 2007

6.5.1. BLG 11

BLG 11 was held in April 2007. At the opening, the Secretary-General stated that Member States should "*redouble their efforts to stem the effects of ship emissions on air quality anywhere in the world"* (BLG 11/16, para. 1.3). It was emphasized that the revision should have a long-term comprehensive approach to avoid unilateral actions. The Sub-Committee later agreed that, in order to avoid unilateral action, the emission limits of Annex VI should be tightened significantly and a long-term strategy should be used. Parts of several documents were considered in the SO_x and PM discussions in the Plenary. This included the report of the intersessional meeting, a draft matrix prepared by the Secretariat on the developed policy options (BLG 11/5/1) and twelve submissions. "A considerable debate" followed with comments by "numerous delegations" (BLG 11/16, para.5.13). Initially, the views were the same as at the intersessional meeting. In fact, the description was the same in almost every word. The debate then continued with the views presented in Table 6.3.

[53] Note that the proposed requirement for 2015 in Option C was intended to apply to all ships and not only to engines installed/built on and after 2015. This modification was not explained in the report.

Table 6.3. Early views expressed at BLG 11 (BLG 11/16, para. 5.14)

Delegations	Views
"A number of delegations"	Further consideration was needed on several issues before decisions were taken. The standards should be developed by a goal-based approach.
"Some delegations"	A specification was needed on the quality of fuel.
"A number of other delegations"	The regulation should apply to "what comes out of the funnel and not what goes into the engine".
"A large number of delegations"	A comprehensive study was needed on the refineries' ability to meet the demands from a global switch to distillates and the environmental/market effects of such a switch.
"Others"	Immediate action was needed and the information already at hand was adequate.

With regard to the diversity of views presented, it was agreed to break down the number of policy options into fewer options that represented the main principles. This task was given to the Working Group on Air Pollution. Instructions were also given to further develop these policy options and to consider the need for an extension of the target completion date and further intersessional work (BLG 11/WP.4).

6.5.1.1. Working Group Consideration

The report of the Working Group informed that six policy options had been identified in the SO_x and PM discussion in the Plenary. Several suggestions on ways to reduce the number of options were considered by the Group. It was noted that Options C and C2 from the intersessional meeting had a global solution, while Options A and B were based on the existing regulations with both a global cap and SECA limits. Two new proposals could be included in the later group: BLG 11/5/15 submitted by the US and BLG 11/5/25 submitted by BIMCO. The US proposal was to establish "*uniformly defined, geographic-based PM and SO_x standards beginning in 2011 for all ships operating within [200] nautical miles of land*" (BLG 11/5/15, p. 14). These standards would only apply to specified coastal waters similar to SECAs. The SO_x limits in such areas were proposed to be set at [0.1]% sulphur content in distillate fuels (BLG 11/5/15). The submission by BIMCO proposed some modifications to Option B. Only distillate fuels should be used in SECAs, port areas, estuaries and a specified distance from the shore. HFO would be allowed outside these areas. The global cap should be lowered to 3.0% in 2012 and 1.5% in 2016. Within the proposed areas, the sulphur content limits would be 1.0% in 2011 and 0.5% in 2015. The use of on-board reduction equipment could be an alternative in these areas and globally. It was concluded that this proposal would give enough time for the refining industry to adapt to the changes (BLG 11/5/25). With regard to the similarities of both submissions, both BIMCO and the US announced a willingness to prepare a joint proposal. Various delegations also suggested deleting Option A. The Group was unable to delete any of the options however. It was concluded that two or three options could be developed from the main principles of the six options. It was also concluded that the options needed further consideration at both MEPC and BLG. The results of the Group's work ended up in a grouping of options. This matrix is given in the Annex to this thesis (BLG 11/WP.4).

6.5.1.2. Further Discussions in the Plenary

Considerable discussion followed in the Plenary. The delegation of the Bahamas emphasized a goal-based approach as given in document BLG 11/5/8 submitted by ICS. This submission had not been fully considered. It proposed that impact assessments be conducted on the proposed measures. It also highlighted that changes in shipping could change the demand for

land-based transportation with higher environmental impacts. A goal-based approach was suggested that would set defined emission limits and leave the solutions of measures to the market. ICS further favoured a reduction in SECA limits and an assessment of the lowering of the global cap (BLG 11/5/8). A number of delegations supported the views of the Bahamas, and it was agreed to send this submission to MEPC 56. As the Working Group was unable to complete all its tasks, it was agreed to request an extension for the work with an additional session as well as an intersessional meeting. The technical work of revision by BLG would thus be finalized at BLG 12 in February 2008. An approval of the revised Annex VI and the NTC would thus be possible at MEPC 57 followed by adoption at MEPC 58 in October 2008. This extension was highly debated in the Plenary. FOEI believed that the evidence was clear enough for action to reduce the emissions and that the revised timetable meant postponed action. In addition, the delegation of Panama raised concern over the increased number of intersessional meetings at IMO. It was underlined that important decisions had been taken at these meetings and that many Member States had been unable to participate. However, "a large number of delegations" supported the holding of an intersessional meeting (BLG 11/16, para. 5.52). The Sub-Committee thus requested that MEPC approve the extended time-table with one additional session and the holding of a second intersessional meeting.

6.5.2. MEPC 56

MEPC 56 was held in July 2007. On the agenda item on air pollution, the Secretary-General introduced his own submission (MEPC 56/4/15), which proposed the establishment of an *informal Cross Government/Industry Scientific Group of Experts* (hereafter Group of Experts). This group would undertake a comprehensive study to evaluate the effects on the different fuel options of the SO_x and PM emissions proposed during the revision. The group would consist of a small number of experts nominated by Member Governments and NGOs. In particular, it was highlighted that the petroleum industry would be represented. A final report was to be finalized in December 2007. The initiative received a high level of support by the Committee and was agreed with minor changes to the terms of reference. The previous proposal by ICS on a goal-based approach was then discussed. Further consideration of this approach was given support by "a number of delegations" (MEPC 56, para. 4.27). An information document by the European Commission (MEPC 56/INF.13) was then noted. The document provided links to several studies on air pollution from ships and measures to reduce them. The information was provided as a response to several delegations' statements at BLG 11 that there was a lack of scientific information. It was stated that these studies could help the Group of Experts to prevent further delay (MEPC 56/INF.13). Later on, the extensions requested by BLG were approved along with terms of reference for the second intersessional meeting (MEPC 56/23).

6.5.3. Second Intersessional Meeting of the Working Group

The second Intersessional Meeting of the BLG Working Group on Air Pollution (BLG-WGAP 2) was held in Berlin, Germany, from 29 October to 2 November 2007. More than 120 Member States and observers participated. The instructions given to the Group did not include anything on SO_x emissions, as they were considered by the Group of Experts. Nevertheless, there were some relevant issues, e.g., how to address PM emissions and the development of a draft text on all the draft amendments made by the Group (BLG 12/6). Several presentations were given during the meeting. The Netherlands presented information on a study on the contributions from ship emissions in the North Sea to its air quality. It was concluded that reducing emissions from ships could achieve one-third of the effects of its

land-based reduction in 2020. It was also considered more cost-effective than the land-based measures. Two approaches to address PM emission reduction in Annex VI were then discussed: (1) to include specific emission limits in Annex VI or (2) to "*recognize that PM emissions are reduced as a function of reducing sulphur emissions"* (BLG 12/6, para. 5.32). The second approach meant that both Regulation 14 and Appendix III (*Criteria and Procedures for Designation of SO_x Emission Control Areas*) could be revised in order to reduce PM emissions. It was agreed that further consideration was needed on this issues at BLG 12. The work at the second intersessional meeting resulted in a text on all the draft amendments that had been made to Annex VI. The former Regulation 14 was now named Regulation 15.While awaiting the results of the Group of Experts, however, this regulation was not considered in detail. The global cap thus looked the same as the 1997 Protocol, though two decimals were now used.

6.5.4. The Report of the Group of Experts

The Group of Experts held four meetings in 2007, starting on 11 July 2007 during MEPC 56. The final report was submitted to both BLG 12 and MEPC 57 (BLG 12/6/1 and MEPC 57/4). The report was supplemented with two information documents. BLG 12/INF.10 provides the background information and discussions from four subgroups established under the Group of Experts. BLG 12/INF.11 provides an analysis of the impacts on the global refining industry and consequential CO_2 emissions of the different options proposed. This section focuses on the main report. The Group of Experts had been given the terms of reference to conduct an objective study, leaving policy recommendations to the MEPC. The general scope of the study was to "*review the impact on the environment, on human health and on the shipping and petroleum industries, of applying any of the options identified as possible amendments to MARPOL Annex VI*" (MEPC 57/4, Annex, para. 1.1). It would focus on the effects of the proposed fuel options for reducing SO_x and PM emission set at BLG 11, as given in the Annex of this thesis.

6.5.4.1. Emissions and Fuel Markets

The Group assessed the total consumption of distillate and residual fuels by international shipping. Based on the fuel consumption, emissions for 2007 and 2020 were calculated for the different fuel options. As no conclusion was given on the results, parts of a table related to SO_x emissions are reproduced in Table 6.4. The table indicates that the highest estimated reduction of SO_x emissions was through a global switch to distillates of a 0.5% sulphur content (17.8 million tonnes, compared with 3.4 and 3.7 for only SECA limits with 0.5% and 0.1% respectively). A similar table was presented in the modelling of Options B1 and B2 (switch to distillates in coastal sea areas). According to the report, the results indicated that an extensive reduction of SO_2 emissions would be achieved by switching to distillates in coastal sea areas. A global switch would provide even more reductions (78.2% compared with 50%). Global fuel market trends up to 2020 were then assessed by the Group. It was expected that the sulphur content of crude oils would increase from the current average of 1.2% to 1.4% in 2020. It was also noted that increased demand for petroleum products had resulted in significant price increases for crude oil in recent years. HFO prices had also increased as a direct result. As HFO is of low value, however, it was considered to be an incentive to invest in higher-value fuels in the future. The demand for lighter and cleaner products for land-based transportation had also increased, which had resulted in greater investments in refinery processes. As a result, the capacity to convert residuals into lighter fuels had increased. In

contrast, the capacity for desulphurization of residuals had decreased due to these conversion investments.

Table 6.4. Calculated SO_x emissions in 2007 and 2020 (MEPC 57/4, Annex, para. 16)

Calculation assessment	Result 2007 Mill. Tonnes	Result 2020 Mill. Tonnes
Total SO_x emission from ships	16.2	22.7
SO_x emission reduced by current SECAs	- 0.78	*
SO_x emission reductions for a 0.5% S Marine Distillate global cap	- 12.7	- 17.8
SO_x emission reductions in a multiple SECA environment with a 0.5% Marine Distillate SECA cap	*	-3.4
SO_x emission reductions in a multiple SECA environment with a 0.1% Marine Distillate SECA cap	*	-3.7
PM_{10} emissions from ships	1.8	2.4
PM_{10} emission reductions for a 0.5% S Marine Distillate global cap	- 1.5	- 2.0

* Not applicable

6.5.4.2. Impacts on the Shipping and Petroleum Industry

The Group assessed and compared the practical issues for the different options from a shipping industry perspective. It was first noted that a sulphur content requirement below 1% would require the use of distillates.[54] The future cost increase of using distillates instead of HFO was not fully estimated, although a model (EnSys World) indicated that Option C would result in a 40 million USD/year increase from the base case in 2020. The corresponding figures for Option B2 would be 7.8-8.2. As such, all the options would increase the costs of maritime transportation. It could also result in increased competition from land-based transportation. The operational and technical aspects presented are summarized in Table 6.5.

