THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Sulphur Regulations for Shipping – Why a Regional Approach?

Scientific and Economic Arguments in IMO Documents 1988-1997

ERIK SVENSSON

Department of Shipping and Marine Technology
CHALMERS UNIVERSITY OF TECHNOLOGY

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ERIK SVENSSON
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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

Some environmental issues for shipping are regulated globally with uniform standards and others with stricter regulations in specific areas. This thesis aims to provide an understanding of why a regional approach was chosen with *SO_x Emission Control Areas* (SECAs) as the main form of control of sulphur oxide emissions from international shipping, with explanations based on documents from negotiations within the *International Maritime Organization* (IMO) during 1988-1997. The documents were investigated in search of scientific and economic arguments (including supportive information and reported discussions). These were analysed through two 'conceptual lenses' to provide different explanations, focusing on the roles of science and economic interests. These lenses were expected to show many explanatory differences, but significant interactions were found.

It was found that the Marine Environment Protection Committee of the IMO faced great scientific uncertainty on ship emissions and their contribution to acidification on land. This allowed for an increased role of economic interests, in particular when the Sub-Committee on Bulk Chemicals Handling began drafting regulations for Annex VI to the MARPOL Convention. The actors' interests decided the policy relevance of science, which was used by the environmental and economic interests to compete rather than to enable consensus. Based on the economic interests of the actors that caused the problem and that would bear the costs of regulation, a science-critical policy environment emerged in which these actors showed as low a contribution as possible to acidification from shipping and extreme economic implications. The focus on the high costs for the oil industry and, in turn, higher fuel costs for shipping, was found to be the primary factor in explaining the regional approach. It was emphasized that economic self-interests are paramount in understanding both the economic and the scientific arguments and the way these could shape policy-making through the power of persuasion. Scientific arguments and claims were used to justify views with underlying economic arguments, which were strengthened with legitimacy. The IMO principles of a compelling need and taking into account costs and economic implications were the primary causes of the cost focus and the critical policy environment. This is a lesson for future policy issues in terms of achieving a balance between industry interests and environmental interests.

This thesis' empirical contribution is based on a large quantity of documents that revealed the scientific and economic basis of different actors' policies and the policy choices and decisions made by two bodies of the IMO. It contributes theoretically by viewing an international environmental policy-making process through different conceptual lenses. In order to understand why policy-makers in some cases follow the path of environmental protection based on scientific claims and in others follow the path of economic self-interests, we need to take into account both with different conceptual lenses.

Keywords: IMO, MARPOL, Annex VI, regional approach, SECA, SO_x, international, shipping, environmental policy-making, conceptual lens, science, framing, policy environment, economic interests, directional problem, distribution, costs, benefits

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My research involved crossing disciplines, which has been a real challenge. I have met many arguments among different traditional disciplines that my research area should be studied with just their methodologies and within just their way of thinking. The more I explored, however, the more I realized that what was missing among these disciplines was an attitude of openness to other thinking. The ways of thinking have been locked in traditions and norms within disciplinary boundaries that have to be followed in order to become a respected researcher. But like Frank Zappa said, *progress is not possible without deviation from the norm. To* deviate and stand up for your way is a necessity when conducting cross-disciplinary research.

This realization and deviation from the norm was derived from discussions with Thomas Polesie, whose words I did not really understand the first year under his supervision. A common confusion has been that he sees connections to things that others, like me back then, would discard as irrelevant to the research. But doing some reading of the many books and references to books he has given over the years changed it all. His former strange words and ideas became clearer and clearer, and today I look back to things he said to me five years ago and wonder why I did not understand. Thomas seemed to have seen my confusion among disciplines and pushed me towards with self-confidence to stand up for myself. Thomas has been a mentor and a true friend guiding me in difficult times and simplifying complex phenomena. He has faithfully called me on late hours to see how it was going and how I was doing, as well as given me personal advice on many different things. I am very grateful.

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1 Introduction

Some environmental issues for shipping are regulated globally with uniform standards and others by regional approaches with stricter regulations in specific areas. This thesis addresses what we can learn from the documents of international negotiations during 1988-1997 that resulted in a regional approach to address *sulphur oxides* (SO_x) emissions from ships. The following sections present a background to international shipping, SO_x emissions, sulphur regulations and the problem of a regional approach. This is followed by the aim, research questions, objectives and delimitations of this thesis, along with an outline of the structure.

1.1 International Shipping and a Level Playing Field

Shipping is a truly international industry and an engine of world trade. About 80% of the world trade volumes are transported by sea (Stopford, 1997; UNCTAD, 2013). The shipping industry is global not only in terms of ship movements but also in its complex global web of companies in different countries. An owner in one country could register its ships in a second, its crew could be from a third, the charterer from a fourth, and so on. Due to the international nature of shipping, it is regulated by an extensive variety of conventions and other international agreements. A frequent argument in the development of international maritime regulation has been to ensure a 'level playing field'. As ships sail on international routes, it is important to harmonize the diversity of national rules that would otherwise apply to a ship on its journey across the waters of many countries. Regional and *unilateral*[1] regulation complicates ship operations with different rules and certificates in different waters, which in turn affects industries dependent on sea transport in a highly globalized world (Stopford, 1997; Boisson, 1999; Campe, 2009). The *International Maritime Organization* (IMO) is the responsible international body for measures on safety, security and pollution prevention for international shipping. Since its start, the IMO has been advocating the principle of a level playing field with universal standards to be implemented and enforced on all ships, irrespective of which flag they sail under (IMO, 2014a; MEPC 58/INF.24). Its role is officially described as creating a level playing field for shipping by a "fair and effective, universally adopted and universally implemented" regulatory framework (IMO, 2014a).

1.2 SO_x Emissions from International Shipping and MARPOL Annex VI

Emissions of *sulphur oxides* (SO_x) are primarily associated with relatively high sulphur contents in fossil fuels (Smith et al., 2011). During combustion, the sulphur (S) in the fuel reacts with oxygen gas (O_2) and forms different oxides of sulphur. The abbreviation SO_x is often used for *sulphur dioxide* (SO_2) and *sulphur trioxide* (SO_3), but almost all of the sulphur is emitted as SO_2 (Finlayson-Pitts and Pitts, 2000; Agrawal et al., 2008). Since the 1970s, much attention has been given to reducing SO_x emissions, primarily in Europe and North America. For many years, the attention was directed at an environmental problem known as 'acid rain', i.e. acidification. Today, there is more emphasis on health problems and climate impacts associated with the atmospheric formation of *particulate matter* (PM) (Vestreng et al., 2007). SO_x emissions further cause significant damage to buildings and structures and thus incur significant economic costs (Warfvinge and Bertills, 2000). The impacts and atmospheric processes of SO_x emissions are briefly described in Annex 1 of this thesis.

[1] One-sided requirements taken by a single State or union

With absence of exhaust gas cleaning on board, the amount of SO_x emissions from ships depends solely on the sulphur content of the fuel (Corbett and Fischbeck, 1997). The main fuel powering the international fleet is *heavy fuel oil* (HFO), which is a mix of residues from the refinery processes to produce lighter high-quality products. The term *residual fuel* is thus often used. In general, the sulphur content is above 1%[2] (<5%), though this is dependent on the sulphur content of the crude oil, which varies in different regions of the world (Winnes, 2010; CONCAWE, 1998; Bengtsson et al., 2011). Of the approximate 277 million tonnes (mt) of fuels consumed by international shipping in 2007, approximately 213 mt were HFO. The remaining 64 mt were distillate fuels (Buhaug et al., 2009); e.g. *marine gas oil* (MGO)[3]. Some refineries produce MGO with sulphur contents below 0.5% (Bengtsson et al., 2011).

Due to the correlation between sulphur content and emissions, increased shipping activity has resulted in increased SO_x emissions while land-based emissions, primarily in Europe and North America, have decreased as result of abatement measures and international agreements.[4] Smith et al. (2011) found that global SO_2 emissions fell significantly until the beginning of the 21th century but increased between 2002 and 2005. Although China and developing countries in general represented a major part of this increase, emissions from international shipping have represented a significant contribution with a steady increase. Dalsøren et al. (2009) found that shipping contributed 15-25% of the sulphur deposition in Northwestern North America and Scandinavia, and 15-20% in Southwestern Europe and Northwestern Africa. The total global contribution of shipping to *wet deposition*[5] of sulphur was found to be 4.5%. Corbett et al. (2007) found that the health impacts from ships' PM emissions were concentrated in the coastal regions along the major trade routes around the world. It was estimated that ship emissions caused about 60,000 premature deaths annually.

The MARPOL Convention (MARPOL 73/78)[6] is the main international convention to prevent and minimize marine pollution from ships. It consists of a set of regulations in six annexes. Annex VI (Prevention of Air Pollution from Ships) was adopted in 1997 after IMO negotiations had been held since 1988. Regulation 14 of Annex VI addresses SO_x emissions with a global limit on 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). The sulphur content was limited to 4.5% globally 1.5% in SECAs. An alternative to reduce SO_x emissions in SECAs was to use an exhaust gas cleaning system or other on-board abatement technologies. It would take until 2005 before Annex VI entered into force. During this period, SO_x emissions from ships increased due to the increase in shipping activity. Awareness of the health effects also increased, primarily in the EU and the USA. A revision process was decided on in 2004 and the revised Annex VI was adopted in 2008 (IMO, 2014b, c; MP/CONF. 3/34; Svensson, 2011, and references therein).

With the revised Annex VI, the sulphur content of bunker fuels was set to be reduced progressively from 2010 to 2020 as illustrated in Figure 1.1. The initial 4.5% global cap was first reduced to 3.5% from the 1st of January 2012, and this is set to be followed by 0.5% from the 1st of January 2020. However, the latter date is dependent on the results of a review in

[2] Percentage by mass, i.e. $m_{sulphur}/m_{fuel}$.
[3] Also, marine diesel oil (MDO) is a blend of HFO and MGO (Bengtsson et al., 2011)
[4] In the EU-27, SO_x emissions decreased by 82% between 1990 and 2010 (European Environment Agency, 2012). The corresponding figure for the US was about 61%. (USEPA, 2014).
[5] See Annex 1.
[6] *International Convention for the Prevention of Pollution from Ships, 1973*, as modified by the Protocol of 1978 relating thereto.

2018 on the availability of compliant fuel oil for 2020. If the parties to Annex VI conclude from this review that it is not possible for ships to comply by 2020 it can decide to extend the date to the 1st of January 2025. For SECAs, the sulphur limit was set to 1.0% from the 1st of July 2010 followed by 0.1% from the 1st of January 2015 (Reg. 14, Res. MEPC.176(58)). The 2008 amendment entered into force on the 1st of July 2010. Since then, the SECA concept has expanded to include further pollutants[7] with the term *Emission Control Area* (ECA). As shown in Figure 1.2, the present ECAs are in the Baltic Sea (effective since 2006), the North Sea and the English Channel (effective since 2007), around the coastlines of North America (effective since 2012) and a small area in the Caribbean Sea controlled by the US (effective from 2014) (IMO, 2014c,d). No application for further ECAs has yet been submitted to the IMO (as of April 2014, submitted MEPC documents, Swedish Transport Agency, 2014).

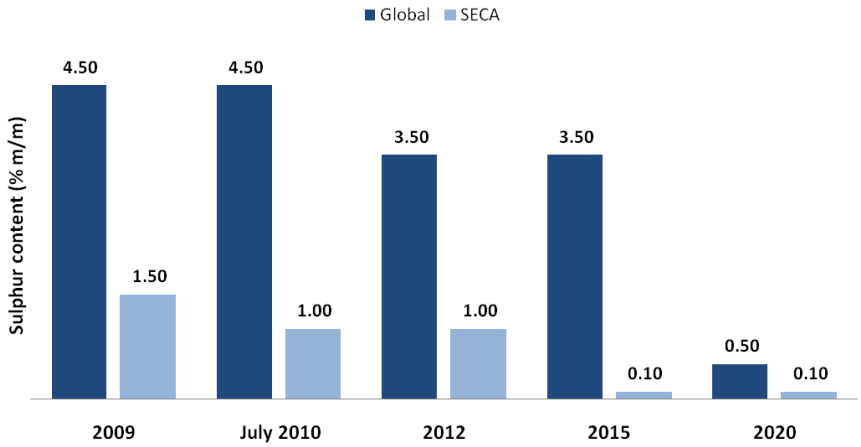


Figure 1.1. Revised MARPOL Annex VI Sulphur Limits for Bunker Fuels (Reg. 14, Res. MEPC.176(58))

Figure 1.2. Emission Control Areas (from: Neumeier, 2014, with permission)

1.3 A Regional Approach: Problems and Puzzling Policy Choices

The implications of the SECA regulations were heavily debated after the adoption of the revised Annex VI, primarily in Europe and increasingly in the US, as the effective date of the North American ECA approached. A number of consequence analyses have been conducted

[7] The North American ECA and the United States Caribbean Sea ECA include NO_x, SO_x and PM. PM emissions are currently merely regulated as a result of the reduction in sulphur content.

by governments and associations. These studies show various implications for the shipping industry and sea transport-dependent industries located around SECAs due to the increased costs of maritime transport in SECAs against cheaper transport around the world. There has been particular emphasis on the implications for short sea shipping, as it forms a significant part of the transport logistic chain in the countries surrounding SECAs (EMSA, 2010; personal observations 2010-2014). The European Maritime Safety Agency (EMSA, 2010) reviewed seven consequence analyses. All the reviewed studies estimated fuel price increases for ships within SECAs in 2015. The required switch from fuels with 1.5% sulphur content – of mostly HFO – to MGO with 0.1% sulphur content could result in a fuel price increase in the range of 65-85%. Another review of six studies was conducted the same year by Entec (2010). This review estimated an 80% fuel cost increase and predicted a significant shift from short sea shipping to land transport (so-called modal shift) at 3-50% of freight volumes. The review by EMSA (2010) instead concluded that a modal shift would be limited to a few specific routes and price scenarios. A year later, the European Commission (2011, p. 70) concluded that it was clear that "short sea shipping will experience increased costs and competition from road, rail and deep sea shipping".

A later Swedish study (Trafikanalys, 2013) showed a 50-75% increase in fuel costs from the 0.1% limit in 2015 compared with the costs of the 1% limit that took effect in July 2010. A study on the implications in the UK (AMEC, 2013) also indicated a modal shift representing 1.3-3.6 million tonnes of freight. As mentioned above, increased fuel prices for shipping mean increased transportation costs for sea transport-dependent industries located around SECAs compared with cheaper transport around the world. Trafikanalys (2013) highlighted an increase in transportation costs per ton for paper of about 10% from the northern parts of Sweden to the UK and Benelux, and about 3% for steel transported from central Sweden to Denmark. AMEC (2013, p. v) found that "as many as 2,000 full time, part time and contract positions are likely to be at risk in the UK and on the continent".

With regard to environmental and social benefits of the sulphur regulations, Brandt et al. (2011) estimated a small decrease in external costs due to the health impacts in Europe between 2007 and 2011, but the costs were then expected to increase to 64 billion euro in 2020 due to increased shipping activity. Mestl et al. (2013) found that today's global limit of 3.5% had not yet been effective in reducing the emissions or the global average sulphur content. It was speculated that Regulation 14 might have resulted in some environmental benefits locally but not globally. Moreover, "no reduction worth mentioning" (Mestl et al., 2013, p. 6100) could be expected with this cap as long as blending of low-sulphur HFO and high-sulphur HFO can occur. Any global reductions would not be shown until the cap goes below the global average, i.e. below 2.7% (ibid.). To clarify, this means 2020 or 2025 depending on the review. Mestl et al. (2013) further expected an increase of SO_x emissions until then due to the growth of shipping.

Why are SO_x emissions from international shipping regulated with SECAs as the main control of the emissions? According to Tan, (2006, p. 75), "no analytical account of shipping regulation is complete without examining the work of IMO" (Tan, 2006, p. 75). Moreover, Birnie et al. (2009, p. 12) emphasized that "understanding of the sources and the lawmaking processes" is "crucial to any assessment of the current state of international environmental law". In the previous work of a licentiate thesis, I investigated documents of IMO negotiations during 1988-2008. I found that a crucial turning point towards regional SECA regulations occurred in 1992 at the 22nd session of the *Sub-Committee on Bulk Chemicals Handling* (BCH). It was a sub-committee to the main committee for environmental issues: the

Marine Environment Protection Committee (MEPC). The BCH developed a framework for regional control of SO_x emissions despite the MEPC having agreed on a target to halve the emissions globally by the year 2000. This started a first consideration of emission control measures within a defined regional concept, and a combination of stricter SECAs and a global cap was eventually adopted in 1997. This combined approach was then maintained in the revision process (2006-2008). It is therefore central to this thesis to investigate the documents of the first process in more depth.

1.4 Aim, Research Questions and Objectives

The **aim** of this thesis is to provide an understanding of why a regional approach was chosen to control SO_x emissions from international shipping through explanations based on IMO documents, focusing on the roles of science and economic interests.

An explanation of the following **research questions** is central to this aim:

1. *Why did the BCH sub-committee change the focus to regional measures for SO_x emissions when the main committee MEPC had a global reduction target?*

2. *Why was a combination of stricter SECA limits and a global cap adopted in 1997?*

The thesis is based on the premise that explanations provided by a conceptual framework are limited by the framework's basic assumptions (see Section 3.1). This thesis focuses on what roles science and economic interests have been given in the policy-making process and how these roles could explain the research questions.[8] Two conceptual lenses, described in Chapter 3, form the basis for providing such explanations. To achieve the above aim, the following have been the **main objectives** of this thesis:

- *Guided by the research questions and respective conceptual lens, to investigate the documented scientific and economic arguments – including supportive information and reported discussions – from IMO negotiations during 1988-1997.*

- *To provide two explanations for the research questions by analysing the respective empirical results with the corresponding conceptual basis on the role of science and economic interests respectively.*

1.5 Scope and Delimitations

The studied policy-making process encompasses the years 1988-1997. The thesis is delimited to the work of the IMO (MEPC and the BCH Sub-Committee) and includes the (third) diplomatic Conference on Marine Pollution in 1997. The empirical basis was delimited to what was reported in the investigated IMO documents. Domestic politics, economic and scientific aspects within individual member States and actions of individual actors are not within the scope of the research. The thesis is further delimited to discussions on sulphur content reductions and thus excludes early discussions on other reduction alternatives (e.g. scrubbers). There is also a clear delimitation to the specific SO_x emission regulations in

[8] My previous work (Svensson, 2011) highlights the importance of, on the one hand, the natural science behind the needs for regulation and, on the other, the economic interests affected by such regulation.

MARPOL Annex VI, i.e. Regulation 14. Discussions on other interlinked regulations, such as Regulations 4, 17 and 18 were excluded from investigation.

1.6 Outline of the Thesis

This thesis is structured in eight chapters. *The next chapter* provides a background that introduces the reader to the IMO and the studied process. It focuses on the functions of the IMO, the actors involved, the procedures of adopting and amending conventions and relevant earlier research. *Chapter 3* then describes the theoretical framework of two conceptual lenses, providing the conceptual basis for analysis. *Chapter 4* proceeds with presenting the methodology of the thesis.

The thesis's empirical contributions are presented in Chapters 5 and 6. *Chapter 5* investigates the role of science and *Chapter 6* the role of economic interests. *Chapter 7* analyses and discusses the empirical findings for each conceptual lens and then discusses connections and differences between the two explanations. This is followed by discussions on methodological and theoretical implications, as well as research contributions. C*hapter 8* concludes, presents recommendations to policy-makers and stakeholders, and ends the thesis with propositions for further research. Annex 1 is recommended as guidance for readers unfamiliar with atmospheric processes and impacts of SO_x emissions.

2 Background

This chapter introduces the purpose, functions and structure of the IMO, followed by a brief overview of the actors and interests involved in environmental issues at the IMO. It then describes the procedures for adopting and amending IMO conventions and introduces the studied process. The chapter ends by highlighting relevant earlier research.

2.1 IMO: A Specialized UN Agency

Under the Economic and Social Council of the *United Nations* (UN), there are 15 *specialized agencies* that have legal and financial independence and function under specified conditions[9] (United Nations 2013; Boisson, 1999). These are generally concerned with international standard setting, developing treaties of a technical character (Birnie et al., 2009). The *International Maritime Organization* (IMO) is such a specialized UN agency. Officially, the IMO is described as a "global standard-setting authority" (IMO, 2014a), though the role of the IMO should not be viewed as an 'authority' but rather as a forum in which States can discuss, negotiate and take common decisions on maritime regulation. The convention that established the IMO in 1948 (Convention on the International Maritime Organization, 1948) provides its purpose and functions as shown in Annex 3 of this thesis. The IMO's main function is to develop draft conventions that are recommended to States for adoption at international diplomatic conferences. An equally important part of the IMO's work – or an even bigger part of its agenda – is to amend existing conventions. The IMO also develops a variety of codes, guidelines, resolutions and recommendations that are not legally binding. Although they are not binding, conventions can refer to guidelines that need to be taken into account, and 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 (Convention on the International Maritime Organization, 1948, article 2a,b; Tan, 2006; Boisson, 1999; Harrison, 2011).

The IMO has grown significantly since its first meeting in 1959, and today it is a very different organization. The changes reflect not only the development of the maritime industry but also of the politics over the years. It was initially established for a shipping industry that had been dominated by major maritime nations for centuries. Maritime conventions such as the 1974 *International Convention for the Safety of Life at Sea* (SOLAS) have their origins in the UK's dominance as a maritime nation, and it is not a coincidence that the headquarters of the IMO are located in London. Today, however, the developing countries represent the majority of its member States and – with the exception of the Council – the IMO's bodies are open to all members (IMO, 2014e, 1998a; Boisson, 1999; Tan, 2006; Harvey, 2012).

The **Assembly** is the governing body of the IMO, and its main task concerns the functioning of the organization, such as deciding on the rules of procedure and financial arrangements. All member States are included, and they meet in regular sessions once every two years, though it can also hold additional sessions. The **Council** is IMO's executive body under the Assembly with the main task of supervising the work of the organization. Except for the reserved right of the Assembly to make recommendations on maritime safety and pollution prevention to its member States, the Council has the same functions as the Assembly during the time between

[9] The conditions are set in Article 63 of the United Nations Charter – the treaty of the United Nations signed on June 26, 1945.

Assembly sessions. Its other functions include coordinating the activities of the IMO's bodies and commenting on and making recommendations on their reports to the Assembly and the member States. The Council consists of representatives from 40 member States that are elected by the Assembly for two-year terms and 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 and that represent the world's main geographical areas (IMO, 2014f). Hence, shipping and trade interests have particular influence at the IMO through the Council where coastal States claiming their rights to protect their environments (see Section 2.2) are underrepresented (Campe, 2009). This is a result of strong pressures to protect the interests of the traditional maritime nations under the conference establishing the IMO in 1948. They were concerned that the users of shipping services would create standards in the name of safety that were "over-constricting and over-expensive" (Boisson, 1999, p. 62). The solution was restricted membership of the Council and to assign it with significant powers. The initial criteria for membership were thus the supply of shipping services and interests in international seaborne trade. To increase the democracy of the IMO, the third category was introduced and the membership increased (ibid.).

The main work of the IMO is conducted in **five committees**: *Maritime Safety Committee* (MSC), *Marine Environment Protection Committee* (MEPC), *Legal Committee* (LEG), *Technical Co-operation Committee* (TC) and *Facilitation Committee* (FAL). These are assisted by **seven sub-committees**. In short, the committees are the arenas where decisions are made and most political negotiations take place, while the sub-committees are given instructions to conduct technical work and report back with proposed actions. This technical work is also a policy-making process with negotiations at a detailed technical level, but the main policy issues are dealt with by the committees. **The MEPC** is the main IMO body on environmental issues, with consideration of all IMO matters on prevention and control of pollution from ships. Its main task is to develop conventions and other instruments for adoption and to amend existing instruments. Like the other committees, the MEPC consists of all the member States. The MEPC and the MSC are assisted by the seven sub-committees. **The MSC** is IMO's highest technical body. Its function is to consider all the maritime safety matters of the IMO. Besides adopting amendments to conventions, such as SOLAS, it develops safety recommendations and guidelines that could be adopted by the Assembly (IMO, 2014f; observations from investigated documents; Svensson, 2011).