Table 6.5. Summary of operational and technical aspects for three options (MEPC 57/4)

Global switch to distillates	Switch to distillates in SECAs	Alternative use of abatement equipment in SECAs
• No competitive advantages between ships • Possible competition from land-based transportation • Easy enforcement • Improved combustion • Reduced workload on board	• Time-consuming changeover • Different temperature requirements of HFO and distillate • Need to carry two fuels with additional tanks and fuel systems - three fuels with national requirements • No expected engine optimization	• Not fully assessed • Not available on the market - lack of experience - lack of data • Potentially lower SOx and PM emissions than 0.5% sulphur content fuel

The assessment of impacts on the petroleum industry was made by a consultant using the EnSys World model. This model has several limitations and assumptions. As such, it presented slightly overstated estimates of the costs and CO_2 emissions for the switch to global distillates. When investigating the report, it was found that the modelled scenarios were not presented in a comparable manner.[55] It was thus difficult to summarize this section. Nevertheless, it was stated that in addition to the USD 318 billion of investments required to

[54] According to information from refiners

[55] Example: investment costs were presented for a global cap of 1.5% (for Option B2) and in investment units for the 0.5% cap (Option C)

meet the demand for the base case scenario, the investment in a shift to global distillates was estimated to be at USD 126 billion. It was also noted that several recent studies on the impacts of petroleum industries in different regions had been conducted, but these was not reviewed in detail by the Group. It should be noted that CONCAWE (2006) was frequently referred to in the report. A significant conclusion of the CONCAWE report was that it would be more valuable for refiners to convert residual fuels into distillates than desulphurization. Both options would result in significant investment costs, but distillate fuel is a higher-value fuel (CONCAWE, 2006).

6.5.4.3. Health and Environmental Impacts

Initially, short information on the key impacts of SO_x and PM emissions was presented. It was later stated that several regional and global studies had addressed distributions of pollutants from ships and some had estimated their health impacts. Section 11 of the supplementary document BLG 12/INF.10 was thus briefly investigated in order to find out more about the results of these studies. Several regional studies and one global study were presented. Among the regional studies, a study by the *Ocean Policy Research Foundation* (OPRF) of Japan assessed the environmental impacts around Toyo Bay in relation to Options B and C. It was concluded that significant improvements could be made to the air quality within 30 km using low-sulphur fuels. Moreover, a study of the *South Coast Air Quality Management District* (SCAQMD) estimated that over 700 premature deaths could be avoided by controlling ship emissions in Southern Californian waters by 2015. The global study by Corbett et al. (2007) estimated that global PM emissions from shipping caused approximately 60,000 annual deaths due to cardiopulmonary and lung cancer deceases. It was estimated that this figure could increase by 40% by 2012 as a result of growing shipping activities. The worldwide mortalities were presented on a map, as given in Figure 6.2. The figure shows that the impacts from ships' PM emissions were concentrated in coastal regions in connection with major trade routes. The highest number of mortalities was found in Europe, East Asia and South Asia.

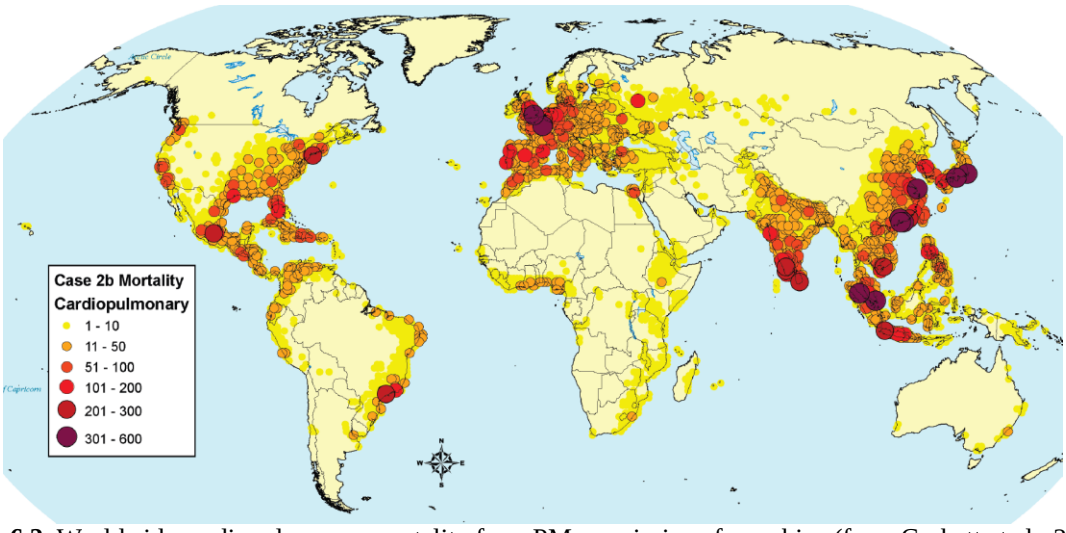


Figure 6.2. Worldwide cardiopulmonary mortality from $PM_{2.5}$ emissions from ships (from Corbett et al., 2007, their Figure 2, p. 8514[56])

Going back to the main report, the results of the modelled emissions from shipping up to 2020 were presented. The study was based on EMEP data and was geographically delimited to Europe. In order to generalize for other areas, control measures from EU legislation and

[56] Representing "Case 2b" in Corbett et al. (2007).

existing SECAs were excluded. It was concluded that Option C (0.5% global cap in 2015, see Annex) would provide for the biggest reduction of SO_2 (79%). Option B1 (US proposal to use 0.1% in specific waters) would result in an almost equal reduction (78%). Option C also provided for the largest reduction of $PM_{2.5}$ (73%) followed by B1 (65%). Furthermore, the conclusions included the following:

- Option B (0.5% in SECAs): 66% SO_2 reduction and 60% for PM
- Option B2 (proposal by BIMCO): 75% SO_2 reduction and 59% for PM
- Option C2: Not modelled, though considered comparable to Option C
- Both Option C and an expansion of SECAs in Europe improve European air quality
- Similar improvements could be expected in other areas

6.6. 2008: Towards Adoption of a Revised Annex VI

6.6.1. BLG 12

BLG 12 was held in February 2008. This was the final session for the Sub-Committee to work on the revision. It thus had the aim of finalizing draft amendments to Annex VI and the NTC. Early on in the agenda item on the revision, the delegation of Brazil expressed concern over proposed target dates with regard to available technology. It was proposed to allow some flexibility of the target dates for in-depth studies and testing of technology. The representative of the European Commission responded that this session was the last one dealing with technical matters and information gathering. Otherwise, decisions on a revised Annex VI could not be made in 2008. It was later agreed that the considerable amount of information provided by the Group of Experts would enable the Sub-Committee to make progress on considering which future regulations were appropriate for adoption by the MEPC.

6.6.1.1. SO_x and PM Discussions

Significant discussions related to SO_x and PM emissions were held when discussing general issues related to the revision. A submission by FOEI (BLG 12/6/9) summarized Corbett et al. (2007). FOEI emphasized that the need for additional measures on SO_x emissions was now "absolutely clear" (BLG 12/6/9, p. 5). According to FOEI, this need had been questioned by some observers at IMO as the impacts were not considered to be "adequately established" (ibid.). A discussion then followed, as IPIECA and OCIMF had submitted comments that questioned Corbett et al. (2007). In document BLG 12/6/33, IPIECA and OCIMF had analysed the methodology and found significant limitations "*to the extent that the authors' conclusions about deaths caused by shipping emissions cannot be supported*" (BLG 12/6/33, Executive Summary). It was underlined that "*a careful reading of the Corbett et al. document and its supporting documents will reveal that the uncertainties, acknowledged by the authors, are significant*" (ibid., p. 2). The conclusion by FOEI that this demonstrated a clear need for further measures at a global level was considered to be unfounded. It was emphasized that the rationale behind the SECA concept should remain, i.e., that reductions should be applied where they contributed significantly to air quality problems (ibid.). FOEI then responded that the study was "*undertaken and peer-review by recognized scientists and was based on international accepted science, including methodology developed by WHO and the best available knowledge*" (BLG 12/17, para. 6.55). This view was supported by "a number of delegations" while "other delegations" emphasized that these uncertainties showed a need for further studies (ibid.).

Moving on to discussions held under the sub-agenda on SO_x and PM, document BLG 12/6/2 submitted by BIMCO was considered. BIMCO had revised its proposal B2 based on new information. The previous proposed 1.5% global cap in 2016 had been reconsidered and the new proposal was to have a 3.0% global cap in 2012. This change was explained by the future lower global availability of low-sulphur crude oil. The limits on the existing SECAs should remain but be supplemented with so-called "Micro-SECAs" with [0.2%] or [0.1%] limits in [2011]. A Micro-SECA could be established "*for every major port or as a defined distance from shore*" (BLG 12/6/2, p. 2). The Sub-Committee discussed this concept with several different views and it was agreed that this new approach would be included in the Working Group consideration. The Group was also instructed to reduce the number of options. The question on how to approach PM emissions in Annex VI was then discussed. A submission by Finland (BLG 12/6/5) proposed that PM emissions should only be reduced by lowering the sulphur content. It was reported that "an overwhelming majority" supported this proposal and the Working Group was instructed accordingly (BLG 12/17, para. 6.63).

6.6.1.2. Working Group Consideration and Agreement on a Draft Text

The Working Group on Air Pollution reviewed the existing six options for SO_x and PM emissions and considered the outcome of the Group of Experts and the new BIMCO proposal. The need to reduce the current options was then discussed. It was agreed to identify two to three options that would reflect "*the range of concepts, dates, and reductions proposed to date*" (BLG 12/WP.6, para. 6.5). After a discussion, it was agreed to recommend the three options summarized in Table 6.6.

Table 6.6. Three fuel options developed by the Working Group (BLG 12/WP.6)

Option 1. Global (former Option C)	**Option 2. Global / Regional**	**Option 3. Global / Regional with Micro-Areas**
1. 1.00% global cap by [2012] 2. 0.50% global cap by [2015]	1. Global cap unchanged at 4.50% 2. 0.10% in SECAs by [2012]	1. 3.00% global cap in [2012] 2. 1.00% in SECAs by [2010] 0.50% in SECAs by [2015] 3. 0.10% in optional Micro-SECAs - within 24 nautical miles of the baseline

A discussion on the developed options then followed. It was reported that "*IPIECA expressed significant concern*" over the availability of sufficient volumes of low-sulphur fuels on the proposed dates (BLG 12/WP.6, para. 6.8). The Netherlands suggested changing the 2015 limit for SECAs in Option 3 to 0.1%. Such a limit would reduce the number of fuels needed for ships (and reduce the changeovers). This view was supported by the UK. It was then agreed to keep the proposed options. The Working Group had been instructed to finalize the draft text of Annex VI. Regulation 14 was drafted for all three options.[57] At the Plenary consideration it was agreed to send this finalized draft text to MEPC 57 with the aim of adoption at MEPC 58. The three options for SO_x and PM emissions were considered to represent "*an equitable and fair compression of the different concepts and proposal under consideration by the Organization*" (BLG 12/17, para. 6.88.5).

[57] Interested readers are referred to BLG 12/WP.6/Add.1.

6.6.2. MEPC 57: Approval of Amendments

MEPC 57 was held from 31 March to 4 April 2008. The opening speech by the Secretary-General underlined that the latest developments on the revision "a*ugur well for final consensus decisions*" (MEPC 57/INF.25, p. 5). More than 60 documents had been submitted on the agenda item on air pollution (including the issue of greenhouse gases). Only basic documents without technical details would thus be considered in the Plenary. The delegation of Brazil expressed similar concerns as before at BLG 12. The representative of the European Commission stated that it had earlier clearly indicated that it would await action by IMO instead of introducing its own European measures. It was informed that its position had not changed, though if IMO could not meet its timelines, "*the Commission retained the right to initiate appropriate action to protect the environment*" (MEPC 65/21, para. 4.9). The report of the Group of Experts and the outcome of BLG 12 were then considered. It was noted that the technical aspects of the review had now been completed along with a finalized draft text.

6.6.2.1. Options for SO_x and PM Reductions

The three options developed by BLG 12 were considered in the Plenary along with several submissions. Document MEPC 57/4/30 had been jointly submitted by Finland, Germany and Norway. The three States had put aside their own primary views and studied the options presented from BLG 12 with the view to develop a consensus decision. The interrelationships between measures for NO_x, SO_x and PM were highlighted and the proposal was to deal with them in a package with the same target dates for all of them. The following was proposed on SO_x emissions:

1. 1.00% sulphur cap in SECAs from 1 January 2010
2. 0.10% sulphur cap in SECAs from 1 January 2015
3. 0.50% global sulphur cap from 1 January 2018
   - optional for IMO to introduce steps prior to 2018
   - optional further reduction to adjust for the SECA level of 0.1%

PM emissions were considered to be reduced as a result of the package proposal (MEPC 57/4/30). Moreover, Norway had submitted document MEPC 57/4/38, which presented results from a study on the environmental effects of the package proposal[58]. The results showed that the package proposal would result in a 19% reduction in sulphur deposition in Europe in 2020 (compared with a business-as-usual scenario). This was comparable to the former Option C. In SECAs and nearby land areas, the reduction was comparable to the former Option B1. PM emissions would be reduced by about 20% all over Europe, comparable to the former Options B1 and C (MEPC 57/4/38).

The UK delegation then referred to its submission MEPC 57/4/42, which proposed the following amendments to Option 3 (amendments are underlined):

1. 3.00% global cap in [2012] and <u>1.5% in [2016]</u>
2. 1.00% in SECAs [2010]
3. <u>0.10%</u> in SECAs [2015]

It was further proposed to conduct a review of the availability of fuel needed (MEPC 57/4/42). The UK delegation informed that it was not in favour of including Micro-SECAs in

[58] The same model was used as by the Group of Experts

international regulation. It was further argued that a global cap of 1.5% would avoid the development of additional SECAs.

There were now two new proposals that were given broad support in the Plenary. The support is summarized in Table 6.7. Due to the lack of support for Micro-ECAs, it was thus agreed not to consider this concept further. It was further discussed whether a clause should be included in Regulation 14 to deal with a review of the availability of fuels or technology. It was agreed to include this issue under consideration by the Working Group. It was then agreed that there was sufficient information for an approval of amendments to Annex VI at this session. The Working Group was thus instructed to present a final option for decision in the Plenary (MEPC 57/21).

Table 6.7. Support for two new proposals in the Plenary (MEPC 57/21, para. 4.35-36; MEPC 57/21/Corr.1)

Proposal	Support	Support by Parties to the 1997 Protocol
Finland, Germany and Norway	"a large number"	Belgium, Croatia, Estonia, France, Italy, Latvia, Lithuania, Slovenia and Sweden (also Finland, Germany and Norway)
The UK	"a substantial number"	The Bahamas, the Cook Islands, Liberia, the Marshall Islands and Spain (also the UK)

6.6.2.2. Unanimous Agreement in the Working Group

The Working Group on Air Pollution considered the draft text developed by BLG 12 and submitted documents with the instruction to finalize the draft amendments to Annex VI. A total of 18 submissions from Member States and organizations were considered by the Group on the options for SO_x and PM reductions. They were all briefly summarized in the report. As most of the summaries contained their respective positions on the proposed options, these positions are summarized in Table 6.9. Some submissions with relevant additional information are further described here, as this list of summarized documents is the only thing reported about the discussion that led to the final agreement. Document MEPC 57/4/13 submitted by Japan provided brief results of a study on the impacts on the Japanese oil supply industry. The investments in switching to distillate fuel with a 0.5% sulphur content were estimated at USD 6.790 million and would result in a cost increase of distillate fuel of USD 363/tonne. As it was estimated to take five to ten years to construct new refinery units, the implementation dates for stringent measures should be carefully considered (MEPC 57/4/13). FOEI had submitted document MEPC 57/4/15, providing the study by Corbett et al. (2008), which quantified and compared the health benefits of two proposed measures. The following scenarios were used for the year 2012:

1. *No-action*: 2.7% average sulphur content in residual fuels and no additional measures on PM emissions
2. *Coastal_0.1*: reduced PM emissions from the use of bunker fuels with a 0.1% sulphur content within 200 nautical miles of coastlines
3. *Global_0.5*: reduced PM emissions from the global use of bunker fuels with a 0.5% sulphur content

The results were summarized by FOEI in a simplified table, showing the estimated mean global premature mortality for the scenarios. It is reproduced here in Table 6.8. FOEI further used the results to estimate that the 40,000-50,000 lives saved annually produced about USD

225 to USD 275 billion in social benefits. FOEI concluded that the estimated benefits far outweighed the estimated costs of measures (MEPC 57/4/15).

Table 6.8. Estimated mean premature mortality from international shipping in 2012 (MEPC 57/3/15, p. 2)

Scenario	No Action	Coastal_0.1	Global_0.5
Premature Mortality (mean, 2012)	83,700	42,200	33,700
Mortality Reduction from "No Action"	---	41,500	50,000
Per cent Reduction from "No Action"	---	~50%	~60%

Table 6.9. Reported position in documents considered by the Working Group

Member State / observer	Submission	Supported option	Proposals or comments
China	MEPC 57/4/14	Earlier Option B	Proposed lowering the global cap to 3.5% and keeping current SECA limits
OCIMF	MEPC 57/4/25	Option 3	Proposed a changed time frame for the 1% limit in SECAs from 2010 to 2012. No global switch to distillates.
IPIECA	MEPC 57/4/26 MEPC 57/4/48	Earlier Option B	The second submission proposed a 1.00% SECA limit by 2012. A 3.5% global cap was considered possible by 2012.
ICS	MEPC 57/4/28	Option 3	Proposed the deletion of Regulation 14(8) in Options 1 and 2, which permits different limits in ports.
Finland, Germany and Norway	MEPC 57/4/30-31	-	Their own joint proposal as presented in the Plenary
ITF	MEPC 57/4/34	Option 1	Society demands a global reduction of SO_x emissions from the shipping industry. Option 1 was considered to be the only option that clearly addressed this.
BIMCO	MEPC 57/4/36	Option 2 or 3	Both options were feasible, provided that a lowering of the SECA limit would be carefully assessed. Option 1 was not an alternative.
FOEI	MEPC 57/4/39	Option 1 or 2	The costs of stringent measures were considered to be much lower than the costs to society of no action.
The UK	MEPC 57/4/42	Option 3	Proposal to amend as presented in the Plenary
INTERTANKO	MEPC 57/4/49	Option 1	-

The report of the Working Group then only informs that a "*lengthy and extensive debate*" had been held (MEPC 57/WP.7, para. 7.13). This debate resulted in a unanimous agreement on a set of requirements under Regulation 14 that was reported to result in significant reductions in SO_x and PM emissions. The agreement included the following principal elements:

1. 1.00% sulphur limit in SECAs from 1 March 2010
2. 3.50% global sulphur cap from 1 January 2012
3. 0.10% sulphur limit in SECAs from 1 January 2015
4. 0.50% global sulphur cap from 1 January 2020
   - A review would be completed no later than 2018. Depending on the results, the date could be extended to 1 January 2025

The draft text was finalized and it was noted that it did not have any square brackets "*as a result of the exceptional efforts of all the working group members to find a workable solution on a matter that had been highly controversial and the subject of extensive debate*" (ibid., para. 7.15). Figure 6.3 shows the final draft Regulation 14(1, 2, 5 and 8) developed by the Group. After the agreement, a statement by ICS underlined that the decisions by the Group had the potential to disrupt "*the balance in inter-modal competition and internal fuel markets*"

(ibid., para. 7.17). A statement by IPIECA underlined that the oil industry did not expect that sufficient fuel with the agreed sulphur content would be available in all regions by the agreed dates. Moreover, IPIECA had the view that a 0.50% global cap "*was not supported by scientifically demonstrated needs*" and that it would result in significant increases of energy and crude oil consumption as well as CO_2 emissions (ibid., para. 7.18). It was thus recommended to include these factors in the review by 2018.

REGULATION 14
Sulphur Oxides (SO_x) and Particulate Matter (PM)

General Requirements

(1) The sulphur content of any fuel oil used on board ships shall not exceed the following concentrations:

(a) 4.50% m/m prior to 1 January 2012;
(b) 3.50% m/m on and after 1 January 2012; and
(c) 0.50% m/m on and after 1 January 2020.

(2) The worldwide average sulphur content of residual fuel oil supplied for use on board ships shall be monitored taking into account guidelines developed by the Organization

(5) The worldwide average sulphur content of residual fuel oil supplied for use on board ships shall be monitored taking into account guidelines developed by the Organization.

Review Provision

(8) (a) A review of the standard set forth in subparagraph (c) of paragraph 1 of this regulation shall be completed by 2018 to determine the availability of fuel oil to comply with the fuel oil standard set forth in that paragraph and shall take into account the following elements:

(i) the global market supply and demand for fuel oil to comply with subparagraph (c) of paragraph 1 of this regulation that exist at the time that the review is conducted,
(ii) an analysis of the trends in fuel oil markets; and
(iii) any other relevant issue.

(b) The Organization shall establish a group of experts, comprising of representatives with the appropriate expertise in the fuel oil market and appropriate maritime, environmental, scientific, and legal expertise, to conduct the review referred to in subparagraph (a) of paragraph 8 of this regulation. The group of experts shall develop the appropriate information to inform the decision to be taken by the Parties.

(c) Only the Parties, based on the information developed by the group of experts, may decide whether it is possible for ships to comply with the date in subparagraph (c) of paragraph 1 of this regulation. If a decision is taken that it is not possible for ships to comply, then the standard in that subparagraph shall become effective on and after 1 January 2025

Figure 6.3. Final Draft Regulation 14(1, 2, 5 and 8) developed by the Working Group on Air Pollution at MEPC 57 (MEPC 57/WP.7/Add.1, Annex 1, para. 14)

6.6.2.3. Approval in the Plenary

The Chairman of the Working Group informed the Committee that the Group had reached agreement on all major issues related to the revision. This was described as "*remarkable since many of the issues had been highly controversial with a very diverse set of opinions on what options and specific limitations were appropriate in light of the relevant risks to human health and the environment*" (MEPC 57/21, para. 4.56). The Committee then approved the draft amendments on Annex VI and the NTC for circulation towards adoption at MEPC 58. The Secretariat was requested to prepare the text before MEPC 58. After the approval, the delegation of Singapore emphasized that there were still some details left for consideration at

MEPC 58. All Parties were thus encouraged to carefully consider the text before adoption. Slovenia, which at the time represented the EU with its presidency, congratulated all Member States, observers, the secretariat and the Secretary-General for the "tremendous achievement", which would lead to significant and rapid reductions (MEPC 57/21, para. 4.62). The report further describes the statement as follows:

"*In particular, Slovenia acknowledged and greatly appreciated the co-operation and flexibility showed by all Member States and involved observers enabling IMO to reach this important decision. It clearly demonstrated that IMO was capable of taking important and difficult decisions to protect the environment*" (ibid.).

The formal information on how this approval decision was taken ends here. Before moving on to MEPC 58, it should be noted that minor editorial changes were made to the approved text compared with the draft text developed by the Group.