The structure of the sub-committees has changed over the years. In the studied process of this thesis, the *Sub-Committee on Bulk Chemicals* (BCH) conducted the technical work on many environmental issues, including drafting MARPOL Annex VI. The environmental work of this sub-committee was replaced by the *Sub-Committee on Bulk Liquids and Gases* (BLG) during 1995-2013, and it was once again replaced by the *Sub-Committee on Pollution Prevention and Response* (PPR) (ibid.). The MEPC and the BCH are the most important IMO bodies for this thesis. Some decisions also had to go through formal approvals by the Assembly, the Council and the MSC.

The IMO has its headquarters in London with a **Secretariat** consisting of about 300 technical and administrative staff under the secretary-general. This makes IMO the smallest agency in the UN System. The Secretariat has six divisions focusing on safety at sea, the marine environment, legal affairs and external relations, conferences, technical cooperation and administrative affairs (IMO, 2014f; Boisson, 1999). Campe (2009) viewed the Secretariat as a

'broker' between the member States. Its most important function is to facilitate negotiations and discussions. It is service-oriented – serving member States rather than being driven by a policy agenda – and provides a policy-making arena for the members, with administrative functions such as preparing and holding meetings, collecting documents and pooling technical information, distributing submitted documents, briefing the chairmen, providing information on legal issues, drafting agendas, writing reports and working papers, providing interpreters, etc. Another significant function is to finalize and publish convention texts, guidelines, codes, manuals, etc. in several UN languages. The sales of these publications are part of financing the IMO (Campe, 2009; IMO, 2014f; Boisson, 1999).

2.2 Actors and Interests of IMO Negotiations

The member States of the IMO are the actors with decision-making powers. At the present, the IMO has 170 member States. In addition, Hong Kong and Macao in China, and the Faroe Islands in Denmark are associate members (IMO, 2014g). A basic division between *maritime States* with maritime interests and *coastal States* with interests in environmental protection is central to understanding the regulation of marine pollution from ships, which is characterized by a political contest between these States (Tan, 2006). The **coastal States** are "shoreline states that seek to regulate the movement and activities of foreign vessels in or near the waters adjacent to their coasts" (Tan, 2006, p. 30). A coastal State is also defined as the State in whose waters a vessel sails. Ships in a coastal State's waters oblige themselves to follow the coastal State's national laws (Stopford, 1997). The coastal States assert the right to environmental protection of their coasts and waters and thus seek to protect their waters and coasts by strict regulation of ships. Historically, they have been the primary initiators of environmental regulation for shipping (in particular Canada and Australia). Today, however, many developed countries that were previously large maritime States – e.g. Western European countries and the US – have joined the coastal States in prioritizing environmental protection. The **maritime States** traditionally emphasize freedom of navigation for all ships (Tan, 2006). For the broad concept of maritime States, I highlight three categories based on the suppliers and users of maritime services. These three categories are *flag States*, *States with maritime interests* and *States with interests in maritime trade*.

The flag States have the primary legal authority to control merchant shipping and thus primary responsibility for the regulation of pollution from ships. A flag State is the country that a ship is registered in and whose laws it is bound to follow, i.e. under whose flag it sails. A shipowner may choose to register its vessels through either national registers or open registers. A national registry virtually treats shipping companies as any other company within a country. Shipping companies are thus subject to the country's financial laws, corporate law and working conditions. Open registries are open to all nationalities to register their vessels. If costly environmental regulations appear in one country, a shipowner can simply register its ships in another, and many countries with open registries have as few regulations and as low taxes and registration fees as possible to attract registrations. The term *Flag of Convenience* (FOC) has therefore emerged, i.e. ships registered in these countries sail under flags of convenience. The majority of the merchant fleet by tonnage is today registered in open registries, with the largest fleets registered in Panama, Liberia and the Marshall Islands. All the funding for the IMO is provided by its member States, calculated in proportion to the size of its merchant fleet. The budget is thus largely financed by the major flag States with open registries. The top three contributors to the IMO budget for 2012 were thus Panama, Liberia and the Marshall Islands (Stopford, 1997; DeSombre, 2006; Tan, 2006; IMO, 2014g).

It is important to recognize that flag States only represent States where ships are registered, not the shipowners or other maritime industries. Alongside flag States, there are thus **States with maritime interests**. These States include the interests of maritime industries such as shipowners, charters, brokers, shipbuilding, etc. These industries are primarily located in developed countries, e.g. the US, the UK, Japan, and Western European countries such as Norway and Greece (Tan, 2006). There are also **States with interests in maritime trade**. Tan (2006) included these in the above maritime category, but I have chosen to separate them as users of maritime services as opposed to suppliers above. Such interests include a dependence on seaborne trade and transport. Even inland countries have interests in efficient seaborne trade in a globalized world driven by efficient world trade. Here, cargo owners are included in this category. Although petroleum interests can be included with oil companies as cargo owners, this thesis treats oil interests as a separate category due to the nature of the policy issue (including oil-producing/exporting States and bunker-supplying States; see Section 7.2).

A further significant division of the member States is between **developed** and **developing countries**. In the past, most of the developing countries had few maritime interests and had interests in environmental protection like coastal States. Today, developing countries represent the majority of open registries and account for a large proportion of the world's tonnage. Of the IMO membership, developing countries are in a majority, but the influence of developed countries is significantly greater. According to Tan (2006), the developed maritime States' influence is through participation in the Council and in their leadership and participation where the essential policy is conducted, with emphasis on IMO's various committees, sub-committees, working groups, etc. Developing countries often have low participation, small delegations and little expertise in technical issues due to lesser resources. Since the largest fleets are provided by developing countries, IMO's budget is also based on contributions from developing countries (Tan, 2006; Campe, 2009).

In addition to the member States, 63 inter-governmental organizations and 77 non-governmental organizations are IMO members. The **Inter-Governmental Organizations (IGOs)** have observer status at the IMO. Many are regional IGOs that act as coordinators of their member States at the IMO, e.g. the European Commission, the Helsinki Commission (HELCOM), the OSPAR Commission and the League of Arab States. Others include trade organizations, e.g. the *Organisation for Economic Co-operation and Development* (OECD), *Memorandums of Understanding* (MoUs), etc. (IMO, 2014g).

The **Non-Governmental Organizations (NGOs)** have consultative status at the IMO. An NGO can be defined as "any international organization which is not established by inter-governmental agreement" (Ahmed and Potter, 2006, p. 8). The level of allowed participation by NGOs and the opportunities for influence vary between international organizations. According to Peet (1994, p. 4), the IMO has been "more generous with respect to the opportunities for NGOs to be active", and Harrison (2011, p. 157) stated that NGOs "play a central role in the work of the IMO". No decision-making powers are given to NGOs, but their consultative status gives the rights to submit documents, to have a representative present at sessions of IMO bodies, to receive texts, to speak on any agenda item of interest (subject to approval of the IMO body concerned), etc. (IMO, 2014h, Rule 6). They participate in plenary sessions, and working and drafting groups, make statements and participate in formal discussions, have informal talks with delegates, etc. (Peet, 1994). The Council elects NGOs and regularly reviews their consultative status. Most are *industry NGOs* (INGOs), but the role of *environmental NGOs* (ENGOs) has become more important, in particular at the MEPC.

The following are examples of NGOs in IMO meetings (Boisson, 1999; IMO, 2014g; Harrison, 2011).

- Shipowners and ship operators
  - e.g. *International Chamber of Shipping* (ICS), *Baltic and International Maritime Council* (BIMCO), *International Association of Independent Tanker Owners* (INTERTANKO)
- Shippers and cargo owners
  - including oil industry organizations such as *Oil Companies International Marine Forum* (OCIMF)
- Industry standards organizations
  - e.g. *International Organization for Standardisation* (ISO)
- Classification societies
  - *International Association of Classification Societies* (IACS)
- Ports, terminals and port services
  - e.g. *International Association of Ports and Harbors* (IAPH)
- Environmental NGOs
  - e.g. *Friends of the Earth International* (FOEI), Greenpeace and *World-Wide Fund for Nature* (WWF)
- Shipbuilders, equipment manufacturers, insurers, maritime navigation services, legal associations, etc.

2.3 Adopting and Amending IMO Conventions

This section introduces the procedures of IMO negotiations. An overview of the working arrangements of the MEPC and its sub-committees is first presented. A description of the procedures leading up to the adoption of a new convention is then presented. Lastly, procedures of entry into force and amendments are addressed.

2.3.1 Working Arrangements

The following is based on observations from the investigation of IMO documents and from participating at BLG 15 in 2011[10] and MEPC 66 in 2014[11].

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. Provisional arrangements and a provisional agenda are made at the preceding session, and 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 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

[10] As adviser to the Swedish delegation, observing the 15th session of the Sub-Committee on Bulk Liquids and Gases (BLG 15), IMO Headquarters, London, 7-11 February 2011.
[11] As an invited guest, observing the 66th session of the Marine Environment Protection Committee (MEPC 66), IMO Headquarters, London, 31 March to 4 April 2014.

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 instructions to perform other tasks beyond an editorial nature, however. If further work is needed in order to meet the deadlines, 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 more participants. The report of an intersessional meeting is submitted to the forthcoming session of the concerned committee/sub-committee. A correspondence group is one 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.

As mentioned in Section 2.2, the policy-decisions are taken by the committees and the sub-committees are given instructions to conduct technical work. The report of a sub-committee ends with a list of proposed decisions to be taken by the committee (action points). The MEPC then considers the report and its action points. When all the action points have been decided, the report is 'approved in general'. In addition to this approval, each session of a committee or sub-committee ends with consideration of a draft report, paragraph by paragraph. The contents of a report thus needs approval at each session before the Secretariat can produce a final report.

In addition to the formal policy-making arenas, **informal talks** represent a significant part of policy-making. Much discussion and negotiation occur between the formal working hours of a session. With a two-hour lunch break, much can happen that is not accounted for in the reports of sessions and groups. In addition, informal groups are formally established. These could be named, for example, 'informal consultations', 'informal drafting group' or 'informal group of experts'. No reports are provided for these informal groups but rather proposals of draft texts that have been negotiated in the groups. A further informal step can be taken within these informal groups by the chairman of the group proposing "a short break" for the participants to 'consider' or 'consult' on different versions of a draft text for example. This could result in what is known as a 'huddle', where a new version of a draft text is negotiated face to face and then taken to the chairman who circulates it in the informal group for further negotiation. 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.

2.3.2 Adopting IMO Conventions

The general procedures at the IMO follow the formal procedures under the UN. The IMO does not have the mandate to adopt international conventions however. Adoption has to be through a diplomatic conference. 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. Member NGOs can merely submit background information and recommend or advise the member States to take action[12]. A proposal should

[12] 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.

include a demonstrated 'compelling need' for the proposed measures and an analysis of the costs and benefits to the shipping industry, as well as legislative and administrative burdens. The committee then discusses and considers the proposal and decides if it should be part of the work programme. The committee also considers priorities and decides on a target date for completing the new item (Boisson 1999; IMO, 2014i; MSC-MEPC.1/Circ.2[13]).

If the committee agrees on a proposal for a new convention, it is sent to the Council and, in some cases, to the Assembly. 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, as well as all member States of the UN. The draft convention is circulated for comment before the conference. This is the stage at which the powers of the IMO end. The time needed to reach this stage varies but it could take several years (Boisson, 1999; IMO, 2014i). 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 the 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. The preparatory work by the IMO provides the conditions for consensus among governments.

Once the conference is held, it becomes an international body in itself with its own arrangements and procedural rules, even if it is held at the IMO headquarters. All participating States – not just IMO members – have equal rights at a conference. When adopting a new protocol under the MARPOL Convention, however, only the parties to the convention can adopt it. The addition of a new annex to a MARPOL requires a protocol to be adopted by the parties to the convention. [14] NGOs also participate in diplomatic conferences within their limits of giving advice and providing 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 typical procedure of the MEPC, voting takes place at diplomatic conferences. A convention is adopted when a majority of the governments – that are present and voting – agree (IMO, 2014i; Boisson, 1999; observations from investigated IMO documents). With regard to the adoption of Annex VI, each participating 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).

2.3.3 Entry into Force and Amendments

The adoption of a convention is merely a first stage of a long process. A convention has to become legally binding on to the parties before the standards can take effect. This stage is

[13] It is acknowledged that the *Guidelines on the Organization and Method of Work of the Maritime Safety Committee and the Marine Environment Protection Committee and Their Subsidiary Bodies* (MSC-MEPC.1/Circ.2) were revised in 2012 and replaced by document MSC-MEPC.1/Circ.4/Rev.2. The cited version of the guidelines does reflect the procedures of the studied process more closely however.

[14] The Protocol of 1978 merged with the 1973 Convention and added Annexes I-V. The Protocol of 1997 subsequently added Annex VI.

called *entry into force* (IMO, 2014i; 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 bound" (IMO, 2014i) by an IMO convention. 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.[15] 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, 2014i; United Nations, 2014).

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 parties have a responsibility to ensure compliance with the treaty. The enforcement of maritime conventions has traditionally been the obligation of the flag State. 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 and class certificates by classification societies. With Port State Control, ships can be inspected at the port and detained if they do not meet international standards (IMO, 2014i; Boisson, 1999; Stopford, 1997). A further account on enforcement is beyond the scope of this thesis.

Traditional procedures of adopting amendments to IMO conventions that had entered into force used to be either adoption by a two-thirds majority (of the parties present and voting) at the IMO or at least one-third at a diplomatic conference. These procedures were so slow, however, that some amendments never entered into force. The *tacit acceptance procedure* was therefore introduced. It sets a specific date for entry into force that applies if no objections are received from "a specified number of Parties" before that date (IMO, 2014i). The preparatory work on amendments follows, in principle, the work of a new convention.

2.4 Introduction to the Studied Process

This section briefly introduces this process and Figure 2.1 illustrates key events.[16] Norway raised the issue of air pollution from ships and fuel oil quality at the Second North Sea Conference in 1987. The result of this conference was a declaration to initiate actions through the IMO. The following year, HELCOM also made a declaration to develop standards on fuel oil quality through the IMO. Both declarations were then raised at the 26th session of the MEPC in 1988. After a Norwegian proposal, it was agreed to include air pollution from ships along with fuel oil quality in the future work programme of the MEPC. It was also agreed to deal with the issue of developing improved fuel oil quality standards at MEPC 27, where a proposed action plan for fuel oil standards was agreed on, along with the inclusion of air pollution and fuel oil quality in the long-term work plan of the MEPC.

[15] 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.
[16] This description is basically a summary of the 'procedural' parts of Chapters 5 and 6, and references therein.

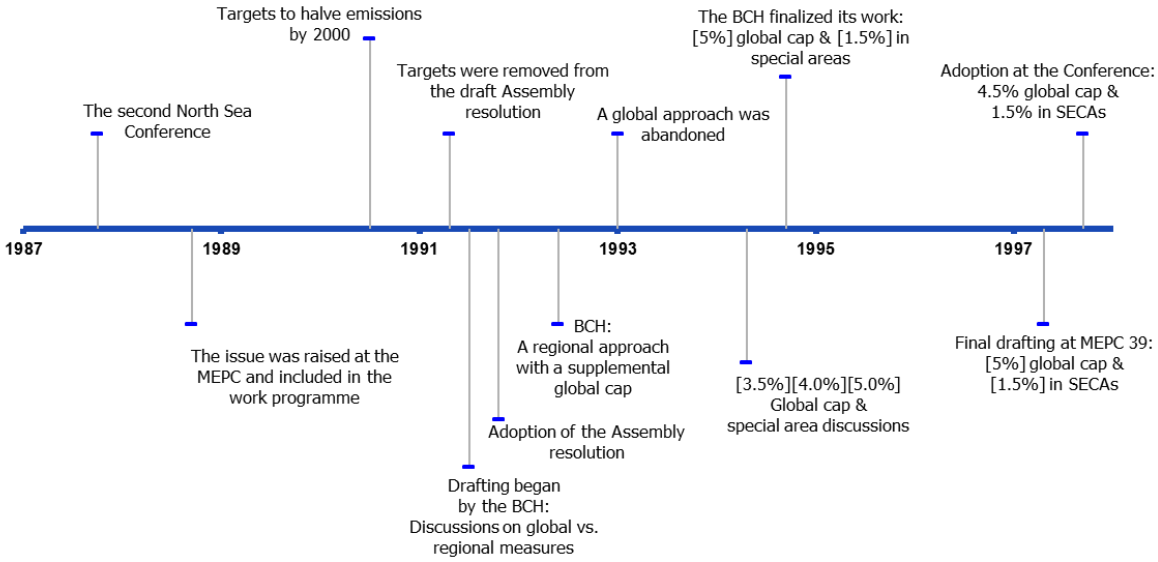


Figure 2.1. Key Events of the Studied Process, 1987-1997

The work then entered a preparatory phase to consider emissions of air pollution from ships and possible measures. At MEPC 29 in 1990, it was agreed to deal with the issue with high priority from the next session onwards. At MEPC 30 in 1991, a target was agreed to halve the present level of SO_2 emissions from ships by 2000, though no definition on the 'present level' was agreed. In this context, it should be noted that global sulphur content limits of bunker fuels between 0.8% and 1.5% were proposed during these initial years, but nothing was agreed on. A strategy for exhaust gases was developed that included a proposed global sulphur content limit of 1.5%, but also with an option to have stricter regulations in certain areas in need of environmental protection.

The BCH Sub-Committee was 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, an Assembly resolution was needed. A draft resolution was developed that included the target levels and dates for the addressed air pollutants, but these were removed from the draft at MEPC 31 in 1991. Instead, the following paragraph was added: "Reduce emissions of sulphur oxides and nitrogen oxides in exhaust gases" (MEPC 31/21, Annex 14, para. 2.3.2). Nonetheless, the target levels and dates were included in a revised action plan of the MEPC.

The work by the BCH sub-committee to draft the new annex on air pollution began at BCH 21 in 1991. A global 1.5% sulphur content limit was proposed in line with the exhaust gas strategy. Already in this session, it drew the attention of the MEPC to "the impracticability of completing its work in 1992" (BCH 21/15, para. 11.60) and to recommend that the target date be extended to 1994. A correspondence group was then established to prepare a draft annex to MARPOL as a submission to BCH 22. The group discussed the question of regional versus global regulation. A global approach with a 1.5% sulphur content limit remained in its draft regulations however. In 1992, the BCH turned the focus to a regional approach. A group of volunteers in the working group developed a proposed regional approach with sulphur limits in specific areas where ship emissions contributed to problems with acidification, so-called special areas. The concept of "global capping" was also introduced by the group of volunteers as part of the regional concept. 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 discussions on special areas focused on criteria and procedures for designation, with delineation of such areas being a key issue. The work of the BCH Sub-Committee was finalized at BCH 24 in 1994. The discussion on global capping was intense. No consensus was reached and a 5% limit was in majority. The draft sent to the MEPC included a 5% global cap and a 1.5% limit in SECAs in square brackets.

As the work went on at the MEPC, the majority favoured a 5% global cap. At MEPC 37, the draft text of the new annex (now Annex VI) was reviewed with the goal to be finalized, though this session had a work overload. A discussion on special areas could thus not take place. MEPC 38 was supposed to be the final MEPC session of the process, though one more session was needed and adoption at a diplomatic conference was postponed to September 1997 instead of March 1997 (MEPC 38/20). At the final drafting session in 1997 (MEPC 39), it was agreed to maintain the 5% global cap limit in square brackets in the final draft text to the international diplomatic conference held in 1997 for adoption of Annex VI.[17] The discussions on SECAs mainly concerned proposed SECA designation of the Baltic Sea Area.

At the Conference, the combined regional solution of SECA regulations with a 1.5% sulphur content limit and a global cap of 4.5% was adopted. The 5% global cap limit remained in square brackets for the major part of the conference, and it was not until the second to last day that agreement was reached on 4.5%. The Baltic Sea Area was designated as a SECA. The North Sea Area was not designated, though a need to take actions against acidification in Europe was recognized in a conference resolution. It was also agreed in another resolution to monitor the average sulphur content in residual fuels.

2.5 Earlier Research

Studies of international environmental negotiations represent a large and broad field within different disciplines that are known under different names, e.g. *global environmental politics* (GEP), international environmental politics and *global environmental governance* (GEG). Its basic foundation is within political science with the focus on the roles of States, international institutions, power, norms, ideology, etc. (Dauvergne, 2012). In particular, there has been a traditional dominance of regime theory within the field of *international relations* (IR), with focus on formation and effectiveness of *regimes*[18] (Sprinz and Helm, 1999; Langley, 2001; Newell, 2008; Lidskog and Sundqvist, 2011). Nonetheless, the nature of environmental problems requires crossing disciplines, which means that "some of the most innovative research is occurring outside of political science – in disciplines such as geography, environmental studies, economics, sociology, law, history, philosophy, developments studies, biology, and human ecology" (Dauvergne, 2012, p. 3). Dimitrov (2012, p. 73) highlighted that "the exchange of arguments is the least explored topic in this field of research" (i.e. on international environmental negotiations). He investigated argumentation and persuasion

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

[18] Krasner (1983, p. 2) defined regimes as "sets of implicit or explicit principles, norms, rules, and decision-making procedures around which actors' expectations converge in a given area of international relations".
The concept of regimes is part of the institutional approach to study GEG, focusing on the roles of institutions. Put simply in the context of environmental policy-making, regimes "are certain kinds of institutions that deal with environmental issues" (Lidskog and Sundqvist, 2011, p. 13).

techniques by delegates in climate negotiations during 2007-2010 based on participatory observations of 12 sessions as a delegate for the EU and Bulgaria, and through document analysis of official statements and interviews with participants. Dimitrov's research focused on the actual communication between delegates in negotiations, and he presented his analysis of arguments divided into the different groups of actors of climate negotiations. Dimitrov then categorized the general arguments and focused his analysis on arguments that successfully persuaded other delegates.

Although international institutions have been a main focus in the broad field of global environmental politics, the IMO has not been studied as much as others. In particular, the focus of the analysis in the IR literature on regimes and institutions has been on the long-range transboundary air pollution regime, the ozone regime and the climate change regime (Zürn, 1998, cited in Dauvergne, 2012). In addition, Dauvergne (2012, p. 14) highlighted concerns of some scholars "that the field of GEP is turning into the study of climate change". Questions on how science or economic interests affect policy have been addressed by scholars from a diversity of fields (e.g. research highlighted in Chapter 3). No research has been found addressing these questions for a specific agenda item at the IMO in a longer international environmental policy-making process for shipping. The following highlights research relevant to policy-making processes of the IMO and the studied process.

Gaskell (2003) addressed decision-making of the Legal Committee of the IMO by widely examining decision-making processes (drafting by the Legal Committee but also diplomatic conferences) for several conventions. This examination was based on his participation as representative for an environmental NGO[19] "with varying regularity since about 1985" (Gaskell, 2003, p. 137). The paper provides an 'insider' perspective on the IMO culture based on his observations of negotiation processes and the influences of States, NGOs and individuals in relation to progress in drafting conventions. Dirks (2001, 2004) addressed the decision-making processes behind the *Standards on Training, Certification and Watchkeeping for Seafarers Convention 1995* (STCW 95). Of relevance to this thesis is his focus on why this convention was adopted despite many conflicting interests and previous positions by shipowner associations and seafarer unions. (Dirks, 2001) and (Dirks, 2004) both show a theory-guided analysis, with testing hypotheses and discussing theories. Notably, Dirks (2004) applied two theoretical approaches within IR: rational choice and social constructivism.[20] No methodology was accounted for, however.[21]

With regard to research on environmental policy-making of the IMO, Campe (2009) addressed the role of the IMO Secretariat as an international bureaucracy. The work of the Secretariat was studied with primary and secondary data, interviews with senior officers at the three divisions of the Secretariat. The main focus of Campe (2009) was on the Marine Environment Division, and its work was placed in the wider context of the influence of international environmental bureaucracies. Her chapter provides insights into the work and functions of the Secretariat, and its influence – or lack of it – on environmental issues among various interests and actors at the IMO. Peet (1994) studied the influences of NGOs on policy-making of the MEPC (as well as under the London Dumping Convention) and how government delegations valued the role of NGOs. His analysis was based on a questionnaire distributed to delegates at an MEPC session. The paper had particular focus on environmental

[19] *International Union for the Conservation of Nature and Natural Resources* (IUCN)

[20] Constructivism in IR should not be confused with constructivism in sociology of science (see Section 3.2).

[21] Other than mostly theoretical literature, the references in Dirks (2001, 2004) were focused on secondary sources (see Chapter 4 of this thesis) and included one interview.

NGOs, was limited to one session of the MEPC and included all agenda items. Peet was also a representative of an environmental NGO (FOEI) at the IMO, and the paper provided no references or theoretical contribution.

Tan (2006) provides a comprehensive overview and analysis of how environmental decisions are made by the IMO and different actors, with general descriptions of the policy-making processes behind the existing environmental regulations for shipping up to 2006. Notably, Tan's brief description of the process behind MARPOL Annex VI was the main inspiration for my research. Other book chapters, papers and reports for this particular process are delimited to somewhat biased authors due to their positions at the IMO (e.g. Okamura, 1995; Ninaber, 1997), background descriptions without a purpose of describing the process (e.g. De La Rue and Anderson, 2009) and MSc theses on Annex VI in general (e.g. Sikirica, 2008).

3 Theoretical Framework

The theoretical framework of this thesis consists of two conceptual lenses: the role of science and the role of economic interests. This chapter first describes the reasoning of conceptual lenses, followed by the chosen conceptual basis for each lens.

3.1 Allison and Conceptual Lenses

In 1971, Graham T. Allison gave important lessons on how international events were explained by theorists and how they could be explained through his book *Essence of Decision: Explaining the Cuban Missile Crisis*. Allison (1971) started by raising a few central questions on the Cuban Missile Crisis that lacked satisfactory answers by previous analyses. A basic premise of his work was that satisfactory answers required more than new information and analysis. He emphasized greater awareness of what both laymen and analysts bring to analyses: that not only the evidence is significant in our judgements of what is important or what we accept as adequate explanations, "but also the 'conceptual lenses' through which we look at the evidence" (Allison, 1971, p. 2). In order to explain an event, one cannot describe everything in the world leading to that event. An analyst thus uses a conceptual model:

> *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).

Allison analysed the Cuban Missile Crisis using three conceptual models and three case studies based on each of them. Each model was seen as a 'conceptual lens' that provided different explanations on the studied event. These lenses were not viewed as simple perspectives or approaches. Rather, each consisted of "a cluster of assumptions and categories that influence what the analyst finds puzzling, how he formulates his question, where he looks for evidence, and what he produces as an answer" (ibid., p. 245). It was shown that the models not only provided different answers to the questions asked and different perspectives on the event, but even the questions were asked differently. Moreover, they did not only provide different explanations for the same event but also different explanations of rather different occurrences.

> *Spectacles magnify one set of factors rather than another and thus not only lead analysts to produce different explanations of problems that appear, in their summary questions, to be the same, but also influence the character of the analyst's puzzle, the evidence he assumes to be relevant, the concepts he uses in examining the evidence, and what he takes to be an explanation* (ibid., p. 251).

The above findings and words by Allison should be kept in mind by the reader as we look more closely at the conceptual basis of this thesis. It is not the intention with this chapter to provide a comprehensive review of relevant theoretical approaches or complete aspects of a reviewed theoretical approach. Rather, the theoretical content provides the basis for a way of thinking when gathering and analysing the empirical grounds: "a cluster of assumptions and categories" (ibid., p. 245), as highlighted above.

3.2 Conceptual Lens 1: The Role of Science

This first lens addresses the role of natural science in international environmental policy-making, by focusing on *Science and Technology Studies* (STS), primarily *Sociology of Scientific Knowledge* (SSK, constructivism) but also the under-and over-critical models (radical relativism). SSK is presented last to show the reasoning of this approach. This section begins with a background on the epistemic community approach within *International Relations* (IR) and then focuses on the under- and over-critical model, followed by SSK, which both criticizes and accepts parts of the former approaches.

3.2.1 Background: The Epistemic Community Approach

Peter M. Haas has criticized traditional institutional approaches in IR with regard to international environmental regimes. Institutionalists focus their analysis on the institutional setting in which decisions are made – where cooperation among States occurs when their self-interests are favoured by cooperation (Haas, 1997, Lidskog and Sundqvist, 2011). According to Haas (1997), it is not only State power that drives environmental regimes but also scientific understanding of environmental issues which decision-makers are unfamiliar with. In an epistemic community approach – based on *constructivism*[22] in IR – consensual knowledge is viewed as essential for environmental cooperation (Lidskog and Sundqvist, 2002), and it is carried forward to the policy-makers by so-called epistemic communities. Haas (1992, p. 3) defined an *epistemic community* as "a network of professionals with recognised expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area". Policy-makers often lack information about pollution sources, the extent of their impacts, etc. Epistemic communities function as experts that States turn to for advice in situations of uncertainty. As the policy-making process proceeds, the decision-makers are informed and bound by the advice they receive. In this regard, Haas (1997, p. 201) argued that international negotiations could be viewed "as a process for reducing uncertainty' and "a process of deferring to specialists". Epistemic communities further have the power to influence policy-makers. They can be even institutionalized in an international regime and can enable environmental cooperation that goes beyond the interests of States (Haas, 1992; Lidskog and Sundqvist, 2011).

3.2.2 The Under- and Over-Critical Models

A traditional view of the role of science in policy-making is that science 'speaks truth to power'. This is a realist's view on the relationship between science and society. In *realism*, the role of science has a traditional positivistic basis, with science separated from policy and producing facts free from values and objectively representing reality – the truth. Due to their "privileged ability to describe present realities and predict plausible futures" (Jasanoff, 1997, p. 230), scientists can influence policy-making. Derived from decades of studies on environmental and technological controversies, *radical relativism* criticizes this traditional view. In its view, policy outcomes are always determined by social relations, with the actors' competing interests and values. The framing of policy issues (including scientific research) and their solutions are both shaped by interests. Hence, science is incapable of determining policy. Jasanoff (1997) described this incapability in the following way:

[22] Constructivism in IR should not be confused with constructivism in sociology of science. Jasanoff (1997) instead terms the epistemic community approach as 'mediated realism'.

> *At best, one side or the other in a policy debate gains temporary advantage by claiming access to superior knowledge, but such gains are eventually wiped out as the opposing side learns to generate competing and equally authoritative scientific claims* (Jasanoff, 1997, p. 231).

A famous example of radical relativism is Collingridge and Reeve (1986). Based on their observations from analysis of regulatory controversies, they drew a negative conclusion about the role of science in influencing policy-making. They argued that the policy environment will always be either under-critical or over-critical to science, and that science will have negligible impact on the actual decisions in either case (Collingridge and Reeve, 1986; Jasanoff, 1990, 1997). The under-critical model, Collingridge and Reeve (1986, p. 32) argued, is "a limiting case of modesty", which only arises when consensus in policy is already in place. In such a situation, science is only used by the policy-makers to legitimize or rationalize political choices already made. Any scientific claim that supports policy is received with an un-critical view. Hence, science is easily accepted in the policy-making process, but it is impossible for science to influence policy (ibid.).

According to Collingridge and Reeve (1986), the use of science does not enable agreement for most of the cases in policy-making. When consensus is not in place, the over-critical model holds that the use of science results in endless debates that strengthen disagreements. Stakeholders affected by regulation are likely to sponsor research that critically questions the basis of the research used behind the policy in order to create doubt about, for example, environmental impacts and benefits of proposed policy. They will look for methodological weaknesses and show unexpected costs or impacts of the policy. Policy relevance in science increases the level of criticism. Existing science and expertise available to policy-makers are not sufficient to determine policy, nor does further research reduce uncertainties. Instead, uncertainties are only exacerbated by more research. Science in policy results in endless technical debates on interpretations of factual claims derived from the policy dispute with deeply divided interests and values. Some scientist act out of self-interest or the interests of their funding sources, which Collingridge and Reeve labelled 'advocates' as they act similarly by gathering evidence of their interests to form a technical case and fighting counterclaims. Others may be less connected to interests, but in this model, the advocates drive the debate (Collingridge and Reeve, 1986; Yearley, 2004). During such a debate, "many long-settled technical issues are reopened for investigation, and attempts to definitely resolve one issue often succeed only in opening up many more technical issues for consideration" (Collingridge and Reeve, 1986, p. 145). The over-critical model implies that agreement is instead reached when the policy-makers decide to stop contesting (Yearley, 2004). Decisions are simply made by compromises between the competing actors, resulting in little use of the science being produced for the policy-making process, which is often a "huge body of literature" (Collingridge and Reeve, 1986, p. 32).

3.2.3 Sociology of Scientific Knowledge

While realism in STS and the epistemic community approach in IR overemphasize the role of science, radical relativism in STS and institutionalism in IR underemphasize it (Lidskog and Sundqvist, 2002; Jasanoff, 1997). Yearley (2004) and Lidskog and Sundqvist (2002, 2011) instead emphasized a turn to *Sociology of Scientific Knowledge* (SSK) – a constructivist approach to STS/sociology of science. In SSK, the role of social conditions is in focus when analysing the possibilities or constraints of science to influence and determine policy-making (Lidskog and Sundqvist, 2011). It is strongly against the thoughts of a linear relationship

between science and policy – with science speaking truth to power. Science and policy are co-produced, meaning that "policy influences the production and stabilization of knowledge and that knowledge simultaneously supports and justifies policy" (Lidskog and Sundqvist, 2011, p. 15). Our understanding of nature can solve social issues, but social factors can also change our understanding of nature (ibid.). The constructivist approach views scientific 'facts' as mostly socially constructed:

> *We regard a particular factual claim as true not because it accurately reflects what is out there in nature, but because it has been certified as true by those who are considered competent to pass upon the truth and falsity of that kind of claim* (Jasanoff, 1990, p. 13).

This construction does not only occur within the scientific community but also extends within society, such as through media, politics and the public. Science becomes valid by the authoritative status of the scientific community in society. To enhance their authority, scientists use different strategies to define its boundaries to society (e.g. politics, law or religion). In fact, in SSK, there are no essential boundaries between science and policy. Such boundaries are established socially by the scientists themselves and the ones using science by a process known as *boundary work*. Actors such as scientists, policy-makers and traditional philosophers of science have – and still do – defined norms and principles on how science should be conducted in order to distinguish between what is science and what is not (Jasanoff, 1990; Sundqvist et al., 2002). Nonetheless, science depends on human interactions and is affected by economics, ideology, culture and political interests, and a socially constructed scientific claim only retains its authoritative status if it is not over-scrutinized on its basic premises by actors with different views than those shared by the scientific community. It follows that scientific claims could lose their factual status by *deconstruction*. In particular, this occurs in the policy-making arena with its competing interest and organizational cultures. Definitions on what is and is not science are negotiated:

> *Labelling an issue as either "science" or "policy" implicitly entails an allocation of power – the power to speak or be heard on the issues in question – and interest groups will fight over these labels* (Jasanoff, 1996, p. 18).

This deconstruction occurs in similar ways, as described by radical relativism. In fact, SSK accepts the existence of both under-critical and over-critical policy environments. Science could either be accepted or deconstructed in critical policy environments (Jasanoff, 1996; Jasanoff and Wynne, 1998). It is merely the conclusions of the over-critical model that there is no closure but constant disagreement that is rejected. According to Jasanoff (1997), radical relativism fails to take into account the amount of empirical data that has shown eventual closure of conflicts in policy-making based on science, such as for environmental issues. In SSK, closure could occur both in policy environments where science is accepted by socially favourable conditions and in critical policy environments by *reconstruction*. As scientific weaknesses are revealed to the policy-makers by deconstruction, this can make them proclaim rights to interpret science themselves. The authority of interpreting uncertain science could be partially moved to the policy-makers. It follows that deconstructed factual claims could retain their factual status in policy-making by reconstruction conducted by policy-makers. The policy-makers do their own readings and make their own interpretations of available scientific evidence, resolving uncertainties politically (Jasanoff, 1987).

With the SSK approach, science can only shape environmental policy with socially favourable conditions (Lidskog and Sundqvist, 2011). It has to gain epistemological and moral authority,

and scientific claims have to be consistent with the legitimizing reasons for political action (Jasanoff, 1997). The outcome often strongly depends on how decision-making authority is allocated, e.g. among political, scientific or legal actors/institutions (Jasanoff, 1987). In other words, the institutional setting where policy-making occurs – with cultures, procedures, rules of decision-making, etc. – is important. The setting could be an international institution, such as the IMO, and science could face either an uncritical (science-accepting) or critical (science-critical) policy environment. The authority could also be allocated to epistemic communities. SSK thus accepts – and actually emphasizes – the importance of epistemic communities. Yet, the epistemic community approach fails to explain how such communities can overcome resistance and determine the outcome in critical policy environments (Jasanoff, 1996, 1997; Jasanoff and Wynne, 1998). Epistemic communities can be formed from shared political interests of a State, self-interests of the scientists, etc., but the image that represents them is as knowledge-based alliances. It is not knowledge that unites policy-makers in environmental policy-making through epistemic communities but shared beliefs of policy that allow knowledge to be used when it is seen as relevant to policy. The success of epistemic communities in policy-making depends on social conditions, for example policy environments being either uncritical or critical. The focus of SSK is thus not on the power of consensual knowledge to influence policy, but on the social conditions that make epistemic communities able to influence (Jasanoff, 1996, 1997).

According to Jasanoff (1997, p. 232), science can be influential in policy if it : (1) "converge with prevailing cultural ideas about responsibility and fault", (2) "support politically accepted forms of discourse and reasoning", and (3) is "ratified by communities that have established, within well-defined boundaries, a privileged right to formulate policy". However, issues in international environmental policy-making that cross cultural and political boundaries between States function differently. Jasanoff (1997) stressed that epistemic communities are needed to produce science that is meaningful to policy. This knowledge production occurs in both micro- and macro-political settings with communities consisting of laboratories, interest groups, political institutions, social movements, States, etc. In addition, science can influence policy if (4) "convergent economic interests of business and government support it, allowing science to play the role of a visible consensus builder" (Lidskog and Sundqvist, 2002, p. 86) and (5) "if it is part of a general technological culture, where technocratic solutions of political problems are supported" (ibid.). To sum up, not only favourable conditions are needed for science to be influential but science itself also needs to be adapted (ibid.).

The following should be at the centre when analysing international environmental policy-making, according to Jasanoff (1996):

- How issues are framed as scientific, and who is framing them
- Rejected or disfavoured policy approaches and problem definitions
- Who are recognized with authoritative knowledge, as well as why
- Rejected or disregarded alternative knowledge or belief

This thesis adopts the view of the concept of *framing* from Lidskog and Sundqvist (2011) as a process of the policy-makers to simplify and package unstable and complex phenomena into a format of an 'issue' suitable for political action. Effective and legitimate solutions to a problem depend on how the problem is framed. Lidskog and Sundqvist (2011) thus argued that framing processes must be analysed, but also in order to understand conflicts and communications between groups. Jasanoff and Wynne (1998) presented a few questions on

framing and definitions of problems for analysis of climate change policies. The following are here of relevance (Jasanoff and Wynne, 1998, p. 6):

> *How do environmental problems come to be construed as global and universal rather than private, particularistic, local, or national?*
>
> *How are conflicts about the scale or means of intervention understood, managed or resolved?*
>
> *To what extent is science itself counted upon to address these problems, and what distinctive issues of science policy and politics are raised by such characterizations?*

In addition, Lidskog and Sundqvist (2011, p. 11-12) highlighted the following questions:

> ... [*W*]*hat actors have the power to identify environmental issues, construct their spatiality, and thereby propose the kinds of measures and cooperation that are important to agree on? And what institutions limit and enable these actors' maneuvering room?*

Jasanoff (1996) concluded that one way to begin to address these questions is to view the knowledge claims of epistemic communities sceptically and, at the same time, focus on the normative foundations of international negotiations. Values and power are always present in negotiations, whether expressed politically or scientifically.

To end this section, a research area that is very close to this thesis is briefly highlighted. Lidskog and Sundqvist (2002) analysed the development of the *Convention on Long-Range Transboundary Air Pollution* (LRTAP) as a case study of using the SSK approach to the role of science within environmental regimes. LRTAP is "one of the most science-based regimes that exists today" (Lidskog and Sundqvist, 2002, p. 86). Their conclusions included that further research should apply SSK to detailed studies of different environmental regimes. Such research could investigate the explanatory power of SSK and analyse the research dependency of different environmental regimes. By several studies and authors in different fields, Lidskog and Sundqvist (2011) explored SSK further, both empirically and theoretically through cross-fertilization with IR. They stressed that knowledge is essential in policy-making, but that science only speaks to power under certain conditions. These conditions have to be studied by social scientists.

3.3 Conceptual Lens 2: The Role of Economic Interests

The second lens addresses the role of economic interests in international environmental policy-making by focusing on how different characteristics of an issue determine collective action among actors with different self-interests. The conceptual basis is *collective action* within *public choice theory* – with a particular focus on the concept of 'issue structure' – and *Wilson's theory of politics* – focusing on how the perceived distributions of costs and benefits affect the policy-making process. Public choice is sort of a mix between the fields of economics and political science. It has been described as using "economic tools to deal with the traditional problems of political science" (Tullock, 2008[2014]). Just like economic decisions, political decisions are choices between costs and benefits. This not only concerns financial costs and benefits but also in general "between whatever has to be sacrificed and whatever is gained as a result" (Butler, 2012, pp. 22-23). One big difference between

economic choices in markets and public choices is that the actors that benefit from a decision are not necessarily the same ones that bear the cost.

Public choice focuses on how collective decision-making is affected by the motivations of individuals, who are driven by their self-interests. Public choice has its roots in *rational choice*, which is a classic approach to explaining international negotiations. It is a basic foundation of both economic theory (primarily neoclassical) and international relations (realism, liberalism and neoliberalism), of which the most prominent uses are within regime theory and game theory (Dauvergne, 2012; Enevoldsen, 2001). The basic unit of analysis is the individual, but this does not mean that theories of rational choice only apply to individuals. A macro-theory on social relations should be founded on a micro-theory of individual behaviour (Enevoldsen, 2001). Political studies using rational choice aim to explain political strategies as well as economic and political outcomes "by showing how these strategies result from the self-defined interests of actors" (Katzenstein, 1984, p. 34, quoted in Enevoldsen, 2001, p. 75). It has been common in IR to view States as rational actors (Allison, 1971; Haas, 2003; Sprinz and Vaahtoranta, 1994; Wiener, 1999; DeSombre, 2007), as this conceptual lens does, which also includes NGOs. A rational actor is typically described as a utility maximizer that weighs the costs and benefits in a choice between alternatives and choses the alternative that maximizes its own utility. The utility is defined by its fixed preferences – its self-interests. This is one of several assumptions on how rational actors behave (see, for example, Enevoldsen, 2001). How do these rational actors act when decisions are needed collectively, and in what situations do States act merely out of self-interest or out of their shared collective interests? This is what collective action is about. The next section describes different characteristics of environmental issues as conditions of collective action.

3.3.1 Issue Structure and Collective Action

Four types of environmental goods are often distinguished by public choice theorists. These are private goods, common-pool resources, club goods and public goods. As seen in Figure 3.1, they share two attributes: excludability and rivalry. *Excludability* means that it is possible to exclude individuals from the benefits or consumption of a good. *Rivalry* (or subtractability) means that one individual's use of a good affects another individual's ability to use it or diminishes the good's value for another (DeSombre, 2006, 2007; Ostrom, et al., 1994; Haas, 2003). DeSombre (2007) emphasized that the ways these two characteristics combine give structure to an international environmental issue; hence the term *issue structure*. Most environmental issues are often characterized as either common goods or common-pool resources. The following subsections address collective action in relation to rivalry and excludability of environmental issues.

		Excludable?	
		Yes	**No**
Rival?	**Yes**	Private Goods	Common-pool Resources (CPRs)
	No	Club Goods/ Toll Goods	Public Goods

Figure 3.1. Types of Goods (DeSombre, 2006; Ostrom, et al., 1994)

3.3.1.1 Non-excludability and Public Goods

Public goods are neither rival nor excludable. A typical description of a public good is the air we breathe. It is not possible to exclude individuals from breathing the air, and one individual's consumption of air does not affect another's. Collective action is traditionally associated with public goods and common-pool resources. Common for both is when an individual actor cannot be excluded from obtaining the benefits of the good, it "has little incentive to contribute voluntarily to the provision of that good" (Ostrom, 1990, p. 6). In his famous contribution to collective action, Olson (1971[1965]) argued that "unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, *rational, self-interested individuals will not act to achieve their common or group interests* (Olson, 1971[1965], p. 2, his emphasis). With non-excludability, an actor – such as a State – will benefit from *free-riding*. Put in terms of environmental cooperation, a State that contributes to an environmental degradation of a public good has no incentives for costly environmental measures since it is more beneficial to let others bear the costs and to benefit from their actions.

In international environmental cooperation between States, the negotiation positions are affected by the ability of exclusion. If a particular State has not been part of protecting a good from environmental harm, but it cannot be excluded from using the protected good, it will benefit from free-riding. A rational State will always put its self-interests first and will thus free-ride in environmental cooperation. If many States realize that they do not have to contribute to environmental protection in order to enjoy the benefits or access to the resource, the protection of the resource will fail. In a strict interpretation of collective action, environmental cooperation should not be possible, especially not globally. Compared with national collective action, the global collective interest of environmental protection is more diffuse. Widespread free-riding and strong opposition by industry interests would be expected (Wiener, 1999; DeSombre, 2007). International environmental cooperation does occur however. An explanation within traditional collective action concerned with public goods would be that enough actors with enough resources willing to protect the good could provide protection despite the impossibility of exclusion (DeSombre, 2007), but environmental issues are rarely public goods.

3.3.1.2 Rivalry and Common-pool Resources

Many environmental issues look like public goods at first sight, but, according to DeSombre (2007), almost all environmental issues have a rival nature that does not fit into this category. A more appropriate category is *common-pool resources* (CPRs). CPRs are non-excludable but rival, which means that one individual's consumption of a good affects another's. Taking the ozone layer as an example, it could be characterized as a public good if not harmed by human activities. No one could be excluded from using the service provided by the ozone layer in terms of UV radiation protection, and an individual's use of this service does not affect another's. However, polluting the air with CFCs depletes the ozone layer and reduces the ability of others to benefit from its protection (DeSombre, 2007; Vedung and Klefbom, 2002). Vedung and Klefbom (2002) expressed this situation as using the ozone layer as a garbage dump, which changes it from being perceived as a public good to a CPR.

Environmental problems are often considered as problems of CPRs, illustrated with the metaphor 'the tragedy of the commons'. Hardin (1968) visualized a pasture open for use by anyone – a common – with rational herders who each strives to maximize its utility by keeping as many cattle as possible on the commons. Each also weighs the benefits of adding

an extra animal to the herd against the costs of overgrazing (Hardin 1968; Ostrom, 1990). Since the herder obtains direct benefits from an additional animal and the costs of overgrazing are shared by all the herders, the rational herder's conclusion is to add one more animal, and then one more, etc. However, this conclusion is drawn by every herder (Hardin 1968).