6.6.3. MEPC 58: Adoption of the Revised Annex VI

MEPC 58 was held from 6 to 10 October 2008. With approximately 1000 participants and 96 Member States present, this session beat the records up to that time (Swedish Maritime Administration, 2008b). In the opening speech by the Secretary-General, the importance of the consensus approval of Annex VI and the NTC was highlighted. The Secretary-General expressed confidence that the willingness to reach a final agreement would also be demonstrated at this session. It was further underlined that the outcome would not only result in substantial benefits for both the environment and the industry but would also demonstrate the effectiveness of IMO and enhance the image of shipping for policy-makers and the public (MEPC 58/INF.24). The adoption of Annex VI and the NTC was considered under the agenda item *Consideration and Adoption of Amendments to Mandatory Instruments*. The approved draft amendments (with additional editorial changes by the Secretariat) were considered by the Committee. It was proposed by a Japanese submission that the date of entry into force of the revised Annex VI and NTC be moved from 1 March 2010 to July 2010. This proposal was agreed with the motivation that it allowed sufficient time to update and develop new guidelines. INTERFERRY (representing the ferry industry) had submitted comments (MEPC 58/5/11) on implications for ferry operations in Northern Europe emanating from the sulphur requirements in the approved text. It urged consideration for the overall environmental impacts in order to avoid competition from land-based transportation. As "a number of delegations" stressed that these issues had already been considered in the revision, the Committee agreed that no further measures would be taken (MEPC 58/23, para. 5.12).

6.6.3.1. Finalization by the Drafting Group and Adoption in the Plenary

A Drafting Group was established to finalize the text of the Revised Annex VI and the NTC. Several significant changes were made in different parts of the Annex (i.e., Regulation 13). Besides the change of implementation date to July 2010, the changes made in Regulation 14 were of an editorial nature. In the action points (i.e., *Actions requested of the Committee*), the Committee was invited to adopt the revised Annex VI and the NTC as annexed to the report of the Drafting Group. When presenting the report of the Drafting Group, the Chairman of the Group stated that the Working Group at MEPC 57 had made such a great job that "*there were few, if any issues, that the Drafting Group found contentious in its deliberations*" (MEPC 58/23, para. 5.41). The Committee then considered the report and the action points one by one. Based on the finalized text and further decisions on specific amendments by the Group,

the Committee adopted the revised MARPOL Annex VI by resolution MEPC.176(58). The adopted Regulation 14(1, 2, 5 and 8) is given in Figure 6.4.

REGULATION 14
Sulphur Oxides (SO_x) and Particulate Matter (PM)

General Requirements

1 The sulphur content of any fuel oil used on board ships shall not exceed the following limits:

.1 4.50% m/m prior to 1 January 2012;

.2 3.50% m/m on and after 1 January 2012; and

.3 0.50% m/m on and after 1 January 2020.

2 The worldwide average sulphur content of residual fuel oil supplied for use on board ships shall be monitored taking into account guidelines developed by the Organization.4

5 The sulphur content of fuel oil referred to in paragraph 1 and paragraph 4 of this regulation shall be documented by its supplier as required by regulation 18 of this Annex.

Review Provision

8 A review of the standard set forth in subparagraph 1.3 of this regulation shall be completed by 2018 to determine the availability of fuel oil to comply with the fuel oil standard set forth in that paragraph and shall take into account the following elements:

.1 the global market supply and demand for fuel oil to comply with paragraph 1.3 of this regulation that exist at the time that the review is conducted;

.2 an analysis of the trends in fuel oil markets; and

.3 any other relevant issue.

9 The Organization shall establish a group of experts, comprising of representatives with the appropriate expertise in the fuel oil market and appropriate maritime, environmental, scientific, and legal expertise, to conduct the review referred to in paragraph 8 of this regulation. The group of experts shall develop the appropriate information to inform the decision to be taken by the Parties.

10 The Parties, based on the information developed by the group of experts, may decide whether it is possible for ships to comply with the date in paragraph 1.3 of this regulation. If a decision is taken that it is not possible for ships to comply, then the standard in that subparagraph shall become effective on 1 January 2025.

Figure 6.4. Final Regulation 14(1, 2, 5 and 8) adopted by Resolution MEPC.176(58) at MEPC 587 (MEPC 58/23/Add.1, Annex 13, para. 14)

Two statements were given after the adoption. The report of MEPC 58 describes the beginning of the statement by the delegation of Germany as follows:

"*The delegation of Germany wholeheartedly thanked and congratulated the Committee, IMO and all its Members for this historical decision, which was a major step forward in the protection of the environment, as well as in enhancing the operational conditions for shipping and, at the same time, the public view of the shipping sector. In its view, the unanimous adoption was a striking proof of what the Committee can achieve, despite the different backgrounds and the diverse positions at the beginning of the negotiations of three years ago*" (MEPC 58/23, para. 5.44).

The German delegation further highlighted that there may be implementation challenges ahead, such as to prevent a modal shift to land-based transportation with higher environmental impacts. The Secretary-General then stated that the adoption "*was a monumental decision for the Committee and IMO as a new milestone in the history of the Organization*" (ibid., para.

5.45). He ended the statement with the words below, which also end the second act and the formal story behind the global cap in Annex VI.

"*The successful outcome of the efforts undertaken proved, once again, that IMO was focused, united and determined to reach decisions by consensus, thereby underlining IMO's relevance as an international body capable of dealing with all items on its agenda, an Organization with the mandate and competence to set global standards in a global environment*" (ibid., para. 5.46).

7. Discussion

7.1. The First Act

7.1.1. Summary

The story started at the time when acidification was a 'hot topic' in the 1980s. It gave rise to questions over the contribution of SO_x and NO_x emissions from international shipping. Ships used residuals from refineries as fuel (HFO), which had a high sulphur content and other quality-related problems. Norway raised the issue at the second North-Sea Conference in 1987. The result of this conference was a declaration to initiate actions through IMO. The declaration was raised at the 26th session of the MEPC in 1988. After a Norwegian proposal, it was agreed to include air pollution from ships in the work programme. The work then entered a preparatory phase to consider emissions of air pollution from ships and possible measures. At MEPC 30 in 1991, target levels and dates for reducing the emissions were developed based on a Norwegian proposal. The targets included halving the present level of SO_2 emissions from ships by 2000, though no definition on the "present level" was agreed. A 1-1.5% sulphur content limit on bunker fuels would achieve this reduction, as the average sulphur content at the time was 2.8-3%. No decisions were made on possible measures, however, due to a lack of information. The BCH Sub-Committee was then instructed to conduct the main work on developing a proposed new Annex to MARPOL on air pollution from ships. In order to develop such standards, a draft Assembly resolution was developed. The targets were removed from the draft resolution at MEPC 31 following a US proposal for the BCH to undertake a technical study before any targets were set. The targets remained in the action plan of MEPC, however.

After the adoption of the Assembly resolution, the work began on drafting a new Annex to MARPOL on air pollution. This work persisted over a period of seven years (1991-1997). The focus of the discussions turned increasingly to the costs for the oil industry and oil-producing States to reduce the sulphur content of bunker fuels. In 1992, the Sub-Committee turned the focus to a regional approach with sulphur limits in particularly sensitive areas. The concept of "global capping" was introduced in the discussions of a regional approach. The idea was to supplement regional standards with a global ceiling (cap). The intention was not to reduce the emissions but to prevent a possible future increase in the sulphur content. As the work by the BCH went on with an extended work period, the majority favoured a regional approach and a possible global cap. Different proposals for a global cap were made during these years. The figures that gained most support were between 3% and 5%. The work of the BCH Sub-Committee was finalized with a draft text of a new Annex to MARPOL at BCH 24 in 1994. It included a [1.5%] sulphur limit in SECAs and a global cap of [5%]. The figures were put within square brackets to indicate that consensus had not been reached. Some indicated that they would be prepared for a compromise of 4.5% in order to reach consensus. The sulphur content at the time was less than 3%. Complaints were thus made that such a high a cap would not result in any global reductions and that the existing ISO standard was already at 5%.

As the work went on at the MEPC, the majority favoured 5% up to the time of the Conference in 1997. At the final draft session in 1997 (MEPC 39), it was agreed to monitor the average sulphur content in residual fuels after adoption. Furthermore, BIMCO highlighted the implications for international shipping of using SECAs and proposed only using a global cap. The Committee agreed to maintain the [5%] figure in the final draft text to the Conference however. At the Conference, both BIMCO and ICS tried once more to draw attention to the

implications for the shipping industry and proposed only using a global cap. The 5% level still prevailed within square brackets for the major part of the Conference however. It was not until the second to last day of the Conference that agreement was reached on a 4.5% global cap, and Regulation 14(1) was adopted accordingly. It was also agreed to monitor the average sulphur content in residual fuels by adopting Regulation 14(2) and a Conference resolution. This is where the first act ends. Figure 7.1 illustrates key events of the first act.

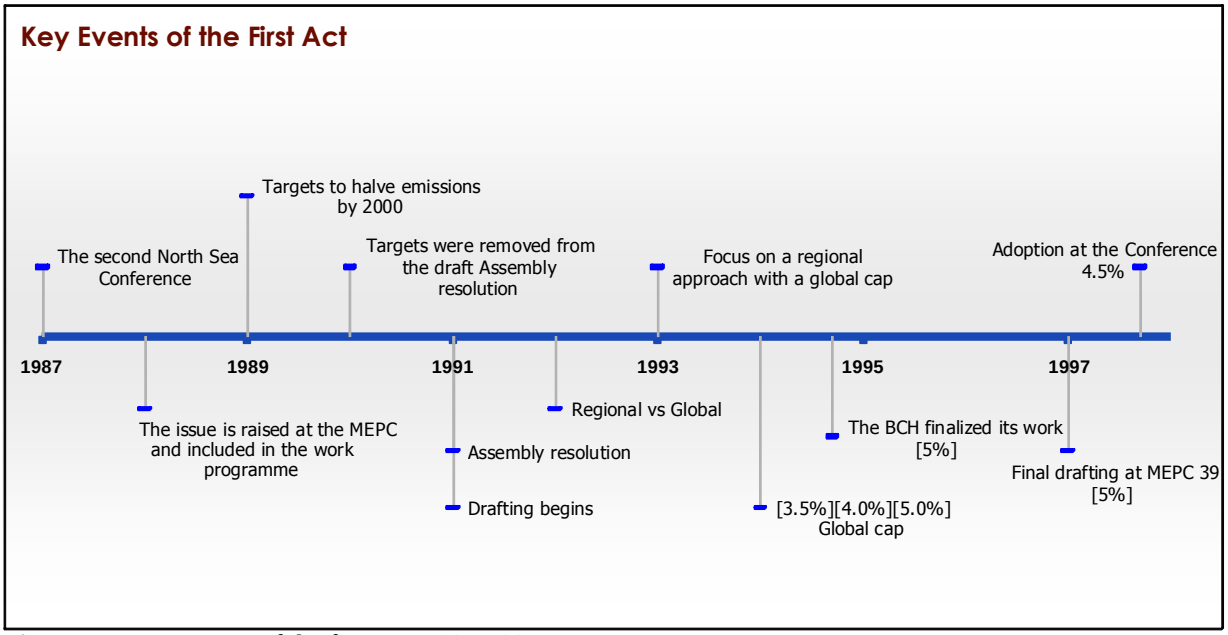


Figure 7.1. Key Events of the first act, 1987-1997

7.1.2. Discussion on the First Research Question

This section discusses the developments described in the first act based on the first research question and additional questions derived from it.