> *... Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit–in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons* (Hardin, 1968, p. 1244).

The metaphor of the tragedy of the commons has been applied to many environmental problems, primarily connected to resource use and depletion such as fisheries, but also to international negotiations (Ostrom, 1990). The rivalry of environmental issues is the primary connection. It can make environmental protection difficult and influence the negotiating power of States reluctant to cooperate. As mentioned above, public goods can be protected given enough actors with enough resources. This is more difficult with CPRs. Similarly to the tragedy of the commons metaphor, the rivalry of CPRs results in the ability of one State to 'destroy' the good despite the will of other States to protect it. Taking the ozone layer as an example, its use as a sink by one State is beneficial to itself but affects others' use of it, as a sink also destroys the benefits of the good: protection from UV radiation. Actors that threaten or are willing to destroy a resource can force concessions from the actors that want to protect it. Hence, rivalry is a source of power for certain States in international negotiations (DeSombre, 2007; Vedung and Klefbom, 2002).

3.3.1.3 Creating Excludability

How can environmental problems be solved in a situation of rational self-interested States with threats of free-riding? Traditional arguments have centred on either privatization or governmental control. Privatization transforms a public good or a CPR into a private good; hence it becomes excludable. Government regulation could also control the good and make it excludable. Hardin's solution to the tragedy of the commons was "mutual coercion, mutually agreed upon by the majority of the people affected" (Hardin, 1968, p. 1247).[23] This does not apply to international environmental policy-making, where sovereign States rule in anarchy without a supra-national body to enforce regulation. There is no body with coercive power, and there may not be a political will to establish the necessary coercive power. According to Lyon (2009, p. 47), "the entire field of environmental governance can be conceived as a study in what happens when the conditions for 'perfect coercion' fail". Global environmental collective action instead depends on voluntary commitments by States.

DeSombre (2007) mentioned one case in which an international issue was actually transformed into a private good: the establishment of *Exclusive Economic Zones* (EEZs) in the *United Nations Convention on the Law of the Sea, 1982* (UNCLOS 1982). EEZs provide excludability of a set of ocean resources by coastal States being in control of them within 200 *nautical miles* (nm) of their coastline.[24] Nonetheless, as fish move further out at sea, it did not result in successful resource protection for fish. It nevertheless shows that it is possible to

[23] Ostrom (1990) challenged this and showed that CPRs could be effectively managed by social mechanisms without governments or privatization, though this is difficult to apply at the international level (Haas, 2003).
[24] In a way, the territories of States are private goods (DeSombre, 2012).

change the issue structure.[25] As reasoned above, public goods and CPRs have to become excludable. According to DeSombre (2006, pp. 63-64) "sovereignty is in a way the power of exclusion, and the globalization of economic activity has removed this power of exclusion". DeSombre (2006, 2007, 2012) argued that exclusion can be brought back through the power of international regulation to transform public goods and CPRs into *club goods*. It comes about through the building of a structure in which those that do not cooperate are excluded from the benefits of cooperation. The formation of organizations with a club character has proven to be the solution to prevent free-riding in environmental regulations for shipping. However, such 'clubs' are connected to enforcement solutions to free-riding problems associated with *flag of convenience* (FOC) (ibid.). Since compliance and enforcement are not within the scope of this thesis, let us instead focus on issue-specific characteristics.

3.3.2 Transboundary Acid Rain: A Directional Problem

The categorization of issues dependent on the variables of excludability or rivalry does not fit well with reality in which the variables "are more likely to form a sort of a spectrum" (DeSombre, 2007, p. 21). The level of excludability and rivalry depends on the characteristics of a specific environmental problem. According to DeSombre (2007), factors such as who causes and suffers from environmental harm need to be addressed because they greatly affect negotiations. In a 'true' CPR problem, all users both contribute to environmental harm and suffer from it.[26] This provides incentives for all involved to cooperate. According to DeSombre (2007), transboundary acid rain has a fundamentally different structure to other atmospheric pollution problems. It fits the description of a CPR problem since it is both rival and non-excludable yet differs in that States do not suffer from the problem or contribute to it equally. Transboundary air pollution means that States sort of send out emissions from their territories in a direction and distance dependent on wind currents etc. Some States could be net polluters and others net recipients. The level of impacts further depends on geographical and geological characteristics such as soil formation etc. The nature of the problem thus has a directional character. The term *directional problem* was used by DeSombre (2007).

DeSombre stressed that this character has "enormous impacts for political efforts to address the problem" (ibid., p. 214). According to Sprinz and Vaahtoranta (1994) [27],, States that were 'victims' of pollution would seek international cooperation in two ways: (1) to provide protection from pollution from other countries, and (2) to seek harmonized international policy and thus avoid competitive disadvantages of their own policies. At the same time, the States that contribute to pollution but are not victims would oppose regulation due to the abatement costs and lack of benefits. The directional problem means that policy-making becomes more difficult as it provides little incentive for the polluters that do not suffer from the problem to cooperate, while those that are worst affected by pollution are dependent on the actions of the polluters. Those States that aim to resist regulation based on their self-interests are thus in a position of great power in international negotiations. According DeSombre (2007), directional problems provide the greatest influence of self-interests of individual States on international environmental policy-making.

[25] Other examples of privatization involve creating a sort of private property; e.g. cap-and-trade for CO_2 emissions and individual transferable quota systems for fisheries.
[26] Such a true problem, however, is rare in reality (DeSombre, 2007).
[27] Sprinz and Vaahtoranta (1994) was based on an interest-based approach in IR that DeSombre (2007) implicitly connected to collective action.

DeSombre (2007) highlighted that international cooperation on a directional problem could be overcome by *issue linkage*,[28] which basically means that a State agrees on an issue as it links the issue with other States' actions on other issue(s). For environmental issues, it could be more beneficial to negotiate a multi-issue treaty than each issue separately. States with different priorities on different issues could thus "trade off their positions and agree to something they might not want in return for a different regulation that is important to them" (ibid. 23). DeSombre highlighted UNCLOS 1982 as a typical example of a multi-issue treaty attempting to address almost all issues of the oceans. For further explanation, I argue that this emphasis on who suffers from and who contributes to pollution connects the famous categorization of goods with another categorization described below.

3.3.3 Wilson's Theory of Politics

This last section deals with how the perceived distributions of costs and benefits from regulation affect the policy-making process. It is based on the work of the American political scientist James Q. Wilson. His 'theory of politics' was initially presented as a categorization of the politics of different policy issues in Wilson (1973) and further developed into a theory in a concluding chapter of empirical studies in Wilson (1980).[29] Although the theory is rare in IR, there are a few Scandinavian studies that have applied and adapted it for environmental issues: Hovik (1997) and Winter (1994, cited in Vedung and Klefbom, 2002) on local implementation of environmental regulations, followed by Vedung and Klefbom (2002) on explaining national and local implementation of the Montreal Protocol in Sweden. The latter briefly connected collective action, game theory and Wilson's theory to the international developments of the 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol on Ozone Depleting Substances. I follow their initiated approach and assume that Wilson's theory is applicable to international environmental policy-making. Wilson (1980, 1986) stressed the importance of two aspects of costs and benefits in politics: (1) the *perception* of costs and benefits, and (2) the *legitimacy* for a particular actor to benefit or to bear the burden. For domestic politics, Wilson described it as "a process of raising and settling disputes over who will benefit or pay for a program and who ought to benefit or pay" (Wilson, 1986, p. 429). The ways costs and benefits are perceived by the actors affected by a proposed policy determine how the politics are played out.[30]

Wilson's theory (Wilson, 1973, 1980) is "a way of classifying and explaining the politics of different policy issues" (Wilson, 1986, p. 430). As shown in Figure 3.2, it is based on the categorization of four types of policy issues in two dimensions: *perceived costs* and *perceived benefits*. The costs and benefits of a policy could be either *widely distributed* to many actors or *narrowly concentrated* to a few (Wilson, 1973).[31] Wilson (1980) noted that there are many intermediate cases, but the four policy issues are what "can be distinguished by considering all combination of the dichotomous cases" (Wilson 1980, p. 367). The parentheses in Figure 3.6 show the names of his four types of politics. They emerged in Wilson (1980) as identification of the responses in American politics to the four types of policy issues. Many such responses are not relevant to the international application in this thesis since they are mostly about reaching majority coalitions, forming organizations with the sole purpose of

[28] There are many other theories that belong to normative theory to explain the solution of environmental problems, which are not part of this lens; e.g. side-payments, sanctions, marked-based measures, etc.
[29] It was then faithfully published over the years in his textbook 'American Government: Institutions and Policies' with its fifteen editions and additional brief versions.
[30] Costs and benefits include both monetary and non-monetary values. This lens focuses on monetary values.
[31] The categorization was generalized from considering cases with also intermediate combinations.

influencing politicians, government agencies, elections, etc. It is here focused on the main lessons of how the ability to agree on a policy – such as a regulation – is heavily influenced by the question of whether the perceived costs and benefits are shared by many or concentrated to a few.

		Perceived Costs	
		Distributed	**Concentrated**
Perceived benefits	**Distributed**	1 (Majoritarian Politics)	3 (Entrepreneurial Politics)
	Concentrated	2 (Client Politics)	4 (Interest-Group Politics)

Figure 3.2. Wilson's Four Types of Politics (adapted from Wilson, 1986, 2011)

1. Distributed benefits and distributed costs
Wilson's theory holds that policies are easily adopted if the costs and benefits are spread over a large number of actors. For such policy issues, significant benefits will be yielded without significant interventions. There are no incentives to mobilize against the policy since no disproportionate share of the benefits or costs is expected to be obtained or avoided, respectively, by a specific group of actors (e.g. industry) (Wilson, 1973, 1980).

2. Concentrated benefits and distributed costs
In a situation in which a proposed policy will benefit a specific group of actors and the burden of the costs is widely distributed, it will naturally be supported by the benefitting group and as in general. No opposition should be expected and the benefitting group of actors will be able to mobilize effective support. The only way for an actor that opposes the policy to gain support is to dramatize and question the motives of those that support the policy. The issue has to be portrayed in moral and ethical terms; e.g. why the costs should be put on all for the benefits of an industry – a selfish industry letting others pay (ibid.).

3. Distributed benefits and concentrated costs
This is the situation in which it is most difficult to reach a collective decision (Vedung and Klefbom, 2002). When the benefits of a proposed policy are widely distributed, but a specific group of actors bears the costs, that group has a strong incentive to mobilize against the policy. It could be expected that such policies would not, or only in rare cases, be adopted, but Wilson found that they were. One explanation is the occurrence of a dramatic crisis (such as an environmental disaster), which could put the previously favoured opponents at a hopeless disadvantage. Another is the above strategy to emphasize moral aspects (Wilson 1973, 1980).

4. Concentrated benefits and concentrated costs
A proposed policy that would benefit a well-defined group but impose costs on another well-defined group will generate "continuing organized conflict" (Wilson, 1973, p. 335). Both the benefitting group and the group that bears the costs have strong incentives to mobilize for and against the policy respectively (Wilson, 1980). According to Wilson, "revisions and amendments and interpretations are endlessly contested and sometimes efforts are made to repeal the initial policy" (Wilson, 1973, p. 335).

According to Hovik (1997) and Winter (1994, cited in Vedung and Klefbom, 2002), most environmental issues belong to Wilson's third category. The benefits are for everyone or at

least diffuse, while the costs are concentrated to specific actors: the polluters. Put in the context of international environmental policy-making, we can thus expect agreements to be difficult due to strong opposition from a concentrated group of interested parties that are affected by the policy: the ones who will bear the cost burden. At the same time, it would be difficult to mobilize in support of stricter environmental policy. However, Hovik (1997) argued that environmental issues could be placed in all four categories, and that category 1 is of particular interest. Her argument was that many environmental problems are public goods. [32]. It is important here not to forget the above lessons that CPR is a more appropriate category for most environmental problems, and that transboundary rain is a directional problem.

The perceived distribution of costs and benefits could further change during a policy-making process. As an example, greenhouse gases could be placed in category 1 as the emission sources are widely distributed and have impacts on all; hence a policy to reduce emissions would benefit all. However, if a climate policy targets a specific activity or a concentrated group of actors, it could be placed in category 3. A policy compromise between different interests on an environmental issue could also be found through efforts to change the issue from concentrated costs to widely distributed costs, which would place it in a different category. Such changes would conflict with the polluter pays principle, however, which could raise arguments of justice (Vedung and Klefbom, 2002; Hovik, 1997).

[32] This connection was made by Wilson (1973). He noted that since public goods are non-excludable, they provide widely distributed benefits. He also stressed that all widely distributed benefits are not public goods.

4 Methodology

This chapter describes the methodology and working procedure of the thesis. It describes the research approach and methods used for data collection and analysis within the two conceptual lenses. It also shows the motivations for the choice of approach and methods.

4.1 Research Approach

The research approach[33] of this thesis involved a number of choices as shown in Figure 4.1. The following subsections address these choices.

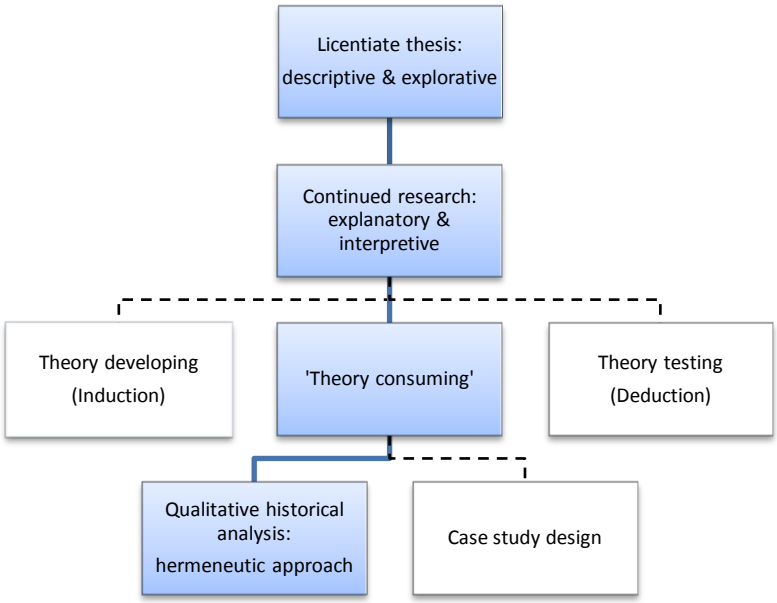


Figure 4.1. Choices of Research Approach

4.1.1 From Descriptive to Explanatory and Interpretive

The first step of this research was in the work of a licentiate thesis (Svensson, 2011), which was a descriptive study. *Descriptive* research in social science is not guided by theory and focuses on the key questions of when, where, how and by whom (Esaiasson et al., 2012). The licentiate thesis showed the policy-making process behind today's sulphur regulations for shipping as described in available IMO documents along with supplemental literature and personal communications. It was an explorative study that allowed for further study of the questions that arose, along with particular emphasis on the need to view the process from more than one conceptual lens. The most puzzling question was why a regional approach was chosen and adopted. With the keyword *why*, the present research aims to provide an *understanding* of this policy choice and decision. To reach an understanding of a social phenomenon, this thesis' analytical approach is inspired by the critical hermeneutic reasoning of Ricoeur (2008[1991]) that understanding is not decoupled from explanations, but rather understanding is reached through *explanations* and vice versa in a dialectic relationship.

[33] This word has different meanings in different methodological literature. Some methodological choices are called research design, research strategy or research approach (e.g. Bryman, 2012, and Esaiasson et al., 2012). By research approach, I include the choices between descriptive and explanatory, between inductive, deductive and theory consuming, and between different frameworks for collecting and analysing data.

Although a deeper discussion on hermeneutics is not in place here, distinctions and relationships between explanation and understanding are important to this thesis. Let us turn to the words of to Ricoeur, (2008[1991]) to gain insight into the intentions of providing explanations in order to understand.

> *... explanation alone is methodical. Understanding is instead the nonmethodical moment that, in the sciences of interpretation, combines with the methodical moment of explanation. This moment precedes, accompanies, concludes, and thus envelops explanation. Explanation, in turn, develops understanding analytically* (Ricoeur, (2008[1991], p. 139).

The methodology is thus *explanatory*. Through the use of two conceptual lenses, this thesis aims to provide an understanding by presenting two explanations. Different conceptual lenses provide meaning to empirical data connected to the phenomenon that is to be explained (Esaiasson et al., 2012; Allison, 1971; Gilje and Grimen, 2007).

4.1.2 'Theory Consuming'

Explanatory research is commonly divided into deductive and inductive approaches, in other words: theory testing and theory developing. The *hypothetical-deductive* approach is traditional in natural science and positivism. Hypotheses are set, empirical data are collected and the hypotheses are tested against the empirical data. An *inductive* study uses empirical data to generate or develop new theory. Data are collected, and assumptions or hypotheses are made and then tested against data. New data are then gathered and, if this confirms a set of hypotheses, a new theory is generated (Bryman, 2012; Esaiasson et al., 2012; Gilje and Grimen, 2007). This thesis instead uses a '*theory-consuming*' approach following Esaiasson et al. (2012). This approach is used for case studies and puts the case at the centre. It is similar to theory testing (deduction), but different theories are used as explanations of a case and not to test a theory. It is this middle approach to explanatory studies on which this thesis embarks.[34]

4.1.3 Qualitative Historical Analysis

With the chosen theory-consuming approach, this thesis studies a 'case' defined by "boundaries around places and time periods" (Ragin 1992, p. 5). It does not embark on the case study approach/design, however, e.g. as described by Yin (2009). A case study focuses on the complexity and nature of a studied phenomenon, i.e. the case itself rather than generalization to other social phenomena. It involves providing an intensive and detailed analysis of the case, often with a holistic approach (Bryman, 2012; Yin, 2009; Thomas, 2011). According to Czarniawska (1997), Robert K. Yin has since its first publication in 1984 monopolized his positivistic approach for case studies. His approach requires the use of multiple sources of data and treats documents as one of several required sources in a triangulating manner (Yin, 2009). Documents are the very core of this thesis' objectives. I follow Atkinson and Coffey (2011) in that documents should be regarded as data in their own right. Yin's approach further limits case studies to only study contemporary phenomena, though, as expressed by Czarniawska (2014, pp. 21-22) "the most famous case studies are historical". The research approach of this thesis has a particular emphasis on how to study events in the past by investigating documents, with inspiration from the use of qualitative historical analysis in IR.

[34] The theory-consuming approach should not be confused with 'abduction'. Dubois and Gadde (2002) stressed that abduction is closer to induction than deduction, and should be viewed as theory developing.

Instead of contemporary 'cases', studies in IR often focus on historical periods, like the Cuban Missile Crisis (Allison, 1971) or a policy-making process resulting in a decision or decisions. Thies (2002) turned to historiography to provide some insights into such studies. By the phrase 'qualitative historical analysis', Thies meant "a methodological approach that employs qualitative instead of quantitative measurement and the use of primary historical documents or historians' interpretations thereof in service of theory development and testing" (Thies, 2002, p. 352). It was not a new approach in IR but rather a label for studies that have traditionally analysed historical events.

A lesson from historiography is that historical 'facts' found by historians are interpretations of a phenomenon made by historians. Objectivity, as advocated by natural scientists in a positivistic epistemology, does not exist. From historical research, we find that "data are 'made' rather than collected" (Thies, 2002, p. 354). Thies clarified that "the fact we find are dependent upon the facts we seek based upon our implicit or explicit theoretical orientation" (ibid., p. 353). According to Levy (2001, p. 51) it is "the conventional wisdom in both history and political science that all empirical observations are filtered through a priori mental frameworks, that all facts are 'theory laden'". Levy (1997) elaborated on the differences of using theory in history and political science and concluded the following:

> *The difference between the disciplines is not that one is theoretical while the other is not, but rather that they use theory in different ways. Political scientists build general theories and test them, whereas historians use theory–or a set of theories–primarily to structure their interpretations of particular events* (Levy, 1997, p. 32).

This puts a reminder of the lessons of Allison (1971) in place, and thus the approach of this thesis. The conceptual lenses guided what to investigate. They were used to interpret the event and to search for explanations. Like historians, the policy-making process was examined by a broad interpretation from different angles. The next section describes the data collection and analysis made within each lens.

4.2 Data Gathering and Analysis

Archival research was conducted on IMO reports of sessions and submitted documents by the participants containing their arguments and supportive information. According to Thies (2002), the selection of historical sources is a crucial step in the research process. The historical sources become your 'evidence'. He made a clear division between primary and secondary sources. *Primary sources* are "the original source material on an event, including all evidence contemporary to the event" (Thies, 2002, p. 356), while *secondary sources* include "everything that has been written about the event subsequent to that time" (ibid.). Diplomatic notes or reports written during a meeting or shortly after (such as UN documents) are generally considered primary sources. This division is not to be confused with primary and secondary data, which are commonly referred to in social science. While interviews and observations are commonly referred to as primary data, documents are referred to as secondary data. Both primary and secondary sources are secondary data.

The empirical basis of this thesis is entirely drawn from primary sources in the form of available documents during IMO negotiations from 1988 to 1997. These were gathered from archives of the *Swedish Transport Agency* (STA). The documents were delimited to what was reported and submitted to the MEPC and the BCH during the process, as well as to what

could be found from the archives of the STA. No documentation of the MEPC and BCH meetings before 1998 has been digitalized at the IMO, and the STA did not start to digitalize IMO documents until 2002. The sources were thus based on prints from the archive at the International Secretariat of the STA in Norrköping. The previous work of the licentiate thesis (Svensson, 2011) provided the benefit of having much of the necessary material already sorted into relevant agenda items and submissions. In the work of the licentiate thesis, 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 result was a descriptive thesis that provided a guide for the continued work. It was soon realized that more documents were needed for the continued work however. I had to dig further into documents with scientific and economic contents as well as with a stronger focus on regional choice and thus more on the issue of special areas (the licentiate thesis focused on the global cap).

The archival procedure of the present research started by investigating the already attained documents. The session reports of the MEPC and the BCH were read to gain an overview of the discussion, policy choices and decisions. Here, the experience from the work of the licentiate thesis was central. I focused instantly on relevant agenda items considering the matter of air pollution and the sulphur issue. The already attained and reviewed reports of the licentiate work had limited the bulk of the pages. The agenda items were usually clear of their names, such as 'Prevention of Air Pollution from Ships', but the relevant information could be found in the agenda items in reports by the sub-committees or 'Any other Business'. In the relevant agenda item, the work of the licentiate thesis had provided me with already marked sections of the reported sulphur discussions. The subject of these discussions was frequently assigned to a working group for further consideration (and later on informal groups and drafting groups). The reports of these groups were also read and, lastly, a brief reading of the already attained submissions. At the same time, a database of relevant submissions was compiled in Microsoft Excel. This resulted in an initial overview of the process and insight into the necessary documents for the scientific and economic arguments. Table 4.1 lists the investigated meetings and policy-making arenas in which the IMO considerations and discussions took place during 1988-1997.[35]

At this stage, it was a question of which submissions should be obtained and investigated further. How could the significant documents for the policy development and the final outcome be sorted out? The list of documents[36] provided for each session was reviewed with the focus on the relevant agenda items. Every document that had something to do with SO_x emissions – also fuel oil quality in the early stages of the process – was listed in the database and marked as initially relevant. Possible relevance to each lens was also marked based on the information provided in the session reports or reports of groups and on briefly reading already attained documents. This resulted in a need to review a large number of documents, but not all were relevant for inclusion as an empirical basis of the analysis. Three more days at the archive were devoted to gathering and copying the necessary material. In total, the database listed 235 documents (158 MEPC documents and 77 BCH documents) of which 18 were session reports and the remaining submissions and working documents. In the end, 150 of these 235 documents were used as references in this thesis.

[35] No official report was produced for the conference in 1997. The investigation of this last 'meeting' was based on the records of decisions of the plenary, working group reports and submissions.
[36] Provided in the reports but for some sessions separate ('INF') documents needed to be attained.

Table 4.1. Investigated Meetings and Policy-making Arenas

Body	Policy-making Arena	Sessions/Meetings	Period
MEPC	Plenary	MEPC 26-39	1988-1997
	Working Group on Fuel Oil Quality	MEPC 27	March 1989
	Working Group on Prevention of Air Pollution from Ships	MEPC 30	November 1990
		MEPC 39	March 1997
	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	1992-1993
		1st intersessional meeting	July 1993
		2nd intersessional meeting	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 2nd intersessional meeting	September 1993 to January 1994
	BCH Drafting Group (on criteria for special area designation)	BCH 24	September 1994
Diplomatic Conference	Plenary	Third MARPOL Conference	September 1997
	Conference Working Group 2	Third MARPOL Conference	September 1997
Informal	Informal Working Group	MEPC 29	March 1990
	Informal Drafting Group	MEPC 38	July 1996
	Two Groups of Experts (global cap and special areas)	MEPC 38	July 1996

The examination of the gathered documents followed the chronological order in line with the historical aspects of explaining an event. According to Thies (2002, p. 357), "an accurate chronology is crucial because the sequence of events tells us how the actors were responding to each other and the situation". The examination was also theory-guided. Each conceptual lens provided a guide on which content to include as an empirical basis for the analysis. For each lens, scientific or economic arguments, supportive information and discussions were examined and non-relevant contents sorted out. The research questions and the conceptual lenses formed the basis when the empirical study was conducted. Questions were asked and documents searched and analysed based on these questions and guided by the conceptual lenses. Interpretation is the keyword for describing the analysis of each document. Here, the historical aspects were significant. According to Larson (2001, p. 343) "we need to understand the purpose of a document and the events leading up to it in order to interpret its meaning correctly". The basic formula was "*who* said *what* to *whom* under *what circumstances* and with *what purpose*" (ibid.).

However, reports of meetings represent subjective and selective views of the actual meetings. Public minutes tend to illustrate a meeting in a way that was publicly acceptable at a given time and social context. It is important to recognize that the studied IMO reports were written by individuals at the Secretariat, but of most importance is that these were written after consideration and approval by the committee/sub-committee, which allowed the participants to reformulate, delete or add text in the initial draft report. It has to be recognized that there are interests behind including or highlighting some things and not others. Of the investigated documents, the most interest-based sources were the submissions, which I viewed and treated as 'party pleadings' in a political debate as a basis for analysis (Denscombe, 1998; Esaiasson et al., 2012). In a way, argument analysis was used in its simplest form. Bergström and

Boréus (2012) described methods to conduct argument analysis as document analysis but also recognized the huge amount of work and time required. It was thus argued that it is often enough to search for the most important or common arguments in a debate or to focus on specific type of arguments. In this context, the analysis of documents focused on the scientific and economic arguments, along with supportive information and discussions, as well as with guidance from the conceptual lens.

The empirical investigations were then presented as a narrative for each lens with evidence investigated and presented in chronological order. The empirical findings were then analysed with explanations sought for each research question through the two conceptual lenses.

5 Investigating the Role of 'Science'

This chapter investigates the reported scientific arguments, supportive information and discussions. With the term 'science' it is here meant as scientific *arguments* and scientific *claims* that were reported or treated as 'science' or 'scientific'. Guided by the first conceptual lens (Section 3.2), this chapter has a particular focus on how different actors framed the problem and policy issue, with supportive information to arguments being centred on environmental impacts and contribution from shipping.

5.1 Background on Prior Framing

Since the experience with environmental impacts of SO_x emissions from land-based sources constitute a background for the issue making its way to the IMO, I begin with a background in the search for the preceding framing.

5.1.1 A Transboundary Problem Framed in Two Contexts

Following the work of Lidskog and Sundqvist (2002, 2011), the origin of the international work of reducing land-based air pollution is put into two contexts: a special East-West geopolitical climate and scientific findings from decades of research on acidification of lakes in Sweden and Norway. Swedish researchers had been monitoring freshwater acidity since the 1940s, showing significant falls in pH 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 (Odén, 1967, cited in Sundqvist, 2011) in the Swedish newspaper *Dagens Nyheter*. Odén argued that SO_2 was being transported long distances and that precipitation over Scandinavia had become more acidic, primarily due to SO_2 emissions from industries in the UK and Central Europe. Hence, other countries could be the primary cause of acidified lakes in Scandinavia, which in turn caused fish deaths[37] (Underdal and Hanf, 2000; Lidskog and Sundqvist, 2002; Sundqvist, 2011). Evidence of *transboundary*[38] acid rain was found by observations from soot and sulphur measurements that started in 1966 along the Swedish coast. Pollution episodes were found that could only be explained by long-range transport due to specific weather conditions. Moreover, other studies of rainwater chemistry showed significant increases in acidity over Northwestern Europe and parts of Central Europe from the period of the Second World War to the 1960s. This was not limited to concentrated areas with large emission sources, indicating a wider distribution and a large geographical scale over much of the European continent (Pleijel and Grennfelt, 2007). According to Odén, there was a "more or less permanent mass of polluted air over Central Europe, including central and southern Sweden" (Odén, 1967, quoted in Sundqvist, 2011, p. 203, his translation). Odén's initial framing of the issue was thus not as a local problem as previously thought, but as a large-scale regional problem (Lidskog and Sundqvist, 2002).

Odén's decision to publish in a Swedish newspaper meant that new findings were first presented to the Swedish public. Acidification discussions thus instantly spread outside the scientific community, and Swedish politicians quickly engaged (Sundqvist, 2011). It met with difficulties being internationally accepted however. Long-range transport of air pollutants was a highly controversial idea among researchers, politicians, industry in Europe. Nevertheless,

[37] Acidification and fish deaths in Scandinavia had previously been linked (Lövblad et al., 2004).
[38] Something that crosses national or other political borders. See *long-range transboundary air pollution* below.

scientific evidence of long-range transport of air pollutants accumulated, and it soon pushed the issue to the international arena. A programme under the *Organisation for Economic Co-operation and Development* (OECD) to measure long-range transport of air pollutants in Europe was initiated in 1970. Eleven countries in Northern and Western Europe participated and formed a network of measurement stations to monitor sulphur concentrations in precipitation and in the air (Pleijel and Grennfelt, 2007; Lidskog and Sundqvist, 2011). In 1972, a Swedish case study and background document were presented at the first UN environmental conference in Stockholm (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 being deposited. Emphasis was put on international agreements, legislation and control (Swedish Ministry for Foreign Affairs and Swedish Ministry of Agriculture, 1971). At the conference, however, delegates from other European States and developing States did not fully support the Scandinavian initiative. General acceptance of the transboundary nature of air pollution was still not in place. Nevertheless, the conference declared that States had "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).

Although the Soviet Union and allied States boycotted the Stockholm Conference due to the Cold War conflict, it was the Soviet Union, together with Norway, that later pushed the issue to negotiations within the *United Nations Economic Commission for Europe* (UNECE). Following the work of Lidskog and Sundqvist (2002, 2011), the turn towards cooperation on the issue of air pollution could be explained by a deadlock in the Cold War, in which a less controversial issue was searched for by the politicians to enable cooperation that could mitigate the East-West conflict. The environmental field was first chosen for cooperation by the Soviet Union in 1975, and soon the choice was made to cooperate on the specific issue of air pollution. Thus, the start of an international agreement on air pollution "was not much about science, but more about world politics" (Lidskog and Sundqvist, 2002, p. 87). Nevertheless, science enabled cooperation. The 1976 International Conference on Effects of Acid Precipitation in Norway has been considered the time and place when transboundary air pollution became accepted as a scientific fact (Sundqvist, 2011). One year later, the final report of the OECD programme was published. It 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" (OECD, 1977, quoted in Lövblad et al., 2004, p. 9). Moreover, individual national measures would only have limited success in reaching substantial reductions of sulphur deposition in a country.

The OECD report formed the basis for evolving the OECD measuring programme into the *European Monitoring and Evaluation Programme* (EMEP). It was made independent of the OECD and formed the first inter-governmental initiative to deal with air pollution with over 25 participating countries in Europe. It had the purpose to provide information to governments on the extent of long-range transport and depositions of air pollutants (Lövblad et al., 2004; Lidskog and Sundqvist, 2002). Together with pressures from the Soviet Union and Norway, the forming of EMEP paved the way for UNECE negotiations towards adoption of the *Convention on Long-Range Transboundary Air Pollution* (LRTAP) in 1979 by 34 countries and the EC Commission (Lövblad et al., 2004; Sliggers and Kakebeeke, 2004). The term long-range transboundary air pollution was defined by the following:

> *... 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).

EMEP was integrated as an important part of LRTAP with functions as information production, distribution and exchange, and as an arena to develop emission reduction scenarios and emission control agreements. In fact, the very first protocol to the convention was about maintaining financing of EMEP to guarantee its continuation and development. EMEP then evolved into a European research community bound to the LRTAP regime (Lövblad et al., 2004; Lidskog and Sundqvist, 2002, 2011).

Although a framework convention was now in place and 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 high sulphur content. The reports of dead forest trees in the 1980s caught the awareness of the general public and politicians[39] (Lövblad et al., 2004). Pleijel and Grennfelt (2007, p. 27) described the 1980s as "a golden age of environmental policy" in the sense of an environmentally friendly public opinion and willingness of policy-makers to invest to meet the opinion, as well as increased environmental efforts of the commercial sector. Newspapers and election propaganda were filled with pictures of lakes without fish, dying forests and suffering animals. Record-high levels of air pollutants in 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). We have approached the time period when the North Sea States and the Baltic Sea States framed air pollution from ships as an issue for the IMO.

5.1.2 Prior Framing for Ship Emissions

With the preceding (primarily European) attention to land-based air pollution described above, questions arose over the contribution of shipping, which resulted in two regional initiatives to take action through the IMO. At the Second International Conference on the Protection of the North Sea held in London 1987, the issue of air pollution from ships and regulating the sulphur content of bunker fuels was raised by Norway. The North Sea States declared that they would initiate actions at the IMO and ISO for improved fuel oil standards that would reduce atmospheric and marine pollution (the London Declaration, 1987, para. 31). The following year, at the *Helsinki Commission* (HELCOM), the Baltic Sea States declared that they would promote the international development of "environmentally sound standards of marine fuels" (Declaration on the Protection of the Marine Environment of the Baltic Sea Area, 1988, p. 5). Pressures for the IMO to deal with air pollution had thus appeared from both the *North Sea States* (NSS) and the *Baltic Sea States* (BSS). The ministers' framing concerned the quality of marine fuel oil, which in the case of the NSS comprised both marine and atmospheric pollution. The NSS and BSS represented States affected by acid deposition from transboundary air pollution. The Norwegian initiative should be viewed in light of a study that indicated that emissions from domestic shipping contributed to about 14% of the Norwegian SO_x emissions (and about 40% for NO_x). In addition, the work in EMEP had

[39] Note that a connection between transboundary air pollution and forest dieback due to acidification has not been scientifically proven (Pleijel and Grennfelt, 2007).

showed big discrepancies between models and measurements in coastal areas. Hence, attention was drawn towards ship emissions as an explanation (MEPC 29/18). With this prior framing in mind, let us approach the issue of SO_x emissions from ships at the IMO.

5.2 1988-1989

5.2.1 MEPC 26, September 1988

Although both of the above declarations of the NSS and the BSS were considered at MEPC 26 (MEPC 26/24; 26/INF.19), the real turn towards IMO addressing air pollution was made by a Norwegian proposal to include air pollution from ships in the future work programme of the MEPC (MEPC 26/22; 26/INF.3O). The proposal framed the problem in IMO's mandates to protect coastal States and the marine environment from pollution: "Discharges of pollutants to the air from ships affect both marine environment, the coastal States, and the ozone layer […]" (MEPC 26/22). A brief overview of air pollution from ships was presented. On SO_x emissions, it mostly focused on the quality of fuel, with high sulphur contents in bunker fuels as the source. It only mentioned acidification with regard to NO_x emissions. No actual problem definition of SO_x emissions was thus found except an estimated contribution to the total emissions. One notable aspect of this first estimation is that it assumed that the average sulphur content of HFO at the time was about 4-6%. It thus used a 5% sulphur content to calculate an estimated contribution of global SO_2 emissions from ships to 10% of total global emissions (MEPC 26/INF.3O). No discussion on emission levels was reported however. In fact, the report of MEPC 26 does not mention any discussion but merely that the Committee agreed to include air pollution from ships in the future work programme of the MEPC after "positive expressions of support" by several delegations (MEPC 26/25, para. 24.4). It was also agreed that the issue of improving quality standards for HFO – as declared by both the NSS and the BSS – should be dealt with at MEPC 27 (MEPC 26/25). SO_x emissions from ships were thus framed in two separate policy issues: air pollution and fuel oil quality.

5.2.2 MEPC 27, March 1989

The submissions on air pollution at MEPC 27 were dominated by Norway and the BSS, which preferred a global solution to SO_x emissions from ships. Norway (MEPC 27/6/2) highlighted a trend of decreasing quality of bunker fuels and increased sulphur content (often about 4-6%). It was estimated that annual global SO_2 emissions from ships were about 10 million tonnes (mt), which was considered to add to the huge negative consequences of acid rain. A different framing was then presented: "This problem is global, but in particular serious in the North Sea area with its high density of ship traffic" (MEPC 27/6/2, p. 2.). Hence, Norway framed the problem as global, but there was a regional aspect of it that was not due to sensitive environments or geology but to high volumes of ship traffic. No scientific information or further arguments to support this framing were given however. An upper limit of 1% sulphur content in bunker fuels[40] was considered desirable "from an environmental point of view" (ibid. p. 1), though desired emission reductions would require evaluation in a study by the IMO. The BSS (MEPC 27/6/3) presented scientific arguments with supportive information to their view on air pollution in general, with background information on emission formations and reduction methods. No specific figures were presented on SO_x emissions, however. The BSS had the view that reductions of SO_x emissions should be given

[40] Note that reduction options were not limited to reducing the sulphur content. On-board reduction technology such as scrubbers was also considered here and further on. It is not within the scope of the thesis however.

priority (together with NO_x and dust/particles). It was stated that SO_2 emissions had a direct relation of the sulphur content in the fuel, which was a factor that should be considered when developing standards. No connection was made between particles and sulphur specifically, but interconnections with other pollutants and health impacts from particles were recognized.

Contrary to Norway's estimated 10 mt, an informal meeting between oil industry representatives and the environmental division at the IMO (MEPC 27/6/7) had estimated 2 mt emissions from shipping (not specified if S or SO_2), with a comparison of 23.7 m tonnes from OECD Europe and non-OECD Europe (USSR/Eastern Europe). Contrary to Norwegian estimations, the meeting also assumed a global sulphur content average of 2%, though this could not be verified. No discussion on this meeting was found in the session report. Despite the first reported objections – with lack of information and clarity of the issue being raised by the delegations of Kuwait, Mexico and Venezuela – the MEPC considered SO_x emissions one of the main items for consideration when analysing environmental problems caused by fuel oil quality, and a proposed action plan for fuel oil standards was agreed on. It was further agreed to include air pollution and fuel oil quality in the long-term work plan of the MEPC. No scientific arguments were reported given however (MEPC 27/16; 27/WP.3).

5.3 1990-1991

5.3.1 MEPC 29, March 1990

At MEPC 29[41], air pollution from ships, including fuel oil quality, was an agenda item for the first time. The issue of air pollution from ships became clearly framed towards high priority global action by the committee, recognizing 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, emphasis added). Based on this recognition, it was agreed to deal with the issue as a high priority. However, the reported discussions did not include anything that could be related to this framing, and no specific framing on SO_x was found. So, let us look at the submissions. MEPC 29 was the session at which scientific arguments, supported by studies and references therein, first emerged. Norway submitted two studies. The first (MEPC 29/18) was a report prepared by the *Norwegian Marine Technology Research Institute* A/S (Marintek) and the second (MEPC 29/18/6) a study by *Det Norske Veritas* (DNV). Despite different methodology, the two independent studies resulted in similar figures on the estimated global contribution of ship emissions to total emissions. Marintek calculated emissions from bunker consumption for ships in international trades and the given emission factors, while DNV used average sulphur contents for HFO and MDO and their respective annual fuel consumption. Notably, the average sulphur content for HFO was found to be 2.82%, and >4.5% was very rare, which is a direct contradiction to Norway's earlier estimate. Marintek estimated that global SO_2 emissions from international shipping were 6.5 and 4.5 mt for 1980 and 1986 respectively. This represented about 4% of the total global emissions. The total emissions were based on emissions in OECD for 1980, which implies estimations of unknown methods for the rest of the world. DNV arrived at the figure 5.82 million *tons*[42] between 1988 and 1989, which represented 5.3% of total global emissions. DNV also based the total emissions on OECD data for 1985 (MEPC 29/18; 29/18/6).

[41] MEPC 28 was held as an extraordinary session without relevance to this thesis.
[42] 5.82 tons = 5.28 tonnes.

Marintek further charted ship emissions on maps for international trade routes and made a detailed case study on the North Sea and the English Channel with *EMEP maps*[43].While emissions over open seas were found to be distributed over many routes, emissions were more concentrated in the most trafficked coastlines. Particularly high emissions were found in and between the English Channel and the Strait of Gibraltar, in the South China Sea, the Strait of Malacca, the Persian Gulf and the Red Sea. About 4% of the total global emissions from ships were emitted in the North Sea and the English Channel, which is equal to the emissions in countries such as Belgium, Denmark, Norway and the Netherlands. Since the emissions were high in areas with high traffic, it was concluded that the local contribution was considerable. Much uncertainty and a need for further studies were highlighted. Estimated ship emissions were considered too low, e.g. due to domestic shipping not being included (MEPC 29/18).

It is also of relevance that Norway framed SO_x emissions as regional, and it was stated that the Marintek report could be used in further discussions on whether air pollutions from ships required international regulations (MEPC 29/18). It also stated that the studies had convinced Norway that air pollution from ships was a *significant problem* that could be reduced (MEPC 29/18/4). It also 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 MEPC should recognize SO_2 as a *significant problem*, and that the next step for the MEPC was to discuss reduction targets and requirements. The BSS (MEPC 29/18/1) showed some notable framing and views of scientific support. It emphasized that there were "already facts available to support in general the need to introduce requirements" (MEPC 29/18/1, p. 1) on sulphur contents and that only the limits needed consideration. No such scientific support was presented in the submission however. It framed acid rain as a issue identified worldwide with impacts on the environment and, in the very end, humans. These consequences strongly highlighted a need for action. Acidification from SO_x emissions was actually framed as *a global problem* as well as *serious* and increasing. The link between sulphur content and emissions was highlighted, and it was considered that fuel oil quality aspects should be given priority in IMO's work on air pollution. From an environmental aspect, in combination with economic reasons, it suggested a sulphur content limit near 0.8% for HFO. There were no scientific arguments or support given for this limit (ibid., Annex). In addition, parts of the framing of the issue by *Friends of the Earth International* (FOEI) (MEPC 29/18/2) have similarities with that of the committee: "Air-pollution from ships is an issue of *considerable environmental concern* and requires *international regulations* to protect the *marine* and *global* environment" (MEPC 29/18/2, p. 3, emphasis added). No supportive information was presented for this framing however.

The above submissions argued for action and mainly focused on strict sulphur content regulations, though one opponent was found. A submission by Kuwait questioned whether a reduced sulphur content of marine fuels would result in the required environmental protection and stressed that it needed to be exclusively proven (for reasons of economic and technical implications) (MEPC 29/18/5). In addition, a UK report had concluded there was little data on emissions and that fuel oil qualities and environmental impacts needed to be clear before action (MEPC 29/18/6).

[43] EMEP used grid maps (at the time 150 x 150 km) of its area where it charted national inventories on emissions, depositions, critical loads, etc.

5.3.2 MEPC 30, November 1990

Not many scientific arguments were reported on the discussions at MEPC 30. The NSS and the Commission of the EEC (MEPC 30/14/2) proposed a reduction in the present global level of SO_2 emissions by 50% at the latest in the year 2000. Fuel oil standards for HFO should be developed with a maximum sulphur content of 1.5%. However, a second measure was proposed: "to jointly develop regional measures" (MEPC 30/14/2, p. 1) for ships sailing in areas where SO_2 emissions were likely to affect the air quality adversely. Such areas could be inland waters, harbours and territorial waters, and "near coastal zones" (ibid.). The sulphur content for such areas was proposed at less than 1%. Except for the premise "if deemed necessary" (ibid.) and the above focus on adverse air quality impacts, no scientific arguments were given. The BSS (MEPC 30/14/6) had the same proposals, though it clarified that a 50% reduction could be achieved using a maximum sulphur content of 1.5% (a regional sulphur content was not specified). The BSS further used the term *special areas* for areas where stricter air quality standards were desirable (MEPC 30/14/6). As with the NSS, no scientific support was given for these proposals.

A note by the Secretariat (MEPC 30/INF.17) contained conclusions and draft recommendations from an EMEP workshop on emissions from ships held in June 1990. It was concluded that the contribution from shipping to the deposition of air pollutants in coastal areas within the ECE region was significant. Earlier inconsistencies between the results of models and measurements could now be partially explained by ship emissions through preliminary interpretations of model calculations that included ship emissions. 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. Moreover, it was concluded that different calculation methods for SO_x emissions that used oil consumption as a basis had showed rather similar results and could be used as a basis for assessments. The workshop also highlighted that a reduction method for a specific pollutant could lead to adverse effects and increase other pollutants, such as CO_2 (MEPC 30/INF.17). In this context, the UK (MEPC 30/14/7) highlighted that desulphurization of HFO could result in additional environmental impacts. It further stressed that quantitative data were lacking on actual ship emissions in operations, and highlighted a first phase of a research programme by Lloyd's Register to address emissions from ships on the open sea under steady state conditions (MEPC 30/14/8).

The global proposal by the NSS (MEPC 30/14/2) was agreed by the Committee. A target level of 50% of the present emission level of SO_2 was thus agreed to be achieved universally by the target date of 2000. Agreement on which year the 'present level' would be based was not reached, however, but the working group showed a tendency to agree on 1990, as proposed by the Netherlands. The Japanese delegation reserved its position and expressed that any decision on targets "should not be taken before and unless clear scientific justification for setting such targets would be gained" (MEPC 30/WP.11, para. 8). The agreed global target did not mean, however, that universal regulation was the only method to reach the target. A strategy for exhaust gas was considered in the working group, and the Committee based it primarily on the NSS recommendations to develop quality standards of 1.5% sulphur content globally and regional measures with 1.5% in certain areas. Several Member States emphasized that more information was needed, and full account was taken of the views presented by the Netherlands (MEPC 30/WP.3), which proposed collecting information, assessing target dates, etc.

Lastly, at MEPC 30, the framing of the issue had now arrived at the point at which it was formulated in a draft Assembly resolution that requested that the MEPC prepare a draft annex

to MARPOL on air pollution from ships. 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" (MEPC 30/24, Annex 13; Resolution A.719(17), 326). The agreed target levels and dates for the considered pollutants – including the target for SO_x – were included as desired objectives. It further requested the MEPC collect and assess information on emissions to establish reference levels and develop requirements for reducing emissions (ibid.).