- **Research Question 1:** *How did the development of regulating global sulphur oxide emissions from ships end up with a global cap of 4.5% together with a regional SECA limit of 1.5%?*

7.1.2.1. Influences of the North Sea States and High Reduction Targets

The North Sea States, with Norway in the lead, were the main drivers of stringent air pollution measures for shipping, and they had the main influence at IMO up to MEPC 30 in 1990. Personal communication indicated that Sweden and the Baltic Sea States had a bigger role in initiating air pollution at IMO than was found from the investigated documents (Lemieszewski, pers. comm.). The question of what really occurred requires further research. Nevertheless, Norway and Sweden represented the States most affected by acid deposition from transboundary air pollution. Acid deposition in Norway mainly originated from other countries and ships in the North Sea. At the first intersessional meeting in the second act, the Norwegian Minister of Environment explained that international agreements were thus *"the only way to reduce acid rain in Norway*" (BLG 11/5, Annex 1, p. 1). This explains Norway's drive towards global regulation of SO_x emissions from ships, but why did the IMO Member States listen to Norway? It played a major role in the world trade in the previous century. According to the Secretary-General at the same meeting, Norway was *"one of the most active*

and influential of IMO Member States, as well as being a generous supporter of the Organization's technical co-operation programme" (BLG 11/5, Annex 2, p. 1). This could explain its early influences in the first act. In addition, other European States had the same drive towards global regulation at this stage, in particular Parties to LRTAP. These European influences resulted in the early high ambition goals at IMO, i.e., to halve SO_x emissions from ships by the year 2000. In order to achieve this target, a global sulphur content of 1-1.5% had been suggested. A content as low as 0.8% had even been proposed by the Baltic Sea States in 1990. Why then did IMO end up with regional measures and a negligible global cap of 4.5%?

7.1.2.2. Changed Pattern of Influences: the Oil Industry

A first observed breaking point was the removal of the target dates from the Assembly resolution at MEPC 31. No decisions on target dates were to be taken before the outcome of the technical consideration by the BCH. As such, there was time for impact assessments before decisions were taken. This could be argued to have been a well-founded policy-choice: to take action after an analysis of its benefits, costs and possible implications. It could also have been a reason for the Nordic Sea States, the Baltic Sea States and the EEC Member States agreeing on this, despite some expressed preferences to keep the targets. This choice could also have opened a possibility of influences by the oil industry and oil-producing States however: a possibility that would postpone the final decision with lengthy and intensive debates. In addition, another Assembly resolution referred to could also explain the coming discussions and the slow process. Resolution A.500(XII) set objectives for IMO in the 1980s. It recommended that the Committees "*entertain proposals for new conventions or amendments to existing conventions only on the basis of clear and well-documented demonstration of compelling need*", taking into account "*the costs to the maritime industry and the burden on the legislative and administrative resources of Member States*" (Res. A.500(XII), para. 3)

The focus on the costs was put on the oil industry, however, though its costs, in turn, had impacts on the shipping industry. Okamura (1995) explained the slow process of developing a draft Annex VI as a result of the oil industry's and some oil-producing States' concerns over the implications of the proposed sulphur requirements. An observed pattern in the investigated documents is the increasing number of submissions by oil industry-connected organizations and oil-producing States during the years of the first act. The single most important factor for their resistance to global, stringent measures was to protect the market of residual fuels for use as bunkers. The only remaining market for these low-quality, high-sulphur fuels was for use by ships, due to the stringent on-shore standards. Unlike the Norwegian oil production, with low-sulphur crude oil, States that produced fuels with a high sulphur content (e.g., Venezuela, Mexico and the Persian Gulf States) opposed stringent global measures (Tan, 2006; Ninaber, 1997). Along with observer organizations such as OCIMF and IPIECA, these States were active with submissions that showed the implications of supplying sufficient low-sulphur fuels and the costs of producing them. According to Okamura, IMO had been confronted with "astronomical figures" on the costs to the oil industry during the whole process of developing Annex VI (Okamura, 2005, p. 193). Obviously, this raised concern for the shipping industry, with increased bunker fuel prices. According to Stopford (1997), fuel costs account for approximately 47% of the total voyage costs[59]. An increase in bunker prices would thus increase the costs of shipping, with risks of competition from land-based transportation and ultimately higher consumer commodity prices. The arguments against a

[59] Voyage costs are costs that vary for a specific voyage.

stringent global measure thus gained increasingly support from Flag States and Coastal States that were not affected by acidification.

7.1.2.3. Why Turn to a Regional Approach and a Global Cap?

It was observed that the initial global reduction targets turned out only to apply where they were most needed: in particularly sensitive areas. According to Tan (2006), a special area solution was introduced, as the global solution met resistance from both the shipping and oil industries. Mr. Stefan Lemieszewski further explained that the oil industry was pushing for as small special areas as possible and preferably small regions near ports (Lemieszewski, pers. comm.). A regional approach was first discussed in a correspondence group but was then focused on in a working group at BCH 22. This is the second observed breaking point towards moderate global regulation. An explanation of why the group was instructed to focus on a regional approach is not provided in the reports. The third observed breaking point appeared in the Correspondence Group on Regional Control Options. The report gave so many arguments of a regional approach that there was little support to proceed with global stringent measures at BCH 23. In fact, the lack of support was one of the report's main arguments. This is an important aspect as a common perception is that SECAs were introduced because certain sensitive areas needed further reduction. The critical loads concept was indeed an important argument to develop a special area but the main argument was the lack of support for a global solution. Due to the strong arguments of the Correspondence Group, the regional approach triumphed very early at BCH 23. It would be applied together with a global "cap". The concept of "capping" was introduced to avoid a possible increase in the sulphur content of fuels and not to reduce global emissions. This explanation was not provided anywhere in the studied literature related to MARPOL Annex VI (e.g., Tan, 2006; IMO, 1998, IMO website; De La Rue and Anderson, 2009). Tan (2006) argued that a global cap was introduced by the European States. This could not be supported by the investigated documents due to wage transparency, e.g., "*a number of Members favoured a regional approach"*. The turn to a regional approach was a decision, which according to some delegations contradicted the targets and instructions of the MEPC. How could the BCH make such a turn in policy-making when it is a technical Sub-Committee? After a Swedish complaint, the US delegation responded that the target levels should not be seen as a rigid MEPC tasking without further technical review. The delegation was comfortable with an approach that did not strictly follow the targets as they were not included in the Assembly resolution. This statement confirms that the removal of the target dates was a first breaking point towards a negligible global regulation.

7.1.2.4. Choice of Global Capping Level

As the story continued, it focused on the level of the global cap. The initial proposals were about 3-3.5%. How did IMO end up with 5% for a long time and then 4.5%? Despite loud complains by the North Sea States and the Baltic Sea States, it could be concluded that the high reductions that would be achieved in their own area made them support a regional approach. Did the same reasons make them accept a negligible global cap? Tan argued that the oil industry accepted stricter regulation in special areas (e.g., 1.5%) and a flexible geographical extent in order to make proposals for a strict global cap more easily resisted. One possible explanation for a moderate global cap is thus that Member States prioritized the SECA limits and let the global cap be moderate in order to at least end up with some stringent measures where they were most needed. As expressed by Captain Eivind S. Vagslid at the IMO Secretariat, "*limits and regulations in Annex VI were set at very modest levels in order*

to be accepted" (Vagslid 2006, PowerPoint slide 40). The influence of the oil industry is one explanation that could be concluded with high confidence. The 5% sulphur content limit was already an ISO standard developed by the petroleum industry, as fuels with sulphur contents above 5% were likely to disintegrate the engines (Ninaber, 1997). Hence, by setting a global cap of 5%, no additional measures would be imposed on the oil industry. It is important to highlight that despite an average sulphur content of about 3%, there were States that exported fuels with sulphur contents over 4%. Tan (2006) reasoned that a global cap below 5% would thus have had negative effects on their exports.

It can be seen from Table 5.1 that a majority favoured a global cap of 4-5% already in 1994. This group included oil-producing States, major Flag States and oil and shipping industry organizations. A smaller group favoured 3.5%. The shipping industry and major Flag States thus seemed to have the same views as the oil industry in 1994. It could be observed that the shipping industry then made a turn in 1997 by proposing only the use of a global cap. ICS and BIMCO highlighted implications for international shipping with the use of SECAs. These implications had not been in focus before. It had been discussed by, for example, Norway at BCH 22 in 1992 but had not attracted any significant attention after that. In 1997, the shipping industry then tried to attract the attention of the Committee to their implications, but it seemed to have little effect. This indicates that the Flag States had listened more to the voices of the oil industry than the voices of the shipping industry. Mr. Roger Karlsson gave an example of how the strength of the discussions laid on the oil companies and not the shipping industry at the later MEPC sessions. According to Mr. Karlsson, INTERTANKO, BIMCO and ICS (i.e., representatives of the shipping industry) presented their views at MEPC 39 that the global sulphur emissions should be reduced and only with a global cap. The delegation of the Netherlands then stated that the shipping industry could not handle such requirements (Karlsson, pers. comm.). Given that the Netherlands had earlier proposed a global sulphur content of 1.5%, it could be concluded that the Netherlands had made a major turn in its position over the years. Whether this turn was the result of oil industry interests could not be concluded in this thesis. Nevertheless, it illustrates the political developments at IMO during the years of the first act just by looking at one of its Member States.

7.1.2.5. The Results of the Conference

Leading up to the end of the first act, there is a question that is still unanswered: Why did the global cap change from 5% to 4.5% at the Conference in 1997? According to the Swedish report, the agreement on the global cap was reached after discussions in the Plenary and working groups, and in informal talks (Swedish Maritime Administration, 1997). The question of what occurred at the informal talks could not be answered in this thesis. Personal communications provided some insights however. Outside pressures and pressures within the UN both played a significant role at the Conference. The views and words of the Secretary-General were affected by these pressures and influenced the final decision (Lemieszewski, pers. comm.). According to Mr. Karlsson, the change from 5% to 4.5% was a political issue for IMO as an international organization responsible for ship emissions. The delegations could not walk out of the Conference by accepting the same standard as the already existing 5% ISO standard. By changing to 4.5%, it would be seen that IMO had its own standard and actually took global action, despite its moderate level. The possibility of lowering it in the future was also seen as higher than by just referring to the ISO standard. It was its own standard and changes could be made to it (Karlsson, pers. comm.).

When looking at the results of the Conference, they must also be seen in the context of the previous reasoning. Of particular interest is the reasoning of the Correspondence Group on Regional Control Options in 1993. It stated that a cap of 3% "*will not lead to any reductions of sulphur oxides worth mentioning*" (BCH 23/7/4, p. 6). It could thus be concluded that a 4.5% cap would not lead to any reductions, as the average sulphur content at the time was about 2.8-3%. As pointed out several times in this thesis, a global cap was only introduced to prevent a possible increase in the sulphur content. The 3% proposed early on could at least be motivated by this reason. If the cap had been set at 5%, it would not have had this effect, as the sulphur content was unlikely to increase above 5% due the ISO Standard and the fact that such a high sulphur content would result in engine problems. A 4.5% cap is very close to this ineffectiveness. So, what was the point of a 4.5% cap? At BCH 23 in 1993, the delegations that were in favour of a global cap of about 3-3.5% had the view that the cap was a first step in a step-by-step approach to achieving the target level. As seen above, this may also have been the reasoning at the Conference. It could thus be concluded that a 4.5% global cap only had the motivation that it was a first step in a global regulation that could be amended in the future. The view of the EU States that it was better to have a not entirely satisfied Annex VI than none at all seems to have been the common view at the Conference.

7.2. The Second Act

7.2.1. Summary

It would take until 2005 before the 1997 Protocol entered into force. This period showed significant factors for an upcoming revision. After three years of monitoring the average sulphur content in residual fuels used on board ships, a reference value was set at a sulphur content of 2.7%. If the results showed an increase of 0.2%, the MEPC would conduct a review of the sulphur limits in Annex VI. No such increase was found. Nevertheless, SO_x emissions from ships had increased since 1997 due to the increase in shipping activity. The awareness of the health effects of PM emissions had also increased, with many studies and reports. With stricter standards on land-based sources, the attention of Governments increasingly turned to ship emissions, in particular in the EU and the US. In addition, the technology to reduce NO_x emissions had evolved so much that the standards in Annex VI were seen as obsolete when it entered into force. A Conference resolution had called for a review of NO_x limits after five years of compliance with Annex VI, but compliance was met already in the year 2000: five years before Annex VI entered into force. The MEPC had also struggled with a large number of implementation issues in Annex VI, which indicated that the text was difficult to interpret. These developments all contributed to several proposals to amend Annex VI being submitted at MEPC 53 in 2004. A submission by Iran had particular impact. It highlighted technical limitations for compliance with the sulphur limit in SECAs and proposed a global sulphur standard. After a discussion, the Member States were invited to submit proposals on amendments at MEPC 53. Several such proposals were submitted, and a joint submission by Finland, Germany, Italy, the Netherlands, Norway, Sweden and the UK had a significant impact. It included the factors above as arguments for updating Annex VI and led to an agreement to initiate a general review of MARPOL Annex VI and the NTC.