5.3.3 MEPC 31, July 1991

The target levels and dates were removed from the draft Assembly resolution at MEPC 31.[44] No scientific arguments were given for this removal (MEPC 31/21; MSC 59/2/7).[45] Nevertheless, a Norwegian proposal (MEPC 31/13/2) elaborating on the reference levels and years stated that the methods used for estimating global emissions from ships (by using statistics on fuel consumption and ship movements) were not accurate enough for establishing reference levels and years. An approach to NO_x emissions was suggested that would mean a reference level without using reference years. It was not proposed for SO_x emissions, but Norway intended to further develop its ideas and to provide documentation for discussion on target dates and levels at BCH 21. Hence, it seems that not only the reference years and levels needed further consideration but also the target levels and years. The committee noted that available documents could be regarded as a basis to decide on reference levels and years, though it was recognized that further consideration was needed at the BCH (MEPC 31/21). Before moving on to BCH 21, let us look at a Swedish submission (MEPC 31/13/4). The earlier proposal to use 0.8% sulphur content was now considered a long-term target, and a first step would be a standard of 1.5%. This would effectively decrease the contribution of ship emissions to "the global acidification" (MEPC 31/13/4, p. 3). No scientific support for this argument was given however.

5.3.4 BCH 21, September 1991

At BCH 21, few scientific aspects were reported. Although reference levels and years were included in the instructions for BCH 21, no such discussion was found. The BCH noted that the scope of application needed further consideration, i.e. global or restricted to certain areas. Let us investigate the submissions for scientific arguments behind this note. The *International Association of Classification Societies* (IACS) (BCH 21/11/4) particularly highlighted the lack of and need for data as a basis for reduction decisions. It considered it "clearly unrealistic" (BCH 21/11/4, p. 1) to set target levels without access to a reference base with data on emission levels (and available technology). There was further a need to define present levels and years, and they should be supported by sufficient data. Regarding the exhaust gas strategy, it was stressed that the scale of the problem should be quantified as a useful basis for action, and that data on local, regional or global significance of ship emissions in relation to other sources were lacking. Moreover, IACS found that the proposed measures for SO_x appeared to be directed towards specific regions. It was stressed that "by limiting emission restrictions to coastal regions, the bulk of SO_2 emissions from ships are likely to remain unchecked" (ibid., p. 3).

[44] The target levels and dates were kept, however, at the MEPC in its revised action plan (MEPC 31/21).
[45] Amendments were first made at the 59th session of the MSC after a proposal by the US.

A communication (BCH 21/11/5) from the *International Energy Agency* (IEA) of the OECD stressed that scientific knowledge of the contribution of SO_x emissions from ships was highly uncertain. In particular, it was unclear whether SO_2 emitted out at sea actually affected concentrations on land. It was considered possible that local sulphur content restrictions in coastal waters and in port could provide "a vast majority" of the desired reductions of on-shore concentrations (BCH 21/11/5, p. 1). No supportive scientific information was presented, though it expressed that no decisions were to be taken before the results of listed ongoing studies. Almost all of the ongoing studies were conducted by oil industry organizations, e.g. the *Oil Companies' European Organization for Environmental and Health Protection* (CONCAWE)[46] and the *International Petroleum Industry Environmental Conservation Association* (IPIECA). The BCH noted the IEA submission as well as other ongoing studies and requested that members submit further information to the next session "in order to facilitate co-operation between Members" (BCH 21/15, para. 11.23).

Furthermore, Japan's submission (BCH 21/11/6, Annex, p. 1) had the heading "realities of SO_2 emissions in the world", under which it first framed the issue of acidification as "a major international environmental issue in specific areas" (ibid.). It then cited Norway's study (MEPC 29/18) to highlight that emissions were not significant globally but specific to countries and areas. It was concluded that a reduction target should include a thorough examination of the location of problems. It framed the issue as a necessary problem to be dealt with globally and, especially, a problem for coastal areas with serious damage. It thus proposed to treat the issue separately.

5.4 1992: Towards a Regional Approach

5.4.1 MEPC 32, March 1992

At MEPC 32, two submissions were discussed. The first (MEPC 32/12/1) was from the *Oil Companies International Marine Forum* (OCIMF). It included an interim report with the first results of the study by CONCAWE mentioned above. The study assessed the contribution of ship emissions to the overall sulphur burdens in Scandinavia and Northwestern Europe based on EMEP data for 1988. The results indicated that the contribution was less than 2%, which was reported as minimal by both CONCAWE and OCIMF. The study concluded that reductions of land-based sources provided "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 global measures could not be justified by environmental benefits. The report noted, however, that ship emissions could make important local contributions, which would be further assessed. No discussion was found in the session report other than that the delegation of Germany expressed that it could not share the view of minimal contribution (MEPC 32/20). The reader should be aware, however, that the CONCAWE study will reappear in different forms and discussions as we move further in the process. The second submission (MEPC 32/12/2) was from the *International Association of Independent Tanker Owners* (INTERTANKO). It framed the problem as international and as requiring international regulation. However, it highlighted that quantities of SO_x emissions were unknown, and thus the 'present level'. A long-term research activity was required in order to determine worldwide quantities. INTERTANKO was concerned that reduction levels would

[46] The abbreviation stands for *Conservation of Clean Air and Water in Europe.*

be set without this knowledge. It considered that data gathering on the present level should be given the highest priority, and that a percentage reduction should be established thereafter.

5.4.2 BCH Correspondence Group on Air Pollution from Ships

Although the above developments had discussions on regional versus global regulation, the Correspondence Group on Air Pollution from Ships was the first policy-making arena in which such discussion was explicitly reported. From the report, I found that the way different actors framed the problem was a significant factor in how they viewed the scope of actions. 'Some members' preferred the regional solution, as the problem of acid deposition was restricted to coastal areas, while the "fairly well documented" (BCH 22/7/3, p. 3) long-range transport of SO_x made 'some members' prefer a global solution that had mandatory regulations even far out at sea. The global reduction target of the MEPC was a significant factor that BCH 22 should consider for this policy choice. The global approach was considered to be the only option for achieving the target of reducing emissions by 50% before the year 2000. It was reported that "a slight majority" (ibid., p. 4) favoured a global approach. The regional option implied a need for the MEPC to change the target. A related aspect of the global preference is that the group had in its instructions to develop controllable regulations, and that control of different regulations in different areas was considered difficult or even impossible. According to the report, this instruction suggested global, unified regulations and no special areas. The developed initial draft annex to MARPOL thus showed a 1.5% global sulphur content limit (though in square brackets since there was no consensus).

5.4.3 A Regional Approach at BCH 22, September 1992

We have now arrived at BCH 22 when a framework for regional control – termed 'a regional approach' or 'the regional concept' – was developed with sulphur limits in specific areas and a supplemental global cap. Other than a discussion on the necessity of action, the relevant reported discussions did not include scientific aspects. Nevertheless, reasoning on the 'regional concept' for control of SO_x emissions was given by a 'group of volunteers' who developed a proposed regional approach (BCH 22/WP.4, Annex). to prepare a framework on the regional concept. The only scientific argument given for choosing a regional approach was the protection of areas affected by acidic emissions.[47] It specifically defined the approach as control of emissions within coastal zones and special areas. *Coastal zones* could be identified by working out the distance from the shore at which environmental effects do not occur. *Special areas* could be identified as areas with unacceptable deposition effects. It was stressed that a substantial amount of data was needed for identification and to ensure that regional control did not result in environmental harm on the open sea. It was further stated that regional control "does not preclude possibilities of measures of a global level" (BCH 22/WP.4, Annex 2, p. 2). The concept of global 'capping' was then introduced as an "element included in the regional concept" (BCH 22/WP.4, p. 4). Regional control was considered the leading principle, and a global cap would merely be a supplement. The general idea was to form a worldwide barrier (or ceiling) of possible rising sulphur levels in bunker fuel as a result of increasingly stringent standards for land-based fuels. It was suggested to "cap" (or limit) the sulphur content in bunker fuels to 3.5% (presented in square brackets). In the working group, the delegation of the Bahamas expressed that a relatively high cap of 3.5%

[47] Another reason was problems with undeveloped on-board exhaust gas cleaning and problems with marine pollution from these systems. How this was a reason for regional control was not clarified.

must be considered for any meaningful effect on global SO_2 emissions levels. The working group could not proceed with further discussion (BCH 22/WP.4; 22/14).

A striking observation of BCH 22 is that the scientific arguments were dominated by support for three views: (1) no global measures with preferred regional measures, (2) no measures at all or local measures at most, or (3) postponing action. Scientific arguments for global measures were absent. The only scientific content found that could have been used as an argument for global measures concerned the long-range transboundary nature of SO_x emissions highlighted in a Norwegian submission (BCH 22/INF.16). It did not show the global contribution or argue for global measures, and much information could be interpreted as both a regional/local contribution and a large-scale contribution.[48] Nevertheless, it highlighted that with a typical offshore wind of 10 m/s, SO_2 was found to be transported 700-1500 km before deposition, which was not the case in the arguments of the three views. The scientific arguments and supportive information for the three views are addressed in the following subsections.

5.4.3.1 Arguments for Regional Measures Instead of Global

The arguments for regional measures instead of global ones were characterized by three themes: the contribution of ship emissions, the concept of critical loads, and the negative environmental aspects of global control.

Contribution of Ship Emissions

OCIMF submitted three documents on the agenda item. The study by CONCAWE was in focus. It had been conducted in three parts: (1) the Northern European situation, (2) the regional European situation, and (3) the local European situation. The first part was summarized in the earlier interim report (MEPC 32/12/1), and the other two were in focus at this session. However, OCIMF highlighted the first repeatedly in two submissions (BCH 22/7/9; 7/12). BCH 22/7/9 highlighted the minimal contribution in Europe and that if it was not proven otherwise, it was unnecessary with global measures. Regional measures were not considered unnecessary in this particular submission, however, and it saw the concept of special areas as a prominent alternative.

The first submission (of eight) by Japan (BCH 22/7/4) presented contemporary views, as it awaited the results of its studies and investigations. One of the views was that the issue of SO_x emissions should be treated separately as a global problem and an additional problem in specific areas – note its view at BCH 21.This was motivated by economic arguments, but when investigating the subsequent submissions (BCH 22/INF.10-14; 22/7/8), scientific arguments were used to support this view. In fact, the same view was presented (BCH 22/7/8) as a conclusion of Japan's review of SO_2 emission data. A similar study to the Norwegian Marintek study (MEPC 29/18) was presented (in BCH 22/INF.10). It had estimated SO_2 emissions from ships and divided the total figure per international route. Only Northern Europe was presented on a map. As in previous studies, different years were used for different data (e.g. bunker volumes for 1991 and trade volumes for 1986), and OECD data were used for land-based emissions, which implies estimated emissions in non-OECD countries. It was found that emissions from ships represented about 4.5% of the total global SO_2 emissions. The comparison thus confirmed the Norwegian conclusion of a contribution about 4%. This

[48] 80% of the emissions in the Ekofisk area (mid-North Sea) would be deposited on land. A larger percentage would be deposited on acidified areas if the sources were closer to Norway, and a new study by Marintek had found that 65% of the emissions from international shipping occurred within 12 nm of land (BCH 22/INF.16).

was considered "extremely small" (BCH 22/7/8, p. 2), though SO_2 emissions from ships were "especially a problem for special areas" (ibid.) with serious damage and high traffic.

One way of designating special areas, according to Japan, was to focus on areas and routes where emissions were high, by calculating emissions and contributions to total emissions in specific areas. The results of such calculations were presented for four areas in the world. As before, land-based emissions were estimated from OECD data. Emissions from ships were found to be especially high in Northern Europe (672,000 tons; 5.2% of the total), followed by North and Central America (503,000 tons; 1.9%). By contribution to the total emissions, however, Southern Europe and the Middle East were the highest (237,000 tons; 5.5%). East and Southeast Asia had the smallest emissions and contribution (200,000 tons; 1.1%) (BCH 22/INF.13). Northern Europe was highlighted and high emissions in the Strait of Dover, the English Channel and Scandinavia were mentioned (BCH 22/7/8). In addition, Japan submitted information on the present state of air pollution in its own territory. It highlighted that damage caused by acid rain was severe in Europe and North America and then stated that there was no evidence of significant impacts in Japan despite considerably high acidity in the rainwater. It further highlighted decreasing SO_2 concentrations due to successful measures on land-based sources in Japan (BCH 22/INF.14).

Critical Loads

The concept of *critical loads* was introduced at BCH 22 by the UK (BCH 22/7). It was defined by the UK as "the quantity of a substance falling on a given area over a given period which a specified part of the local environment can tolerate without adverse effects occurring" (BCH 22/7, p. 1)[49]. A conference within LRTAP had agreed to the use of critical loads as guidelines for the level of abatement of air pollution, e.g. by developing maps that showed critical loads and deposition ratios for different pollutants. The UK stressed that the effects of acid rain had great geographical variations depending on factors such as local geology. A critical loads analysis could be conducted to determine whether ship emissions were absorbed in the open sea, which in such a case would make emission reduction unnecessary on the open sea and necessary close to the shore or in 'special areas'. It was realized that analyses of critical loads for every coastal zone in the world were problematic, and thus an initial policy solution was proposed to introduce requirements within a certain distance of the coast, with the possibility of excluding certain areas depending on a future analysis.

Negative Environmental Aspects of Global Emission Control

Potential additional environmental impacts of global measures were highlighted by OCIMF (BCH 22/7/9) and the Netherlands (BCH 22/INF.7) as an aspect that needed to be taken into account. This mainly concerned increased energy consumption, and in turn increased CO_2 emissions, due to energy intensive desulphurization processes at the refineries.

5.4.3.2 Arguments for Local or No Measures

This session did not only represent different views on local, regional and global measures but also on the very necessity of action. This resulted in an agreement by the BCH to request the MEPC to consider the necessity of measures. Before this agreement, three groups of members (of the working group) had given the following arguments (BCH 22/14; 22/WP.4):

[49] A commonly used definition of critical loads is "a quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge" (Grennfelt and Nilsson, 1988, p. 9).

- Shipping's contribution to total global emissions was too small to take action.
- The necessity for action was clear. The contribution would increase in the future while land-based emissions would be reduced.
- The developments had been too fast and further studies were needed on emissions.

This section investigates the scientific arguments and supportive information for both local measures and questioning the need for action. A common theme for these arguments was the contribution of ship emissions but with four different scientific arguments to show an insignificant contribution: (1) emission versus deposition, (2) lack of empirical evidence, (3) dilution at sea, and (4) the use of distillate fuels in coastal waters. Before investigating these arguments, the Norwegian submission (BCH 22/INF.16) should be noted despite its lack of arguments. It highlighted a calculation made by the Norwegian Metrologic Institute for an EMEP report. It had found that SO_2 emissions from international shipping represented only 2.5% of the total emissions in Europe. However, the EMEP report noted that the figure was probably too low due to, among other things, the lack of data for emissions in the heavily trafficked Mediterranean Sea.[50]

No Significant Regional Contribution: Emissions versus Deposition

OCIMF (BCH 22/7/11) provided scientific counterarguments to the Norwegian submission (MEPC 29/18). The criticism concerned analysing the contribution of ship emissions by focusing on emissions and not depositions. It was considered necessary to analyse the contribution of ships to the total deposition of sulphur on land. It specifically targeted Norway's finding of a 14% ship emission contribution to the national emissions in Norway[51] and stressed that it was essential to include all contributing sources to a country's sulphur burden (depositions). In such an analysis, the emissions from other countries were the largest contributors and the national emissions were very small: 5% in Norway according to OCIMF. The ship emission contribution was even less, with EMEP data indicating only a 2% contribution in Norway. It did not specify, however, whether this concerned national or international shipping (Norway's figure was for national shipping). With the second part of the CONCAWE study, OCIMF (BCH 22/7/12) further highlighted a minimal regional European contribution. The ship emission contribution to sulphur depositions was assessed using EMEP data provided in grid squares of 150 km^2 (150 km x 150 km) for four countries. Again, Norway was highlighted. The results showed that a significant proportion of Norway's land area was "virtually unaffected by ship sulphur emissions" (BCH 22/7/12, Annex, p. 2). While Benelux (Belgium, the Netherlands and Luxembourg) had a high sulphur burden, the contribution from ships was small. It was concluded that the contrition was minimal even at a regional European level.

Lack of Empirical Evidence to Support Measures

Liberia's submission (BCH 22/7/7) strongly based its views on the CONCAWE study and OCIMF's previous conclusions (BCH 22/7/7, p. 1):

> *The drafting work on the Annex was initiated when it was believed that ships were a significant source of air pollution. Evidence now submitted by the Oil Companies International Marine Forum indicates that, in fact, in the case of SO_2 such ship-based pollution is small relative to that from all other sources*.

[50] It also assessed the distribution of ship emissions along the Norwegian continental shelf (using EMEP grids of 50 x 50 km^2). It was found that the SO_2 emissions from international shipping were more than twice those from national shipping in Norway (BCH 22/INF.16).

[51] Earlier unknown study described in MEPC 29/18

According to Liberia, there was lack of empirical evidence of such high emission levels from ships that the environment would be significantly improved if emissions were removed. It could not support regulations if OCIMF's conclusion of a minimal contribution was correct. Shipping was not considered a dangerous threat to the atmosphere. It acknowledged a contribution in isolated local areas, and thus saw local solutions where it could be proven.

No Significant Local Contribution: Emissions Are Diluted at Sea

The third part of the CONCAWE study assessed the local contribution (BCH 22/7/12). It had modelled emission dispersion on three ship sizes burning bunker fuel with 3.3% sulphur content. A model by the US Department of the Interior (the Offshore and Coastal Dispersion model) was used to calculate dispersion and the distance where maximum 1-hour concentrations occurred (at sea level). It merely focused on dispersion and did not include deposition or atmospheric reactions. Nonetheless, the conclusion highlighted by OCIMF was that "the emissions from a given vessel have an insignificant *contribution to local sulphur burdens*" (BCH 22/7/12, Annex, p. 2, emphasis added). It was found that dilution from the smallest modelled ship occurred at a distance of 5 km and at up to 20 km for larger vessels. Despite an insignificant contribution, OCIMF concluded that ship emissions could be a local problem under heavy traffic and adverse dispersion conditions, and that further studies were needed before considering legislation on local problems. In addition, Japan (BCH 22/INF.13) made a similar calculation on a hypothetical ship and route but without arguments for local measures only. It was part of a second proposed option to designate special areas, focusing on coastal zones where ships affected land areas a specific distance from the shore. For that purpose, Japan suggested using the Pasquill method to estimate dispersion and calculate SO_2 concentrations for a specific distance from the source. It was found that the maximum concentration (C_{max}) was at a distance of 1.5 km, with half of C_{max} at 4.3 km and a tenth of C_{max} at 15 km (BCH 22/INF.13).

No Significant Local Contribution Due to Distillates

ICS, Liberia and OCIMF (BCH 22/7/6; 7/7; 7/ 9) had the view that regulations should only apply to main engines and not to auxiliary engines, which were stated to be responsible for only 10% of air pollution from ships. In addition to these arguments, the information provided by Norway (BCH 22/INF.16) included a conclusion that shipping could not be considered an important contributor to local pollution. Ships near shore mainly used distillates with low sulphur content, which implied relatively small emissions. It was further noted that emissions in port areas only constituted a small part of the total emissions from ships and that the 10% figure was used by Norway in its calculations despite a previous estimation of 15%.

5.4.3.3 Arguments for Postponing Action: Lack of Research

Several submissions stressed the importance of research and the need for sufficient information before taking decisions. Liberia (BCH 22/7/6) emphasized that air pollution from ships needed to be understood far better before the BCH could recommend a draft text. It further saw an urgent need to explain the big differences between the CONCAWE study and earlier findings. ICS (BCH 22/7/6) and OCIMF (BCH 22/7/9) both expressed that the development had been too fast with insufficient research. OCIMF believed that well-founded studies should guide environmental regulations, and had the view that no decisions on SO_x emissions should be taken until ongoing research had been completed. ICS saw a need for the IMO to instantly assess known and ongoing research in order to compare emissions against land-based sources and to evaluate environmental impacts.

5.4.4 MEPC 33, October 1992

At MEPC 33, the reopened question on the necessity of action was considered. It was recalled that a strategy to deal with air pollution had been developed based on "substantial information and data" (MEPC 33/20, para. 12.4) and that the Assembly resolution requested the committee develop regulations and a new annex to MARPOL. Several delegations expressed that the necessity had already been justified at previous sessions and that there was no further need to discuss this issue. The committee thus agreed that the BCH would continue its work (MEPC 33/20). The committee further considered a submission by the US (MEPC 33/INF.17) without reported discussion. It provided a bibliography of papers and reports related to air pollution from ships compiled by the *Society of Naval Architects and Marine Engineers* (SNAME). On a closer look at this bibliography, I found 171 papers and reports covering 1971-1992 with several published in scientific journals or conference proceedings. However, most were reports of governmental agencies, industry, conferences and meetings, as well as many earlier submitted IMO documents. The titles of several studies did not clearly show that they addressed ship emissions, and studies on specific pollutants focused on NO_x. The only inclusion of sulphur emissions in titles were in IMO documents.

5.5 1993-1994

5.5.1 MEPC 34, July 1993

No discussion was reported at MEPC 34, though some submitted documents were noted and referred to the BCH for consideration (MEPC 34/23). OCIMF (MEPC 34/3/1) submitted a study undertaken by IPIECA (prepared for OCIMF for its submission). It highlighted that SO_x emissions had historically been identified as responsible for regional acidification and poor local air quality, and the IMO had taken the first global initiative. Based on bunker testing on delivery at 100 ports around the world, the average sulphur content for 1990 was found to be 2.9%. Contrary to earlier discussions at the MEPC, IPIECA concluded that increased stringent land-based regulation was unlikely to have big effects on the sulphur content of marine fuels. Based on different scenarios, the global average could either remain at the 1990 level or in the worst case increase to 3.12%. IPIECA thus questioned if any environmental benefits would be achieved with a 3.5% cap. It estimated a 5% emission reduction at most. Given that only 25% of the emissions reach land[52], it concluded that the reduction benefits over land would be "imperceptibly small in all situations" (MEPC 34/3/1, Annex, p. 3). OCIMF further added that the net reduction in SO_x pollution in Northern Europe and Scandinavia with a global cap of 3.5% was estimated to be 0.1%. In addition, only a 1% reduction would be gained from a 1.5% sulphur content limit[53]. IPIECA recognized the potential benefits of a regional reduction in areas with clearly identified sensitivity and potential benefits however. OCIMF thus supported regional or local controls.

Sweden (MEPC 34/INF.20) distributed an extensive report (Alexandersson et al., 1993) conducted by the consultant Mariterm AB. It intended to calculate emissions from ships in the area closest to Sweden. Movements of merchant ships over 300 GT were mapped within an area delimited to a line between Helsinki and Tallinn in the east and Skaw and Kristiansand in the west. It used official statistics, arrivals and departures in several ports and a survey sent to ferry operators. For SO_x, the sulphur content and fuel consumption were used to calculate

[52] The minimal contribution found in the CONCAWE study was explained by about 75% of the emissions from ships not reaching land. Data for other regions were seemingly not available, and it was stated that there was no reason to expect higher contributions elsewhere due to the high ratio of land to sea masses in Europe.
[53] This was according to OCIMF estimates in BCH 22/7/12, though no such figures were found.

emissions. The results showed that in total, approximately 84,700 tons of SO_2 were emitted in the area in 1987. Emissions were divided into different categories of ship traffic, though the delimitations were many, which affected the results. As an example, ferries had the largest emissions while international shipping had rather low emissions, but this was due to the inclusion of only traffic to and from Swedish ports in the international category. The investigated year was 1987, when the sulphur content of fuels in ferries was about 2%. Since then the ferry lines have switched to fuels with 0.1-0.6% sulphur as a gesture of environmental goodwill. This made the authors exclude SO_x emissions from a further study on emission distribution. Nevertheless, it concluded that deposition in the sea was not a problem since oceans were not exposed to acidification. Besides expressing the importance of evaluating where most emissions were located, the following was concluded (ibid., p. 14):

> *If a controlled sulphur content is introduced only within certain areas, it will almost certainly lead to the passing of high sulphur fuels to uncontrolled markets. Therefore, it will not cause the total discharge of sulphur oxides to diminish.*

France (MEPC 34/INF.21) submitted results of an attempt to evaluate maritime emissions in the western Mediterranean Sea. The studied area comprised the Strait of Gibraltar to Sicily and Cap Bon, Tunisia. Previous studies were based on ship traffic, fuel consumption and emission factors, though they focused on ships operating under steady state conditions of the high seas. Emissions in and near ports were thus excluded, and there were more delimitations; e.g. ships that did not stop in any port in the area were excluded, all routes had the same length to ports – which reshaped the area as a circle – and all ports had similar traffic structures. The results indicated 227,841 tons of SO_2 emissions from ships in the area, which was about 20% of the total emissions in France and slightly below the emissions from all the French industries. Given the big delimitations, it was emphasized that the results had to be taken with caution, and that they were more than likely to be well below the actual emissions.

OCIMF distributed the full report of the CONCAWE study (CONCAWE, 1993) and once again summarized it (MEPC 34/INF.36). Some relevant details and previously unmentioned parts of CONCAWE (1993) are here highlighted. On the details, the first part of the study (the Northern European situation) consisted almost solely of graphs on existing data sets from EMEP for 1988, and it had used the same data as the Marintek study in MEPC 29/18. Domestic shipping was not included, but it was considered not to affect the results significantly due to the main use of distillates. On the regional European situation, the report revealed two case studies on the Norwegian coastline and the Baltic Sea Area that added data on national shipping to the assessments of the report. The result was one-third higher total ship emissions in Norwegian waters, though it was still considered an insignificant contribution. For the Baltic Sea, the emissions increased by 50%, which meant that the sulphur burden from ship emissions would proportionally increase in this area. It did not evaluate whether this was significant but instead focused specifically on Finland, followed by the conclusion that the contribution was still insignificant (6.3% of the total deposition). On the local European situation, emission data were assessed at a more detailed local level for the Dover-Calais area and Marseille Harbour area. Emission concentrations were found to be high along the Straits and exceeded the background concentrations in the English Channel. For the Marseille harbour area, emissions were low compared with inland emissions (11%). Since it was the third largest port in Europe, it was considered a good example of the situation in many highly industrialized coastal areas. It thus concluded that reducing ship emissions would have little impact on the total emissions in such areas.

5.5.2 1st Intersessional Meeting of the BCH Working Group, July 1993

No specific discussion on SO_x emissions was found in the report of the First Intersessional Meeting of the BCH Working Group on Air Pollution (BCH 23/7/7).[54] Nevertheless, the US delegation emphasized "the outstanding need" for evaluating the target levels in studies (BCH 23/7/7, para. 13.1). It was stressed that the objectives stipulated at MEPC 31 "have not yet been supported by an estimation of environmental benefits to be realized through achievement of a given target level" (ibid.). It thus urged for such studies to be conducted within the timeframe of the work plan.

5.5.3 BCH Correspondence Group on Regional Control Options

The report of the Correspondence Group on Regional Control Options for NO_x and SO_2 (BCH 23/7/4) provides a scientific reasoning behind choosing a regional approach, the concept of global capping and the use of a combined approach. To begin with, it argued that a global sulphur content reduction would be the easiest way to achieve an emission reduction at first sight, though at second sight it raised doubts about the necessity of a worldwide reduction. Air pollution from ships was framed as a regional problem, and a stringent global standard was considered 'overkill'. 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. No other scientific explanation for this lack of support was given than the above regional framing and doubts on necessity. Scientific arguments were merely used as justifications for the chosen regional approach. The concept of critical loads was one such justification. It was stated that there were no intentions of applying the critical loads concept to shipping, and that a regional approach could conflict the critical loads concept due to uniform sulphur limits in all designated areas. The justification was instead that it would be impossible to prevent exceedance of critical loads in certain coastal regions with only land-based measures. 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 would be applied in areas where there was "a clear need to protect the environment from quantities or concentrations of pollutants which cause long or short term adverse effects" (ibid. p. 7). Concerns of countries would not be sufficient justification to designate an area. Guidelines would be developed in similar ways as for the concept of 'special areas' under MARPOL, but adapted to air pollution. Such criteria of scientific relevance could include:

- Adverse impacts on air quality and/or acidification
- Contribution of such high levels that land-based measures cannot achieve emission reduction levels below a target level (e.g. a critical load level)
- Adverse impacts on water quality
- Emission distribution as a basis for delineation of the area

It was acknowledged that the regional approach would not preclude global measures, e.g. a global cap of 3% sulphur content. Although the global limit was open for discussion, it was stated in a note that a cap of 3% would "not lead to any reductions of sulphur oxides worth mentioning" (ibid., p. 6). As stated at BCH 22, the point of capping was not to reduce global emissions but to prevent a possible increase in the sulphur content. It was also stated that another reason for a global cap was the introduction of a regulation that could be reviewed if necessary. This integrated approach would "provide for a generally applicable protective

[54]No other documents were found in the archives of the Swedish Transport Agency either (see Chapter 4).

measure, although of a moderate nature, associated with gradual measures for a higher level or protection of certain regions" (ibid.). It was stated, however, 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 target level of a 50% reduction by the year 2000. In fact, it was acknowledged that the reduction target may not be reached in either quantity or time by this approach. It would "nevertheless still achieve some of benefits for the environment that the proponents of the reduction targets and dates had in mind" (ibid.). With a regional approach, it was considered necessary to reconsider the target.[55] Nevertheless, it emphasized that reference years should still be established, and that the choice of reference year should take into account that emissions were increasing. With an early reference year, the actual reduction had to be greater than for a later reference year.

A justification for measures in general inclu ded emission reductions of other pollutants due to the emissions of PM, PAHs and heavy metals being interlinked to the sulphur content. It also included a clear reference to the precautionary principle of the Rio Declaration[56], which was considered to be of particular importance as the extent of the ship emission contribution to transboundary air pollution was not clear and its consequences were not fully investigated. It was concluded that a lack of scientific certainty was no reason for postponement of measures, though further research was required due to the doubts expressed on the necessity of action. It highlighted fields such as distribution modelling, emission factors, air quality and interrelations of pollutants. There was also a need to compile ongoing research. The group was unable to be conclusive on some of the basic questions, which could serve as a basis for discussions at BCH 23. These included the question of whether a global cap should be introduced and whether regional measures would be sufficient for the desired emission reduction. The proposed Regulation 13 included a 3% global sulphur cap and a 1.5% limit in certain sensitive areas, though both figures were placed in square brackets (BCH 23/7/4).

5.5.4 BCH 23, September 1993

At BCH 23, the outcome of the correspondence group was the foundation for the working group. In the discussions, both OCIMF and Norway presented studies on acidification from shipping, though it was not specified which (BCH 23/WP.3). OCIMF's submission (BCH 23/7/5) did not present a study, but it gave positive comments on the work of the correspondence group and strongly supported compiling research. Based on "the best available authoritative scientific information" (BCH 23/7/5, p. 3), it could not accept that there were threats of serious or irreversible damage, as prescribed by the precautionary approach. Norway's submission (BCH 23/INF.18) agreed with OCIMF's view at BCH 22 (BCH 22/7/11) with regard to the significance of deposition when considering acidification. It highlighted that undetermined origins constituted the largest contribution to SO_2 deposition in Norway, which could have been underestimated ship emissions. It then showed tables and graphs of estimated emissions and depositions. It noted that worldwide figures for the ship emission contribution did not exist. Nevertheless, EMEP calculations had been made in 1991[57] on the contribution of international shipping to depositions in Europe. It showed that about 25% of the emissions from international shipping were deposited on land, but the

[55] The target was further viewed as provisional.

[56] "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).

[57] Norwegian Meteorological Centre (1991), cited BCH 23/INF.18.

remaining emissions did not all deposit over sea. About 32% of the emissions were transported out of the geographical area covered by the EMEP model, which was highlighted. It was further found that the contribution to the total deposition over land was merely 0.6%. Note that this is much less than the approximate 2% in CONCAWE (1993). This low figure was explained by a low contribution of ship emissions to total emissions in Europe (1.4%), which was considered likely to be a great underestimation by both EMEP and Norway (e.g. due to no included data for the heavily trafficked Mediterranean Sea). Norway further showed chartered distribution of sulphur deposition on EMEP maps.[58] It was found that high amounts of emissions were distributed and deposited outside the area covered by each map: only 30-45% was deposited within the mapped area. According to Norway, this clearly indicated that SO_x emissions from ships were widely distributed and implied that they were deposited far away from their source. It was thus considered unsuitable with a local or regional approach.

Other submissions contributed further to the scientific discussions (including MEPC 34/3/1; 34/INF.36). The UK (BCH 23/7/1) summarized the results of the second phase of the marine exhaust emissions research programme by Lloyd's Register.[59] Ships' impact on local air quality around the port of Vlissingen in the Netherlands had been studied. This was an area with likely impacts on local air quality due to high levels of ship traffic, few industrial sources, etc. It was found that SO_2 emissions from ships represented about 20% of the industrial sources within the area. Nevertheless, the industrial sources were 15 times higher when considering the relative area of estuary to land mass. Dispersion modelling further showed the highest emissions in port. It was concluded that ship emissions made a relatively minor contribution to the average SO_2 concentrations in the area. Saudi Arabia (BCH 23/7/6) had reviewed European pollution reports from 1985 to 1990 and found that the contribution from ship emissions to the total SO_2 pollution was 2%. A global regulation was thus not 'approved' by Saudi Arabia, but it recognized that certain areas required measures. It further expressed a local framing of the problem as well as a solution, by referring to the results of dispersion modelling (e.g. CONCAWE, 1993). Lastly, the US (BCH 23/7/8) emphasized caution until the full extent of the impacts of air pollution from ships was known. Reference was made to the Assembly resolution on the necessity to collect and assess information, in particular in relation to establishing reference levels. It was stressed that not all the required information had been compiled and that it was necessary to obtain. The US further framed the problem as regional based on the available information, though the transportation of SO_x over oceans needed to be better understood.

There was little support for a global approach in the working group, which thus left it behind and focused on either regional measures alone or in conjunction with a global cap. The opinion on whether global capping should be used was evenly divided within the group, and the BCH was unable to draft requirements for SO_x emissions. The delegations that were in favour of a global cap had the following scientific arguments (BCH 23/WP.3; 23/14):

- Avoidance of a future increase in sulphur content in fuel oil
- It could be a first step in a step-by-step approach to achieve the target level.
- Only regional measures could result in high-sulphur fuel being distributed to other areas. Emissions could thus be exported to areas outside regulated areas.
- SO_2 emissions are transported long distances and affect wide areas.

[58] Calculations conducted by Barrat and Berge (1993), cited in BCH 23/INF.18.
[59] The reports were also handed out during the session in limited copies.

- Global measures could be justified by the precautionary principle and the acidification status at the time.

The delegations that did not support a global cap had the following scientific arguments:

- The environmental benefits gained from global capping were negligible.
- The regional approach would deal with acidification caused by ships in designated areas, which meant there were no environmental reasons for global capping.
- Presented figures showed no indication of an increase in the sulphur content.

As a compromise, the delegations of the US and the Netherlands suggested that the sulphur content of fuel oil be monitored, and if a threshold value of 3.2% sulphur content was exceeded, a 3.5% global cap would be applied (BCH 23/WP.3). In plenary, the Swedish delegation raised some concerns. It highlighted and questioned the numerous elements favouring a global cap not having been treated equally to the less environmentally justified arguments against it. According to Sweden, it had been impossible to reach consensus due to this situation. On the MEPC targets, it felt 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). In addition, the delegation of Egypt stressed the need for further data on air pollution levels before any decision (stated in connection with economic arguments) (ibid.).

The working group continued its work after its report to the plenary. It was realized that the definition of special areas could not be restricted to the special area concept of MARPOL. Since air pollution affects surrounding land areas it had to be included in addition to sea areas. The geographical delineation would have to include a set of criteria in guidelines, including transportation and distribution of pollutants, meteorological conditions, etc. A uniform standard for all special areas with sulphur contents of 0.5-2% was discussed, with 1.5% in majority. There was no reported scientific argument on the basis of these limits, however, nor on why the specific scientific criteria should be used. Moreover, the group exchanged views on its research on the initiative of the US delegation. The result was an agreement to submit information to the Secretariat on current and ongoing research (BCH 24/7/1).

5.5.5 BCH Correspondence Group on the Regional Approach

The report of the Correspondence Group on the Regional Approach for Controlling SO_x Emissions (AP/WG 2/3) described a polarization of views on global capping. The views were 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. No scientific arguments were found on these options in the report. The question of delineation of special areas also had a polarization of views with either 12-15 miles or 200 miles from the coast, or the view that further research was needed before decisions were taken. Since the views were not reported, the following focuses on the scientific contents of the draft text of the regional approach.[60]

A special area was defined as a sea area that controls SO_x emissions from ships for reasons of environmental conditions in sea and/or land areas. A proposal to designate a special area

[60] The views were presented in J-papers during the second intersessional meeting; AP/WG 2/J/2; 2/J/3. These documents were not provided in the archives of the STA.

should contain a background document addressing oceanography, ecological characteristics, scientific significance, environmental pressures (including those derived from ship emissions) and measures (including land-based sources). The document should further include a review of how the proposal takes into account criteria for designation, developed by the IMO. Such criteria would include ecological conditions – including terrestrial ecosystems, threatened species, sensitive or rare ecosystems, adverse impacts on water quality, human health, etc. – atmospheric conditions – including adverse impacts on air quality and/or acidification – and ship traffic in the area. Additional scientific factors that could strengthen the arguments for a special area would include pollution of such a high contribution that land-based measures could not achieve a reduction target on their own, with measures already being taken to reduce land-based sources, factors causing enhanced effects, etc. The determining factors of the location and extent of a special area (delineation) were almost the same as the above criteria. On the measures to be applied, an emission limit of 6.0 g SO_x/kWh was proposed, corresponding to the use of a 1.5% sulphur content limit (both figures had square brackets).

5.5.6 2nd Intersessional Meeting of the BCH Working Group, February-March 1994

The second intersessional meeting was based on the discussions on formulating draft SO_x regulations in the report of the correspondence group and a few submissions with scientific arguments and information (BCH 24/7/6). OCIMF (AP/WG 2/2) presented historical data on the worldwide sulphur contents of HFO and *Intermediate Fuel Oil* (IFO). It was based on a sample analysis by DNV. The weighted mean sulphur content for both had increased from 2.69% to 2.96% between 1983 and 1993 (from 2.76% to 3.07% for HFO and from 2.62% to 2.8% for IFO). OCIMF concluded that this was a very small and gradual increase, and it once again stated that there was little or no noticeable benefit from a global cap. In addition, this argument would be strengthened if it were eventually accepted that emissions were significantly diluted a relatively short distance from the ship. To assist the working group on the delineation of special areas, OCIMF (AP/WG 2/1) submitted an interim report of another CONCAWE study. The full report, CONCAWE (1994), was handed out during MEPC 36 and summarized by OCIMF at both BCH 24 and MEPC 36. To avoid being repetitive, the full report is reviewed briefly here.

CONCAWE (1993) had highlighted the need for further work on local impacts, which was considered vital for the special area concept. CONCAWE (1994) thus aimed to provide data for assistance in designating special areas. It still focused on Europe, but this time in detail on the English Channel and the southern North Sea (including the Strait of Dover). Taken together, this was one of the world's most trafficked sea areas with large ports such as Rotterdam and Antwerp (CONCAWE, 1994; AP/WG 2/1). The report was based on two studies: an emission inventory (Meech, 1993, cited in CONCAWE 1994) and a deposition/air quality modelling study (Lowles et al., 1994, cited in CONCAWE 1994). According to CONCAWE (1994, p. 2), taken together, it was "the most detailed analysis of its type". The emissions were mapped for about 280 shipping routes as well as for about 80 port areas, of which the largest 11 ports were represented in more detail to evaluate their possible impacts on local air quality. The inventory was based on ship movements, fuel types, sulphur contents, fuel consumption and ship-specific parameters.[61] The study on dispersion and deposition modelling was conducted by the *Imperial College Centre for Environmental Technology* (ICCET) using the UK ASAM model. This model used 20 km^2 grids for the UK and 25 km^2

[61] Notably, sulphur content data (obtained from DNV) consisted of the delivery of fuels to each port in the area (on average ~3% sulphur content for all fuel grades). It thus seems that the study assumed that the inventoried ships all obtained their bunker supplies within the studied area.

grids for Continental land areas. It was used as a basis for the second sulphur protocol to LRTAP and was considered suitable for European coastal areas. In addition, 1 km^2 grids were used for detailed assessments of the major ports.

CONCAWE (1994) strongly underlined that in-port emissions were clearly the significant source of ship emissions in the studied area. About 100 kilotonnes (kt) of sulphur (not SO_2) were found to be emitted per year in the area – compared with a large coal plant of 2000 MW in the UK – and of this, about 26% was emitted within ports. Of the in-port emissions, 50% was from the largest ports. On the dispersion modelling, the emissions were found to be higher through the Dover Straits due to ferry movements, and this traffic caused a high deposition on the Kent and Normandy coastlines. This was considered a relative low contribution to the overall deposition from EMEP data however. Contributions over 10% were only found in nine (of 315) grid squares on land. Overall, less than 5% of the total deposition could be attributed to ships sailing outside territorial waters. According to CONCAWE (1994), the results indicated that even in this area with high traffic, ship emissions did not significantly contribute to deposition. Reducing the emissions in only four ports would result in greater environmental benefits than controlling all the emissions in the area (CONCAWE, 1994; AP/WG 2/1).

On special areas, the BSS (BCH 24/7/4) proposed that special areas would require criteria in guidelines, but that detailed scientific evidence did not need to be presented to the IMO for granting special area status. The submission further proposed that the paragraph with 6.0 g SO_x/kWh (within square brackets) should be deleted as the validity of such a value could be questioned and that it was difficult to verify. A 1.5% sulphur content limit should be the regulation. Many delegations and observers opposed the above proposal of no need for detailed scientific evidence. They emphasized that presenting clear scientific evidence was of paramount importance, and reference was given to Assembly Resolutions A.500 (XII) and A.777(18). Resolution A.500(XII) set objectives for the 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" (Resolution A.500(XII), para. 3). Resolution A.777(18) on the work methods and organization not only invited the attention of committees to this recommendation but also encouraged solutions aimed at informed decisions. The many delegations against the BSS proposals expressed that that criteria and procedures should be based on the work of the correspondence group, formulated as guidelines. Only the IMO should designate special areas after being provided with clear scientific evidence and considering it thoroughly against the criteria. The delegation of Norway could not agree with this.

The same emission limit and sulphur content limit for special areas as of the correspondence group were agreed in general (in square brackets), though the proposal by the BSS was added to the draft text. The delegation of Germany, however, stated that acceptance of a maximum sulphur content limit depends on the delineation of the area. The BSS submission also included a proposal to designate the Baltic Sea Area as a special area in the new annex to MARPOL, though no scientific arguments were given. It was considered by the group and placed in square brackets in the draft regulation. An understanding was expressed by many delegations that clear scientific evidence could be provided by the BSS before adoption.

The issue of global capping was discussed intensively but without reported scientific arguments and without agreement. The Bahamas proposed 5% for proposal A and Spain proposed a compromise global cap of 4%. Reported support of members suggests that

proposal A and the compromise solution was in majority. [62] The delegation of Japan stated that the earlier proposed 3.5% had been a compromise of different proposals, including lower figures. It thus had the view that if the BCH and the MEPC considered a figure higher than 3.5%, it should also consider lower figures. The later drafted global cap had all three figures in square brackets combined with proposal B, which it would only apply after monitoring of the sulphur content had showed exceedance of a threshold value of [3.2%] or [3.7%]. No scientific arguments for the 3.7% value were found (BCH 24/7/6).

5.5.7 MEPC 35, March 1994

The BSS proposal to declare the Baltic Sea Area a special area was further discussed at MEPC 35. Although several supported designation, others had the view that designating the Baltic Sea Area a special area would require a review of the supporting evidence and relevant data in relation to the guidelines, which were still under development. The UK, in particular, stressed that it was premature with regard to its ongoing research, which could affect the conditions for special areas and the development of the new annex in general (MEPC 35/21). The delegation of Sweden saw the environmental conditions of the Baltic Sea as enough to justify immediate actions, and it announced that the BSS already had criteria and measures but only for its own ships (ibid.).

5.5.8 BCH 24, September 1994

BCH 24 was the target session for the BCH to finalize its task. With regard to special areas, not much discussion was reported but rather lists of amended paragraphs. This was also the case for a second report of the correspondence group on the regional approach (BCH 24/7/9), which had been given additional work on criteria and procedures after the second intersessional meeting (BCH 24/15; 24/WP.7; 24/7/9). The discussion on global capping was intense but made no progress. There was no support for proposal B, and the 5% limit was in majority. A compromise of 4.5% was supported by a majority of delegations, though no consensus could be reached. A revised draft text thus included 5% in square brackets. No scientific arguments were reported, though discussed global limits were submitted as formal proposals with some scientific arguments (BCH 24/15; 24/WP.2; 24/WP.7).

A 4% global cap was proposed by Spain (BCH 24/7/8), which summarized studies on ship emission contribution to sulphur burdens. The listed studies focused on CONCAWE studies and OCIMF submissions, with a Norwegian study as the exception. Its policy was no global cap and a preference for special areas, but it saw a 4% cap as a compromise solution (BCH 24/7/8). A 5% global cap was proposed by Singapore (BCH 24/7/14). It stressed the importance of controlling sources that made more serious contributions than shipping, and highlighted that a study on the port of Singapore had showed that land-based sources constituted 96.3% of the total SO_x emissions. The study had also showed that a reduction of the sulphur content from 4.5% to 1.5% would only result in a 0.1% improvement in the air quality. Singapore also highlighted a 2% ship emission contribution to total European emissions with the formulation: “according to EMEP” (BCH 24/7/14, p. 2, abbreviated). The submission also stressed the importance of ensuring that reduction methods do not result in increased emissions of other pollutants, e.g. increased CO_2 emissions from refineries. Singapore’s position of 5% sulphur content was further clarified by referring to Assembly Resolutions A.500(XII), A.777(18) and A.719(17) (on air pollution) on the necessity of

[62] See details in Svensson (2011).

information, a compelling need, etc. It also explained that there were only marginal environmental benefits of a 3.5% or 4% global cap. It felt no need at present to control the sulphur content, though a 5% cap was accepted if the BCH felt it was necessary to prevent a future increase of the sulphur content.

A special heading in the session report was devoted to a presentation by OCIMF of CONCAWE (1994), which had been completed (and summarized in BCH 24/7/13, OCIMF). After this presentations, the delegation of Japan presented the results of a study carried out on Tokyo Bay in response to the findings presented by CONCAWE. According to the session report, it was concluded that it was not sufficient with emission control only in port areas. No submission or reference was found on this study (BCH 24/15).

5.5.9 MEPC 36, October-November 1994

Not much was reported on the discussions at MEPC 36. The focus was on the outcome of BCH 24 and the draft text, which the committee could not endorse at the time. Several delegations had expressed their views on global capping, which was briefly highlighted. Two scientific arguments were given. The first was that 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). The second was that the 50% reduction target could not be reached with the proposed requirements (MEPC 36/22). The reported scientific arguments supported stricter reduction limits and not the opposite as seen at BCH 24.