The work started at BLG 10 in April 2006. The discussions included the basic question of whether to lower the global cap or the SECA limits and how to address PM emissions. An Intersessional Meeting of the Working Group was then held in November 2006. INTERTANKO had submitted a proposal to use only distillate fuels and a global cap, which would be lowered to a 1% sulphur content in 2010 and 0.5% in 2015. This started a debate in

which one group of delegations saw many benefits and another group raised concern over the oil industry's capacity to provide the necessary supply of distillate fuels. Three options were identified: (A) to leave Regulation 14 unchanged, (B) to lower the SECA limits and (C) the INTERTANKO proposal. At BLG 11 in April 2007, intensive discussions extended these options to six (see Annex). To help IMO with sufficient grounds for a final decision, an informal Group of Experts was established at MEPC 56 in July 2007. The extensive amount of information in its report included modelling of emissions based on the different options, impacts on the shipping and petroleum industry and assessment of health and environmental impacts. At BLG 12 in February 2008, considerable discussion was held and the results of the Group of Experts were considered. The Sub-Committee was able to reduce the number of options to three: (1) the former Option C, (2) 0.1% in SECAs by 2012 and an unchanged global cap and (3) a 3% global cap in 2012 and 0.5% in SECAs by 2015 with an optional 0.1% in so-called Micro-SECAs. The technical work on the revision had now been finalized and a final decision was expected at MEPC 57 in March-April 2008. Two new options were proposed and several submissions were considered by the Working Group at MEPC 57. The report only mentioned that a lengthy and intensive debate had been held, which had ended with a unanimous agreement on all the aspects of the SO_x and PM emissions and the whole draft text of Annex VI. The text was thereafter unanimously approved in the Plenary. The initial 4.5% global cap will be reduced to 3.5% from the 1st of January 2012, followed by 0.5% from the 1st of January 2020. If a review in 2018 concludes that it is not possible for ships to comply with a 0.5% global cap by 2020, it shall be extended to 1st of January 2025. No major changes were made to Regulation 14 at MEPC 58 in October 2008, and Annex VI was unanimously adopted. Some statements were made on implementation difficulties and a possible modal shift to land-based transportation, but overall the statements were very positive. This is where the formal story of the global cap in MARPOL Annex VI ends. Figure 7.2 illustrates key events of the second act.

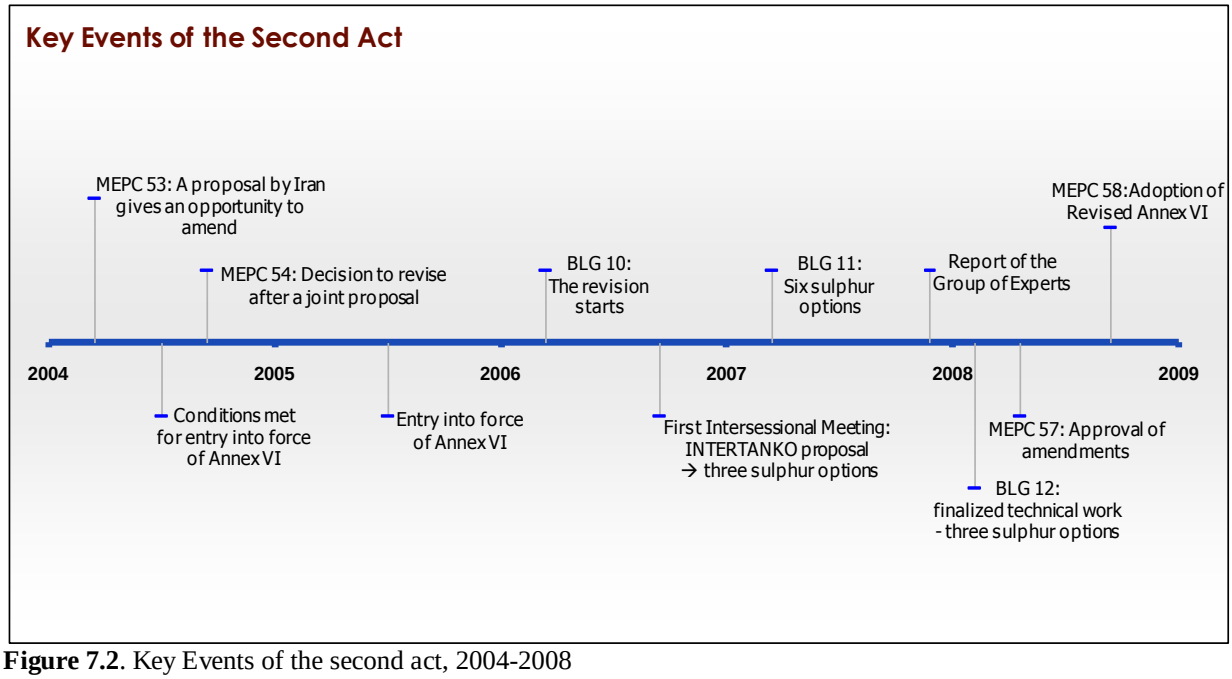


Figure 7.2. Key Events of the second act, 2004-2008

7.2.2. Discussion on the Second Research Question

This section discusses the developments described in the second act based on the second research question and additional questions derived from it.

- **Research Question 2:** *What explains the turn towards a more stringent global cap of 0.5%?*

7.2.2.1. Why Revise Regulation 14?

To answer the second research question, we first have to look into the basic question of why MARPOL Annex VI needed to be revised. The investigated documents indicate that the main reasons were the NO_x review and the implementation issues, e.g., 70 proposals on unified interpretations at one session of MEPC. What role did the sulphur limits play? Tan (2006) highlighted disappointments on the negligible global sulphur cap from the shipping industry, environmental NGOs and numerous States. According to Tan, "*many delegations with environmental interests consider the 4.5 per cent cap to be one of the lowest points in IMO's recent law-making history*" (Tan, 2006, p. 160). It could thus be concluded that these disappointments explained the need for a revision of Annex VI or at least a need to take unilateral or regional measures, which in turn would result in a stronger need for global action. By looking at the developments within the EU in the interim period 1997-2004, it could be concluded that the developments towards unilateral action in the EU was a key factor for a revision at IMO. The EU also had a significant role in the ratification process of Annex VI, as the Commission urged for early ratification by its Member States. Going back to the story, the attention of EU Governments was drawn more and more to the increasing emissions from ships, the health effects of PM emissions and the cost-effectiveness of reducing ship emissions compared with land-based sources. A strategy on ways to address ship emissions included coordinating Member States' positions in IMO to develop stricter measures. A proposal to amend the sulphur directive on certain fuels included a second step of a 0.5% sulphur content that would have applied to all ships in all EU waters. The Council of Ministers opposed this proposal, however, and emphasized the importance of pursuing solutions through IMO. It thus urged its Member States to submit proposals for stricter standards to IMO to revise Annex VI. It could be concluded that the EU was a main driving actor towards the decision to revise it. The joint submission MEPC 53/4/4 by Finland, Germany, Italy, the Netherlands, Norway, Sweden and the UK should thus be seen in the context of the developments within the EU[60]. The opportunity for this joint proposal was opened as a result of the submission by the Islamic Republic of Iran (MEPC 52/4/12) at MEPC 52. It highlighted technical and operational limitations connected to the SECA regulations and proposed a globally uniform standard of the sulphur content without using SECAs. This position by Iran is surprising, given that Iran was the world's fourth largest crude oil producer in 2004 and that its crude oil has high sulphur content (Hornitschek, 2006; Reuters, 2011). It could be observed from the story of the second act that Iran did not play a significant role in the revision. Did its position change? As no answers could be found, this could be dealt with in further research.

7.2.2.2. A Process to Assess and Prove Different Impacts

The revision process from 2006 to 2008 was characterized by many submissions, several different views and intensive debates, including large amounts of information on emissions,

[60] Norway is an EEA/EFTA Member State.

health and environmental impacts, and impacts on the oil and shipping industry. This time, the focus was not on the environment when discussing sulphur emissions. Instead, health effects played a particularly important role in the revision. Already at MEPC 52, the FOEI submission (MEPC 52/4/4) showed a clear turn from environmental to health aspects. In fact, acidification was only mentioned in one sentence. As before, a compelling need for measures and analyses on the benefits and costs to the shipping industry had to be included in the consideration of an amendment to a convention (MSC-MEPC.1/Circ.2). The impacts of the oil industry were as important, but the SECA concept was questioned and a global solution was sought by the shipping industry, some Flag States and environmental interests. The implications highlighted by ICS and BIMCO in 1997, e.g., the need to carry different fuels on board, were of particular importance in the early part of the revision. As observed from the story, the INTERTANKO report then had great importance in the revision process. It became a focal point for the discussions on SO_x measures and started the development of different policy options. It could be concluded that the INTERTANKO report was a milestone factor towards a revised global cap. A single solution with one global fuel was favoured by many Members, though the implications for the petroleum industry were immediately raised. These implications were major arguments for keeping the SECA approach. It was observed that the INTERTANKO report started a significant turn towards several new proposed options. A more stringent limit in SECAs using distillates was an alternative that appeared a short time after the INTERTANKO report. It could thus be concluded that the INTERTANKO report was also significant to the development of the SECA limit. Did the SECA proponents use the same approach as Tan (2006) argued that the oil industry had used in the first act, i.e., to allow a stringent SECA limit in order to prevent a stringent global cap? This question cannot be answered in this thesis. Nevertheless, it could be concluded that IMO lacked sufficient information in 2007 to take final decisions on a revised Regulation 14 in 2008. As in the first act, the oil industry and oil-producing States once again urged cost-benefit and impact assessments before taking decisions. The target completion date for a revised Annex VI was near and the now six options needed further evaluation. The informal Group of Experts was thus established to assess these options.

What impacts did the Group of Experts have on the final agreement? Mr. Lemieszewski explained that the Group of Experts consisted of technical experts who did not represent any specific interests. Experts from the oil industry thus did not represent their industry but provided technical expertise, and shared their knowledge, experiences and facts. As a result, oil industry experts gave clear indications that there were no technical obstacles to producing low-sulphur fuels. It was simply seen as a question of costs and adaption of the oil industry. As the consideration moved on at IMO, it became clear that low-sulphur fuels are costly but that the problems associated with SO_x and PM emissions are even more costly. After the results of the Corbett et al. (2007) study had been highlighted at IMO, the arguments against stringent measures began to dry out. The social costs were on a completely different scale to the costs of producing low-sulphur fuels (Lemieszewski, pers. comm.).

7.2.2.3. How Were the Unanimous Agreements Reached?

As a result of the Group of Experts, the Sub-Committee was able to reduce the number of options to three at BLG 12. Two new options were proposed, however, and several submissions were considered by the Working Group at MEPC 57. The development in the Working Group thus seems to have been dramatic, with a lengthy and intensive debate that reduced three options and two additional proposals to one unanimous package. This debate was not summarized in its report. What happened in the Working Group at MEPC 57 that

made it unanimously agree on amendments for approval by the Committee? Mr. Lemieszewski provided some explanations for this development. The agreement must be seen in the context of a series of significant informal talks before MEPC 57. The aim of these deliberations was to reach consensus on a strong strategic position with as many Parties and Members as possible (Lemieszewski, pers. comm.). A unified strong voice of many Member States was thus presented at MEPC 57. Informal negotiations then continued to have high importance at the session, in particular outside and between formal working group hours (Carlsson, pers. comm.). Furthermore, the significance of the two new proposals needs to be highlighted. The package proposal by Finland, Germany and Norway included a 0.5% global cap from 1 January 2018, and the UK proposal included 0.10% in SECAs by 2015 and a review of the availability of fuel. They were thus very similar to the final decision and were both given broad support in the Plenary. It could be concluded that the final agreement was a combination of these two proposals. In addition, it could be mentioned that low-sulphur HFO with a 0.5% sulphur content will, according the Group of Experts, not be available in the near future as it is a scarce product used for blending. Therefore, the world fleet will have to be provided with distillate fuels (Lemieszewski, pers. comm.).

The above reasoning could explain the sudden unanimous agreement, but why was the debate of the Working Group not accounted for in its report? It was agreed not to include the discussions behind the agreements in order to hide personal statements and positions. The reasoning behind this decision could be explained by the participation of Members of the Group of Experts in the Working Group. Experts connected to an interest could have said or acted on facts in a way not representing their formal positions (Lemieszewski, pers. comm.). Why were the decisions to approve and adopt the amendments then taken as unanimous? The Swedish report of MEPC 57 provides a concise picture of the reasoning behind the approval:

"*The agreement reached in the Working Group was taken by acclamation in Plenary without any debate. There was a concern that one or more delegations would open up any part for discussion and thereby upset the carefully balanced arrangement*" (Swedish Maritime Administration, 2008a, p. 5, translated).

Given that the Secretary-General expressed confidence that the willingness to reach a final agreement would also be demonstrated at MEPC 58, the reasoning of the quotation above could equally be applied to explain the lack of a significant debate at MEPC 58. The fact that the concern of a modal shift to land-based transportation was given by Germany after the adoption and not before further supports this conclusion. Furthermore, outside pressures once again seemed to have had a significant impact on the final decisions. The Secretary-General underlined that the outcome would demonstrate the effectiveness of IMO and enhance the image of shipping for policy-makers and the public.

7.2.2.4. A Struggle for Fast Decisions with a Compromise Solution

An observation of the whole revision process that also explains the relatively fast decisions of IMO is the importance of the target completion date. It was of outmost importance that IMO reached consensus at the target completion date. The revision would only take two or three years. Why was it not extended as before? It had been expressed on several occasions that actions needed to be taken by IMO in order to prevent unilateral action and that the public demanded action on ship emissions. As we have seen, the development within the EU and the possibility of it introducing its own measures were significant factors towards a revision. The threats of unilateral action were also maintained during the revision. Instead of including the

proposed second step in the EU sulphur directive, it was agreed to conduct a review in 2008. According to Mr. Ågren, the planned 2008 review of the directive was postponed by awaiting the results of the revision of MARPOL Annex VI (Ågren, pers. comm.). As such, the European Commission used this review as a threat to establish its own sulphur content regulation in all EU waters if the results of the IMO deliberations were not satisfactory. This is confirmed by the statement given by the representative of the European Commission at MEPC 57, i.e., that it had clearly indicated earlier that it would await action by IMO instead of introducing its own European measures. It was further stated that if IMO could not meet its timelines, "*the Commission retained the right to initiate appropriate action to protect the environment*" (MEPC 65/21, para. 4.9). It is also confirmed by Einemo (2008, p. 6), who added that "*the EU had been sending unambiguous warnings that it would be ready to act alone on SO_x emissions in 2009 if the MEPC failed to make a firm decision during 2008*".

As we have seen, the EU was a main driving actor towards the decision to revise. It could further be observed that the EU maintained its role during the revision with the coordination of its Member States and the European Commission. Another significant actor was the US, which turned out to be a major actor from 2007 when it proposed a 0.1% limit for all ships within 200 nautical miles of land. The US situation had been similar to the developments within the EU, e.g., the attention was drawn to ship emissions due to studies showing increased emissions from ships, stricter standards on land-based sources and increased awareness of health effects from PM emissions. The EU and the US were thus the major actors of the revision process towards a revised Regulation 14. It must be noted that the initial US and European proposals did not prevail at IMO however. It could be concluded that the final solution was a compromise that was once again affected considerably by the oil industry's position. Its influences made the MEPC focus on the impacts on the petroleum industry and turned the focus towards keeping the SECA approach.

7.3. Overall Discussion

7.3.1. Differences and Similarities of Two Processes

A lack of information was highlighted on several occasions during the deliberations of the first act. It could be concluded that the decisions were made with a lack of sufficient information on emission quantities, atmospheric dispersion, impacts and reduction benefits. The information further showed large variations depending on the submitter. According to Okamura (1995), the lack of a general agreement on the quantity of SO_2 emissions from ships contributed to the slow process and the oil industry's concern about cost implications. Okamura also concluded that submissions on the environmental consequences of air pollution had been very few at IMO at the time (1995) (Okamura, 1995). A submission by FOEI gave one estimate of the costs of forest damage from sulphur deposition, but it was merely one of many impact factors for the costs to society. It could thus be concluded that the decisions were based on biased cost assessments that almost only addressed the costs of the industries. When looking at the second act it could be observed that IMO had an enormous amount of information throughout the revision process and the goal of reaching consensus decisions after just two to three years. The Group of Experts was the solution to gathering information and breaking it down into a format for policy-making. The story of the second act thus significantly differs from the first act. Another difference is the environmental focus of primarily acidification in the first act and health impacts in the second. This turn started during the interim period with new scientific knowledge and awareness by Governments. It had a big impact against the arguments of the oil industry interests at IMO, in particular after

Corbett et al. (2007). One similarity between the two acts, however, is the influences of the oil industry. Despite the high awareness of the health impacts and their social costs, the focus on the costs of the oil industry remained high at IMO.

It was observed that IMO was faced with biased grounds for decisions in both acts. Emissions, impacts and reduction benefits were focused on the northern hemisphere, in particular on Europe, while the cost impacts focused on major Flag States, oil-exporting States and the shipping and petroleum industry. The European focus must be seen from the historical perspective of the air pollution regime. LRTAP started as a European initiative under UNECE, influenced by an OECD report and the international striving for regulations by Sweden and Norway. It still does not apply to global emissions and it is centralized in the northern hemisphere. The results of this thesis show an IMO process with the same regional focus. In relation to the acidification focus in the first act, it could be argued to be a sound approach to reducing emissions where they were most needed, but when approaching the second act the health aspects were in focus. The health problems were shown globally, but the European and North American focus prevailed with stricter regulations in SECAs. As a result of the IMO regulations, acidification and health problems in Europe, and North America with the North American ECA, could be significantly reduced. Due to the regional focus of the air pollution regime, it could be seen as a success. This success could not be applied to IMO, which is an international organization with an intention to develop international regulations for all ships of all flags. Due to the regional focus of LRTAP, the research has historically been centralized. The northern hemisphere States have developed awareness and measures of impacts of air pollution on land-based sources. This has led them to reduce ship emissions, but the rest of the world has not had the same awareness and experiences. This could be concluded to have been as important for the developments as the influences of the oil industry.

Another important common factor for both acts is the IMO requirement to show a compelling need and the analysis of the benefits and costs to the shipping industry of proposals for new conventions and amendments. This thesis has shown that these principles have been taken to their heights in the studied process. It has slowed down the process with the focus on the impacts of measures rather than the impacts without measures. Furthermore, another bias for decisions throughout the story is that assessments of the cost impacts on refineries were provided from the refiners themselves. The decision-makers thus had to rely on these estimates being correct and representative.

Finally, it was observed that the shipping and oil industry has had both close and diverse positions during both processes. Sometimes, the oil industry and the shipping industry proposed the same thing and sometimes very different things. It was observed that they both proposed to assess the issues with a “goal-based approach” and a “holistic approach” with all aspects included. This approach could have been a strategy to stall the process and to reach a status quo. The motives for a status quo could have been to postpone decisions that would have meant high costs for both the shipping and oil industry. These kinds of proposals and options were not observed early in the process but later on after the environment or health aspects were in focus for a time.

7.3.2. Three Identified Frames of Reference

According to Allison (1971), "*conceptual models not only fix the mesh of the nets that the analyst drags through the material in order to explain a particular action; they also direct him to cast his nets in selective ponds, at certain depths, in order to catch the fish he is after*" (Allison, 1971, p. 4). The use of a conceptual model may thus have been a simpler method for conducting this research, though it would have required a researcher belonging to, for example, political science. On the other hand, a lesson learned from Allison (1971) is that the use of one theoretical framework gives a narrow perspective. Allison analysed the Cuban Missile Crisis using three theoretical frames of reference and three case studies based on each frame. Each frame of reference was seen as a "conceptual lens" that provided different perspectives and explanations on the studied event (ibid., p. v). The use of several frames of reference provides different answers to the questions asked and different perspectives on the event. Even the questions are asked differently depending on which frame of reference is used. In relation to Allison's use of three frames of reference when describing an event, three frames of reference for sulphur deliberation processes at IMO could be identified from the results. The first involves the *Natural Science and Technology* aspects of SO_x emissions from marine diesel engines and provides the reasons for moving to the second frame of reference: the *Policy Process*. This frame deals with the policy-making towards the regulation of SO_x emissions from ships. This process towards regulation has been proven in this thesis to be highly affected by economic aspects, with the costs of industry being treated equally or more than the impacts on the environment and human health. In fact, these impacts needed to have been translated into monetary terms before stringent measures were to be introduced. The third frame of reference is thus *Economics and Business*. It includes the economics of society and business economics related to the industry. The three frames of reference are presented in Table 7.3, which also provides determinants for use in further research.

Table 7.3. Three identified frames of reference and determinants for further research

	1. Natural Science and Technology	**2. Policy Process**	**3. Economics and Business**
Determinants for further research	- Marine diesel engine construction - Fuel characteristics - SO_x and PM emission quantities - Atmospheric dispersion - Impacts on the environment and human health	The process of sulphur deliberations at IMO: - International relations - National policy - International law - Interest influences - IMO/UN procedures	- Costs to the shipping and petroleum industry from sulphur regulations - Social costs of air pollution - Impact and cost-benefit analysis - Market-based measures

The policy process is the main frame of reference in this thesis and could be applied to Chapters 5 and 6, i.e., the process of sulphur deliberations in IMO. The first and third frames of reference are briefly used in this thesis as both contents and contexts of the process. The natural science and technology frame is found in both the context of Chapter 3 and the contents of the process in Chapters 5 and 6. The economics and business frame is briefly found in the contents of the process related mainly to the costs to the petroleum industry of proposed sulphur regulations. Figures on the costs to the shipping industry have not been the focus of this thesis nor of the studied process. The third frame also includes another aspect of regulation that has been excluded from this thesis. The approach of only setting emission limits and letting the industry decide which measures to use has been discussed during the revision process. This includes market-based measures such as emission trading. Whether this approach is successful for ship emissions is a subject to investigate in further research.

7.3.3. Research Contribution

This thesis has described the process of regulating global sulphur emissions at IMO from an investigation of IMO documents. A summary of 20 years of IMO documentation is a contribution in itself. This thesis does not provide a definitive history, but it gives an insight into how policy-making could happen at IMO. It is a case study on how environmental decisions are made through IMO. It has revealed the process of global sulphur deliberations. No such previous research has been found. This research thus opens up for further investigation into how air pollution is dealt with at IMO. It has broken down the structure of the process and uncovered several pieces for further research.

From this case study, we can learn how IMO works as an international organization responsible for air pollution from ships and how it is reported in its documents. It has shown a variation in transparency during these 20 years. In the first act, several documents were highlighted. In the second, there were too many to summarize in a session report. The thesis has further shown that when the final decisions were taken, the transparency ended. Further research could investigate if this is the same in other cases. Due to this lack of transparency in the end, the methodology used in this thesis cannot provide specific explanations of how the decisions were taken. Similar research on IMO processes must take this possibility into account and use interviews with as many participants as possible. We can also learn that IMO faces growing demand to deal with the increasing number of documents and information. The process could either be slowed down or end up with hastened decisions with consequent criticism. It is further difficult to gain access to IMO documents, in particular old prints. This thesis thus highlights the contents of documents of an organization that is relatively un-transparent and difficult to understand by its complicated procedures. It thus highlights 'what goes on' at IMO to researchers, Governments, industry, NGOs and the public.

The thesis is also a case study on how industry interests affect environmental policy-making and decisions in international deliberations. We have learned that interests, in particular those of the oil industry, have played a significant role in this process. Whether it is the same in other IMO processes is a subject for further study. It also raises the question of whether the strong influences of industry are unique to this specific environmental issue. Is it the same for other air pollutants or emissions sources? The thesis could also contribute to the history and effectiveness of the air pollution regime, as MARPOL Annex VI could be included in this regime with the regulation of air pollution from ships. Finally, the holistic, interdisciplinary approach used could inspire researchers to conduct research by not locking themselves into a theoretical box. It takes at least three frames of reference to study a case like this, or none at all.

8. Conclusions

This thesis investigated IMO documentation to describe the developments of the global sulphur regulation in MARPOL Annex VI. The analysis was then supplemented with literature and personal communication. On the first research question, it was concluded that the agreement on a 4.5% global cap was the result of the following key factors:

- International agreements on land-based sources drew the Governments' attention to unregulated ship emissions.
- Efforts by the North Sea States to reduce acidification emanating from ship emissions through IMO
- The removal of the initial targets from the Assembly resolution
- The importance to the oil industry and oil-producing States of protecting the market of residual fuels
- Presentations of enormous cost figures for the oil industry and oil-exporting States from global, stringent measures
- Concerns of high fuel costs with higher costs of maritime transportation
- Lack of support for a global solution due to these costs.
- A regional solution would be accepted by the oil industry and provide for reductions in the areas in which the States that most needed reductions were located.
- A cap would prevent the global sulphur content from increasing.
- Resistance and lack of support for a stringent global cap
- The 4.5% cap was seen as a first global step, and it could be amended in the future.
- Monitoring of the global average sulphur content would provide a framework for future work.

It was concluded that the introduction of a regional approach was due to the lack of support for a global solution. The critical loads concept was used as an argument but not as the main reason. It was further concluded that this thesis could contribute to a more representative understanding of the use of the term *capping*. A global cap was not introduced to reduce the global emissions but to prevent a possible increase in the sulphur content. The early proposed 3% could at least be motivated by this reason. If, however, the cap had been set at 5%, it would not have had this effect. It was concluded that a 4.5% cap was very close to this ineffectiveness. A 4.5% global cap only had the motivation that it was a first step in a global regulation that could be amended in the future. It was better to have something than nothing at all.

On the second research question, it was concluded that the agreement on a revised global cap of 0.5% in 2020 was a result of the following key factors:

- Dissatisfaction with a negligible global cap and the implications for the shipping industry of using SECAs
- The EU endeavour to reduce health problems associated with ship emissions and threats of unilateral action
- The INTERTANKO proposal on a global switch to distillates and a 0.5% global cap
- The oil industry's and oil-producing States' endeavour to keep the SECA concept
- The high costs for the oil industry of stringent global measures
- The even higher social costs of PM emissions based on the Corbett study
- Compromise proposals on stringent measures in SECAs

- The importance of reaching consensus in a limited time frame
  - To show that IMO was capable of taking significant action against air pollution from ships
  - To prevent unilateral action

It was concluded that the health effects of PM emissions were one of the main reasons for revising the sulphur requirements into stricter limits. This was due to the close relationship between the PM emissions and the sulphur content. Nevertheless, high costs for the oil industry made IMO focus on keeping the SECA approach. The result was a compromise with stringent SECA limits and a global cap that would become stringent after a review of the ability of the oil industry to supply enough quantities of distillate fuels.

The main conclusion of 20 years of IMO documentation is that the global cap is still negligible today even after the revision. The initial target was to halve global SO_2 emissions by 2000. To achieve this, a 1-1.5% global sulphur content limit could have been introduced. Even though the average sulphur content had been about 2.7% before the revision, the permitted IMO limit is still 4.5% today and will be 3.5% from next year and up to 2020 (or possibly 2025 depending on the review in 2018). As we have seen, the 3.5% limit was concluded not to lead to any reductions worth mentioning already in 1993. The global sulphur limits of this decade will thus be remembered as the limits considered to be negligible two decades earlier. What will become of it next depends on whether the policy-makers are aware of this history and decide to take different approaches.

The cap still has no effect and should not be interpreted as an emission ceiling until the future reveals its results. The effects of 20 years of air pollution considerations at IMO will not be seen globally until 2020 or possibly 2025. If so, the implementation of global, stringent measures will occur 25 years after the initial target date (2000) and 37 years after the air pollution consideration began at IMO. Given that it took 20 years to achieve it and that the criticism is even louder today, it is possible that the debates will appear once again at IMO in connection with the review. The story told in this thesis is thus likely to continue in 2018. Given that it is now more profitable to convert residuals into distillates (due to the higher value), it is possible that the switch to distillates of the world fleet will occur when the oil industry has adapted to the market mechanisms and not through international regulations. In this case, IMO will have failed.

The first act showed that the shipping industry took the same positions as the oil industry many times. It resulted in a regional regulation that was hard to remove once it had been agreed on. Despite early complaints during the revision that a global approach was the only solution, the SECA approach was later accepted by Governments and the shipping industry, which were previously against it. This has resulted in the shipping industry itself having partial responsibility for the decisions that it now criticizes Governments for. Finally, a main thing to learn from this thesis is that a decision must be seen in its historical contexts. The focus of the northern hemisphere on the air pollution regime is an important factor explaining the acceptance of moderate global regulation and stringent regional regulation. It is the highest hope of this author that Governments and the shipping industry can learn from this thesis and take environmental decisions for shipping more effectively through IMO.

9. Further Research

This thesis has focused on the developments behind the global gap in Regulation 14 of MARPOL Annex VI. The results of also provide a scattered story behind the SECA regulations. This thesis thus provides a framework for further research on the story behind the sulphur requirements in MARPOL Annex VI, i.e., the complete Regulation 14 and interconnected requirements such as Regulation 18. The thesis has also shown that the story of sulphur regulations in MARPOL Annex VI is a story dominated by oil industry interests. The shipping industry took the same positions as the oil industry many times, and other times it had the opposite views. An observed pattern in the investigated documents is that the shipping industry's interests were put aside when the final decisions were taken. As the SECA requirements today are subject to big debates on the implications for shipping in Europe, the shipping industry's role in the process needs further study. The proposed research would thus be devoted to studying the relationships between a selection of interests and actors during the process. The results could thus contribute to understanding why IMO made decisions that are so highly debated today. It could also be seen as a case study that would contribute to a deeper understanding of environmental policy-making at IMO.

Tan (2006) and Boisson (1999) highlighted differences between regulating shipping and other industries and that IMO differs from other international organizations. Further research could thus focus on studying the relationship between the policy-makers and the industry when considering environmental issues at IMO compared with other international organizations, preferably within the UN System.

The third identified frame of reference, Economics and Business, has merely been touched upon in this thesis. It was concluded that this is a subject for further research. A suggestion is that the focus is put on the impacts on the shipping industry of the different options proposed during the story, or parts of it, as it has not been treated equally to the oil industry at IMO. Although the three frames represent the sulphur deliberations in IMO, they could equally be applied to other air pollutants, e.g., NO_x. A suggestion for further research is to use the approach by Allison and analyse a similar process in IMO using these three frames of reference and three case studies with research questions based on each frame.

Finally, if this thesis were to be reproduced to apply to, for example, the NO_x regulations in Annex VI, the use of a reversed methodology would be recommended. A top-down approach would provide guidance on which documents and information were most significant to the final decisions. Simply start by investigating the documentation of the Plenary adoption at MEPC 58 and identify significant events and positions. Next, work your way down through the documentation history with this guidance. This could prevent confusion on which documentation to investigate in detail and which information is relevant to write about. This would reduce the workload and prevent texts that are too detailed. This thesis could be used as guidance and to identify common developments.

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PERSONAL COMMUNICATIONS

Roger Karlsson, phone conversation, 22.2.2011.

- Representative for safety and environmental matters for the Swedish Shipowners' Association, 1995-2000.
- Participated at MEPC the same years, as Adviser to the Swedish delegation.

Stefan Lemieszewski, phone conversation, 30.3.2011.

- Swedish Maritime Administration, Norrköping Sweden.
- Delegate at IMO during the whole story of Annex VI, and was particularly active in the air pollution considerations and relevant working groups.

Christer Ågren, phone conversation, 17.2.2011 and 29.3.2011.

- Air Pollution & Climate Secretariat (AirClim, formerly the Swedish NGO Secretariat on Acid Rain), Gothenburg, Sweden.
- Participated at MEPC during the revision and has been following air pollution from ships earlier with his work under the European Commission and AirClim.

Carl Carlsson, conversation at Chalmers, 1.4.2011.

- Swedish Shipowners' Association, Head of Unit, Environment and Sustainability.
- Participated at MEPC 57-MEPC 58, as Adviser to the Swedish delegation.

Annex. Grouping of Policy Options at BLG 11

The following matrix reproduces Annex 4 to BLG 11/WP.4 (minor editorial changes).

	GLOBAL/AREA-BASED STANDARDS			GLOBALLY BASED STANDARDS	
REFERENCE BASELINE	**OPTION B: CHANGE TO SECA REQUIREMENTS**	**OPTION B1: PROPOSAL BY THE UNITED STATES**	**OPTION B2: PROPOSAL BY BIMCO**	**OPTION C: CHANGE TO DISTILLATE FUELS**	**OPTION C2: ALTERNATIVE MECHANISMS**
Description					
Current requirements of Regulation 14	Keep the current structure of Regulation 14 with: - A Global sulphur cap (unchanged or lowered) - SECA sulphur cap lowered in two tiers as follows: • 1.0% in [2010] • 0.5% in [2015]	Defined areas [x miles from shore] effective in [2011]: - SO_x [0.4 g/kW-hr] or use a distillate fuel with a sulphur level not exceeding [0.1]% - Shipowners may choose to comply through the use of low-sulphur distillate fuel and/or the use of exhaust gas cleaning technology. PM limits: - [0.50] g/kW-hr for engines with a per-cylinder displacement of 15 litres or more; - [0.27] g/kW-hr for engines with a per-cylinder displacement of 5 litres but less than 15 litres; and - [0.20] g/kW-hr for engines with a per-cylinder displacement of less than 5 litres.	Gradually lowering of the global cap sulphur content as follows: - Max 3.0% in 2012 - Max 1.5% in 2016 - Or use of alternative mechanisms (such as exhaust gas cleaning systems) to obtain equivalent levels of emission reduction. Requiring use of distillate in SECAs, port areas and estuaries, with gradual lowering of the sulphur content as follows: - Max 1.0% in 2011 - Max 0.5% in 2015 - Or use of alternative mechanisms (such as an exhaust gas cleaning systems) to obtain equivalent levels of emission reduction	This is a fuel solution that would require: - Use of distillate fuels for all ships as follows - A Global sulphur cap: • 1.0% in [2012] • 0.5% in [2015] - Include in MARPOL Annex VI the specification for the distillate fuel to be used by ships.	Global caps as specified in Option C but allowance for alternative mechanisms (such as an exhaust gas cleaning system) in combination with residual fuel oil with a higher sulphur content (maximum 4.50% m/m or lower) to obtain an equivalent level of emission reduction as in C for SO_x and PM.