The UK and the Netherlands presented the results of the third phase of the Marine Exhaust Emissions Research Programme by Lloyd's Register. The UK had submitted main findings (MEPC 36/9/6) along with methodological details (MEPC 36/INF.16) together with the Netherlands. The UK submission began with a background that argued that the results of dispersion models could be one of the factors on which agreement on special areas was dependent. Since not a single model could apply to all situations, and numerous assumptions and variables influence the results, discussions on dispersion models were considered difficult. According to the UK, the determination of critical loads is based on, for example buffering capacity, and that successful steps had been taken for objective identifications. Nevertheless, the UK meant that the attempts of the BCH to develop special area criteria and procedures have shown a very subjective agreement on how to protect special areas.

The study had quantified emissions from ships for 1990 in the North-eastern Atlantic and developed SO_x emission reduction scenarios. The study area included the North Sea, the Norwegian Sea, the Irish Sea and the English Channel, which represented a significant proportion of the world trade with both heavily trafficked shipping lanes and open sea. Data on ship movements were obtained from Lloyd's Register, and included domestic merchant ships. Annual emission estimates for 50 km^2 grid squares were based on extrapolated figures from two study periods of ship movements, along with ship-specific data and emission factors (MEPC 36/INF.16). Total SO_2 emissions from ships in the area were found to be between 1.16 and 1.33 mt. Two reduction scenarios were then examined: reductions within 350 km of land – representing a 200-mile coastal zone – and reductions in the whole area. Both scenarios examined reduction benefits of 2% and 1.5% sulphur contents compared with 2.7% for 1990. The results showed that reducing the sulphur content to 1.5% within a 200 nm coastal zone would merely result in a 29% reduction from 1990, while the same sulphur content used in the

whole study area would result in a 44% reduction. The corresponding figures for a 2% sulphur content were 17% and 26% respectively (MEPC 36/INF.16; 36/9/6).[63]

The UK concluded that only a marginal reduction would be gained by using LSF in territorial waters (12 nm) and that reductions gained using a 200 nm zone "would still be substantially below the 50% reduction target" (MEPC 36/9/6, p. 3). The findings further indicated that the target 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 but could be extrapolated to a global context to facilitate decision-making. According to the UK, the best way forward was to examine these scenarios and to agree on an appropriate strategy. This was proposed due to doubts of progress: "Resolution of the debate on acceptable levels of deposition or special area designation appears unlikely to be achieved in the foreseeable future" (ibid.). The UK requested that the MEPC would decide on whether: (1) the 50% reduction target should be re-evaluated, (2) the reduction scenarios were feasible/acceptable, (3) further scenarios should be investigated before taking decisions, or (4) to stick to the previous proposals and draft texts.[64]

5.6 1995-1996

5.6.1 MEPC 37, September 1995

At MEPC 37, the draft text of the new annex (now Annex VI) was reviewed with the goal to be finalized, though this session had a work overload. A discussion on special areas could thus not take place. On global capping, the 5% figure was in majority and thus remained in square brackets. A large number of delegations had expressed their views on global capping, though no discussion was reported. Nevertheless, there were plenty of submissions with scientific arguments and information, and some statements given.

OCIMF

OCIMF's first submission (MEPC 37/13/4) presented its previous positions and arguments for a special area approach with a 1.5% limit[65] and then focused on the size of such areas. In this context, it highlighted its many submissions of CONCAWE papers, and that they were submitted to provide the policy-makers with scientific studies. It stressed that the "weight of evidence" (MEPC 37/13/4, p.1) had shown that significant impacts of sulphur deposition from ship emissions on land only occurred from ships operating close to shore or in large ports. Large special areas were thus not needed. OCIMF's framing was now expressed as a proven local problem, and it could only support special areas if they were limited to ports or port approaches where significant local impacts could be proven. It further did not support any global cap since no limit below the existing 5% ISO standard could be justified based on the available and submitted data (not only scientific data).

[63] Emissions from auxiliary engines were excluded from these scenarios.

[64] Of further relevance to this session, the draft text of the second sulphur protocol to LRTAP was contained in a Secretariat note (MEPC 36/INF.5). Also, OCIMF once again submitted a summary of CONCAWE (1994) as well as the full report. No discussion was reported (MEPC 36/22).

[65] It is worth mentioning that it emphasized that the initial proposals of a 1.5% global sulphur content did not take into account "the fact that the sea and many land areas are able to absorb and neutralise quantities of sulphur dioxide without upsetting the ecological balance" (MEPC 37/13/4, p.1).

In its second submission (MEPC 37/13/5), OCIMF summarized work conducted by ICCET on behalf of CONCAWE. Due to the lack of references, I found it impossible to distinguish what information and which views originated from which of ICCET, CONCAWE and OCIMF.[66] A difference between focusing on *retained* sulphur in the atmosphere and *deposition* was stressed. A recent DNV report[67] had argued for significant impact on land from a great distance of the source as it was found that about 50% of the emitted sulphur was retained in the atmosphere at 500 km from the source. DNV thus argued that this was a reason for establishing large special areas. This approach was criticized in OCIMF's submission since it did not take into account that the plume becomes more diluted with increased distance from the source, which meant a decrease in deposition per unit area. ICCET used its model to demonstrate this. Two wind directions were analysed for a hypothetical ship emitting about 100 kt sulphur annually (corresponding emissions for around 100 ships for reasons of simplicity). It was found that around 75% of the emitted sulphur was retained in the atmosphere at 50 km downwind, which was consistent with DNV's results. Nevertheless, deposition rates for both wind directions fell by a factor of 600 from 1 to 20 km (~12 nm) from the source, and by 2000 from 1 km to 50 km (~30 nm). Hence, the highest deposition rate was close to the source. It was concluded that this shows a very small contribution to the deposition from ships sailing outside territorial waters (12 nm), which was consistent with the results in CONCAWE (1994).

The Bahamas, Liberia and Panama

The delegation of the Bahamas presented a joint submission with Liberia and Panama (MEPC 37/13/3). It contained many references to both CONCAWE and OCIMF, and it argued that most member States had now understood that the problem is not SO_x *emissions* but sulphur *deposition*. Given the figures of CONCAWE (1993) – labelled as EMEP data – most also recognized that it was not possible to address "local acid rain problems" (MEPC 37/13/3, p. 1) by a global sulphur content limit. A modest solution of 4% would not reduce emissions, and a future increase in sulphur content in marine fuels was considered too small for "any measurable global environmental harm" in the coming 10-20 years (ibid., p. 2). This argument was based on figures from DNV (no reference was reported) showing that the average sulphur content had only increased 10% in ten years. With regard to the precautionary approach, there were not considered to be any threats of serious or irreversible damage. According to the three countries, the available information did not support large special areas such as the whole of the Baltic or North Seas. A simple analysis of EMEP data showed that shipping in the North and Baltic Seas contributed to the total deposition in the surrounding countries by only 1% and 0.3% respectively (no data for Estonia, Latvia, Lithuania and Russia).

It was stated that two studies confirmed the findings in CONCAWE (1994) that the contribution from ships was limited to ports or very close to shore: phase 2 of the Lloyd's programme and the study on Tokyo Bay presented by Japan at BCH 24. According to the three countries, the Japanese study had showed that 11-31% of the measured SO_x pollution in six ports was derived from ships. Over 90% of this was derived from in-port emissions in four of the ports, and 53% and 23% for the other two ports, mainly due to ship traffic moving between the ports in the 10 km wide entrance to Tokyo Bay. In addition, rapid decreases of SO_x concentrations with increased distance from the centres of the ports were observed by the three countries. It was stated that any decisions on the delineation of special areas should take these findings into account. The three countries also underlined that there was similar

[66] Notably, the submission first recognized the long-range transport of SO_2 emissions, which is the first time in the investigated OCIMF submissions.
[67] No. 94-3179, cited in MEPC 37/13/5

confusion on the difference between *retained sulphur* and *deposited sulphur* as between emissions and depositions. The findings of ICCET were highlighted, and they basically repeated the reasoning of OCIMF. It was concluded that these new findings, as well as the earlier ones, confirmed that special areas should only be restricted to selected ports or certain areas close to shore where impacts could be proven.

Norway
Norway (MEPC 37/13/6) used the UK study in MEPC 36/9/6 as an argument that a 5% cap would send the wrong signal to a concerned public. Given the highlighted results and that the ministers at the fourth North Sea Conference had declared a need for a global cap resulting in a true reduction of the sulphur content, its proposed figure on the global cap of a maximum of 3.8% could be argued to be symbolic and a compromise (MEPC 37/13/6/Add.1). The ministers had also declared that the North Sea should be designated a special area. The Norwegian submissions thus further concerned such a proposal (MEPC 37/13/6/Add.1) along with a background document (MEPC 37/INF.19) presenting arguments for designation. The background document (prepared for the 4th North Sea Conference) was based on the draft procedures criteria for designation, and Norway considered that these criteria had been fulfilled. The document did not include any evaluation against the criteria however. According to the document, the most sensitive areas as well as exceedance of critical loads were found in the countries surrounding the North Sea, in particular Scandinavia. The above DNV report[68] had showed that the annual SO_2 emissions from ships totalled 270,000 tonnes, which was more than the national emissions in Denmark and the Netherlands, and more than twice the Swedish emissions. This figure was compared with the CONCAWE (1994) figure of 206,600 tonnes for only the English Channel and parts of the Southern North Sea, which implied an underestimation for the whole North Sea by DNV.

The conclusions by CONCAWE (1993) on dispersion and dilution were criticized, and counterarguments to the above OCIMF submission were given. It was recognized that the *concentration* of SO_2 quickly decreases with distance, as shown in CONCAWE (1993). Nevertheless, it was stressed that the total amount of sulphur in the atmosphere and the total deposited were the significant factors to consider when studying acidification, and not only the concentration of SO_2 closely surrounding the source.[69] It was explained that the significant decrease in SO_2 concentration is not the result of immediate deposition but primarily diffusion of the plume over larger volumes taken together with oxidations forming other sulphur compounds by chemical reactions in the atmosphere. It was mentioned that these oxidized compounds were the main contributors to acidification at the deposition stage. An EMEP report[70] strengthened these arguments, showing that 82% of the total sulphur emitted in the North Sea was transported out of the area and mainly towards land areas in an eastward direction. This meant that only 18% was deposited in the North Sea. CONCAWE (1994) was further criticized. It had only mapped some of the deposited SO_2 from the ship emissions. Most of these emissions were considered to be transported out of the studied area and to contribute to deposition in sensitive areas. For these areas it was not sufficient only to reduce local emission sources, and it was stressed that "this understanding is the main fundament for the sulphur protocol" (MEPC 37/INF.19, Annex, p. 3).

The contribution of ship emissions in the North Sea to the total depositions on land was only 1-4%, but there were big variations (e.g. 10% or more along the coast of the Netherlands) and

[68] No. 94-3179, cited in MEPC 37/INF.19
[69] The results on retained sulphur of the DNV report were also highlighted.
[70] EMEP/MSC-W Report 1/94, cited in MEPC 37/INF.19

the contribution was highest in very sensitive areas. Due to high reductions of land-based sources, the relative contribution from ship emissions would at least be doubled by 2010 compared with 1990. The contribution in Norway would be doubled to 10% and in the Netherlands almost tripled to 27%, and shipping would even become the main contributor in some areas.[71] If a 50% emission reduction was achieved with the North Sea as a special area, the relative contribution would almost go back to the levels of 1990. A graph showed that the relative contribution for a selection of sensitive areas would still be higher than for 1990, though this was not specifically mentioned in the report.

The Baltic Sea States

The BSS also submitted their background document for special area designation of the Baltic Sea (MEPC 37/13/7). Before presenting the document, the submission stated that the BSS had been advocating a global solution due to the global nature of air pollution. In the context of the lack of support for a global approach and the emergence of the special area approach, they had decided to designate the Baltic Sea Area as such a special area. The document was long and described the Baltic Sea and its environmental sensitivity, the surrounding countries, the acidification in the area, the emission sources and depositions, and the efforts by HELCOM. It also included a thorough assessment against the draft criteria for designation and annexed detailed information. Sweden was used as an example to demonstrate the environmental situation, mostly due to the availability of data and its long experience of acidification and because it had the most severe environmental conditions in the area. The Baltic Sea Area was described as one of the most heavily trafficked waters in the world. Notably, acidification was neither included in a list of the most serious threats to the marine environment nor in the description of sources of pollution loads, which focused on nitrogen loads.[72] It was highlighted that Sweden, Finland and parts of northern Russia had the most sensitive ecosystems in Europe and that critical loads were exceeded in large areas of Central Europe and in most parts of Sweden and Finland. In Sweden, about 20% of lakes had been seriously damaged with about 10-20% of species lost, and 20% of its forests had shown significant changes in vegetation.

It was stressed that the reductions in emissions by the LRTAP sulphur protocols were far from sufficient: emissions would have to be reduced by 75-80% during 1990-2005 to avoid deterioration in several areas around Europe. Emissions from ships in the Baltic Sea Area affected all surrounding countries. Another study by Mariterm AB[73] had estimated that approximately 56,800 tonnes of SO_2 were emitted in the Baltic Sea Area in 1992. The proportion of ship emissions had increased and accounted for about 20% of the total emissions in Sweden, with an expected increase to 25% in the year 2000. With regard to deposition in Sweden, the contribution was estimated at 5-10%, and 15-20% in the areas worst affected by acidification. In the next ten years, the contribution by ships to the total deposition in coastal areas could exceed 25%. The assessment against the draft criteria was generally a repetition of facts divided into the categories of the criteria, together with arguments that action was needed. As an example, the category of ecological conditions only included the Swedish situation to show the need to protect the terrestrial ecosystems and freshwater quality. According to the BSS, the criteria for designation had been fulfilled.

[71] The reference for these figures was DNV Report No. 94-3437 (cited in MEPC 37/INF.19)
[72] It was noted, however, that the leakage of nitrogen compounds from land increases with acidification.
[73] Mariterm AB (1994). *Effects of bilateral agreements and other measures on exhaust emissions from ships*.

The UK (and the Netherlands)
The UK (MEPC 37/13/9) proposed a 4.5% global cap together with a future 4.0% cap based on 'evidence' that the average sulphur content measured over two years had exceeded 3.7%. The monitoring of the sulphur content was to be based on guidelines developed by the IMO. On special areas, the UK (MEPC 37/13/10) highlighted the results of the research programme, in particular that the 50% reduction target could not be reached and that a limit within territorial waters would only provide marginal reductions. It also highlighted the conclusion of CONCAWE (1994) that significant impacts only occurred from ships close to land or in heavily congested port areas however. According to the UK, both studies had contributed significantly to a better understanding of impacts from ship emissions. The following proposal was then presented (MEPC 37/13/10, pp. 1-2):

> *Where a land or port area is to be designated a special area, that special area shall not normally extend beyond 12 miles [or the territorial limit] from any coastal States coastline.*
>
> *Where precise data, such as prevailing wind direction, vessel trading patterns or other scientific evidence can be produced to show that the relevant country's SO_x situations can be substantially improved by the imposition of a larger special area then that special area may be extended to a maximum of 200 miles from a coastal States coastline.*

The only argument for this proposal was that awaiting further research would delay the finalization of Annex VI. The Netherlands (MEPC 37/13/11) had a similar proposal: it should be possible to designate a special area of 12 nm without a scientific proven necessity, while decisions on larger areas should have to be evaluated against stricter scientific criteria. This proposal also included a review of the requirements and criteria five years after its entry into force. No scientific arguments were given for this proposal however.[74]

A Group of States
A group of States consisting of Austria, Bahrain, India, Mexico, Singapore, Salomon Islands, Vanuatu and Venezuela submitted their joint views (MEPC 37/13/21). Their positions and the content were very similar to Singapore's submission at BCH 24 (BCH 24/7/14) with highlighted results of studies showing minimal contributions, only local impacts, etc. There were references to Assembly Resolutions A.777(18), A.500(XII) and A.719(17) , and it was felt that global capping was not warranted until there was sufficient evidence that ship emissions were responsible for major atmospheric pollution. The majority support for a 5% global cap indicated no scientific justification for a stringent limit according to the group. A 5% cap was also considered to set a ceiling for a future increase of the sulphur content.

Germany
Germany (MEPC 37/13/26) highlighted the significance of taking trade patterns into account in the delineation of special areas to avoid negative environmental impacts from changed patterns. Only setting distance criteria would not solve this problem, and regional solutions such as the Baltic and North Sea Areas were considered more effective. Germany also expressed that the average sulphur content at the time did not justify a 5% cap.

[74] The Netherlands and the UK further submitted (MEPC 37/INF.23) a large overview report of all three phases of the research programme in limited distributed prints.

5.6.2 MEPC 38, July 1996

MEPC 38 was supposed to be the final MEPC session of the process, though one more session was needed, and the adoption at a diplomatic conference was postponed to September 1997 instead of March 1997 (MEPC 38/20). The draft criteria and procedures for special areas (now named SECAs) were revised (by a group of unreported experts) into a draft with no further relevant discussion for this chapter. No scientific arguments were reported. In the discussions on delineation, however, it was reported that the scientific evidence on the transportation of SO_x emissions from ships had led to different interpretations among the policy-makers. The view that the width of a special area should not extend beyond twelve nm from shore was repeated by some members, while others promoted large and clearly defined areas. No further information on these interpretations was given. The need for SO_x-specific criteria and procedures was further questioned by some delegations due to the existing guidelines for designating special areas, though other delegations responded that the existing guidelines were limited to protecting unique marine environments and not harming terrestrial and marine ecosystems from air pollution.[75] Regarding designating the Baltic Sea Area, a number of delegations had the view that such a decision should be taken after agreement on the criteria and procedures and after time to evaluate the information provided by the BSS. It was noted that most of the criteria had been addressed by the provided information, but that it needed to be supplemented with information on the magnitude of the ship contribution to acidification in the area (MEPC 38/20; MEPC 38/WP.12).

The discussions on global capping were first locked in the members' previous positions, but new proposals emerged that broke the deadlock. These were to have a high global cap of 4.5-5% at first, and then at least some lower values in the long term. The first proposals were from an informal drafting group of unreported members (MEPC 38/WP.4) and by the delegation of the Netherlands (MEPC 38/WP.5).[76] Neither of these proposals had any reported scientific arguments and no agreement was in sight. Nevertheless, they led to a new compromise proposal by a group of experts (unreported expertise) (MEPC 38/WP.11; 39/6):

- An initial [4.5%] global cap
- Regular monitoring of the global average sulphur content with a reference value determined by the IMO
- A [4.0%] global cap [twelve] months after evidence had showed exceedance of the reference value by [0.2%][77]

This proposal was not discussed and a 5% global cap was once again left in square brackets. Nevertheless, the views were evenly divided between a 5% cap and a lower figure (unspecified). Hence, the 5% majority had been broken.[78] Let us look at the submissions in search of an insight into this change of positions. Several actors repeated their positions and arguments. The following represents additional arguments and actors.

In the early discussion on the global cap, the chairman of the executive body to LRTAP stressed the importance of the Annex resulting in a true reduction of air pollution problems caused by ships. The chairman participated in the session due to concerns of the Executive Body over air pollution from growing shipping traffic. It searched for harmonized approached

[75] Note that the SECA concept was introduced at this session.
[76] See Svensson (2011)
[77] The informal drafting group had an additional reduction step to 3%. See Svensson, 2011.
[78] It should be noted that the Chairman of BCH 24 recalled (at MEPC 38) that agreement was almost reached on 4.5%. It was stated that agreement on a common value at the conference was a realistic expectation.

with the IMO that would achieve the emission reduction targets of the ECE. A submission by Norway (MEPC 38/9/2) presented a written communication from the chairman addressed to the secretary-general of the IMO. A significant reduction of land-based emissions was highlighted, and it was stressed that without measures on shipping, its relative contribution would be at least doubled by 2010. In this context, it referred to MEPC 37/INF.19 on a possible main contribution to critical loads in some areas. It was also underlined that the patterns of transportation and deposition were the same for ships as for land-based sources and that much sulphur still remained in the air after long distances. Given that the second sulphur protocol provided typical values of the sulphur content in refinery products and that it anticipated future bunker fuels with sulphur contents of 1% in coastal/sensitive areas and 2% globally, the sulphur limits in the draft Annex VI were considered too high (MEPC 38/9/2).

FOEI (MEPC 38/9/6) had the view that a global cap of 0.5-1% was the only solution that would result in a true reduction due to the average sulphur content of 2.8% at the time. It was recognized, however, that agreeing on such a cap would take some time, and a cap was proposed just below the average but with a timetable for further steps of reduction. Preliminary special areas could be established but then be replaced with a strict global limit. This would fulfil a true reduction target and protect vulnerable areas. It further viewed it necessary to consider the possibility that the bunker fuel industry would blend *low-sulphur fuel oil* (LSFO) with the then illegal *high-sulphur fuel oil* (HSFO), which would probably have the net effect of the average sulphur content remaining the same (at best).

WWF's submission (MEPC 38/9/13) intended to apply the precautionary approach to the sulphur content issue in accordance with the newly adopted MEPC guidelines[79] on incorporating the precautionary approach in its work. The submission also included WWF's view of the sulphur debates. It was highlighted that Resolution A.719(17) on air pollution from ships stated a clear desire by the member States to reduce the sulphur content, with a recognition that SO_2 caused acid rain and harm to the environment. A 5% global cap would do little to actually reduce the sulphur content and provide no emission reduction. The argument of minimal contribution from ships was countered with an argument that the relative contribution of shipping to problems was not the significant issue. If one only looked at the contribution from shipping as a reason for action, then all of MARPOL would be inappropriate since land-based sources represented about 70% of marine pollution. Instead, every industry that contributes to the pollution problems must reduce its emissions if the problems are to be solved. This was considered the underlying grounds for the Assembly resolution. It then highlighted the results of the marine exhaust research programme and that studies on deposition rates were complex and warranted further research. WWF argued that the sulphur content issue at the IMO was just the kind of situation that the precautionary approach was designed to address: a recognized environmental problem (or potential problem) with scientific uncertainties of the potential harm. The problem of SO_x emissions was well recognized with far-reaching effects (e.g. by LRTAP), and the uncertainties were scientific, such as the fate and effect of emissions, and over achievable or acceptable emission reductions. With the precautionary approach, such uncertainties should not prevent action to eliminate or reduce the risk of environmental harm. A 1.5% global cap was considered an achievable goal that would result in a desired emission reduction. Further research was also proposed, especially on the fate and effects.

[79] Resolution MEPC.67(37).

In addition to the above, the positions and scientific arguments of Singapore and its allies at MEPC 37 (MEPC 37/13/21) now had the support of nineteen countries[80] in a joint submission (MEPC 38/9/11). Nineteen States thus supported a 5% global cap on the basis of the same scientific arguments.

5.7 1997: Final Drafting and Adoption of the Combined Approach

5.7.1 MEPC 39, March 1997

At the session for the final drafting, the situation was similar to that at the end of MEPC 38. There was significant support for a 5% global cap, and other delegations supported a lower figure (MEPC 39/13). The *Baltic and International Maritime Council* (BIMCO) had submitted a proposal (MEPC 39/6/21) of a single global regulation without any SECAs. A 3% sulphur content limit was proposed for application not only to the fuels used by ships but also to the fuels supplied. The only scientific argument for this, however, was the average sulphur content at the time. The Committee did not agree with the proposal. Instead, two other submissions gained significant support (MEPC 39/13). The combination of a global cap of 5% and 1.5% SECA regulation was again proposed by Singapore allies: this time by a joint submission from Australia, Singapore and Vanuatu (MEPC 39/6/9), and another by the State of Bahrain (MEPC 39/6/17) stating the same views and arguments. Their view was that with a 1.5% sulphur content in SECAs, there was no need for a global cap. 'Global' protection from sulphur depositions derived from ship emissions could be achieved through SECAs under the premise that the criteria for designation were fulfilled. Where adverse impacts had been proven, the 1.5% limit would effectively protect the coastal States against sulphur depositions from ships in both land and sea areas. There was no need to regulate all other areas where there were no observable effects from ship emissions. Continued monitoring of member States would provide for a possibility to designate further areas or extend existing ones where adverse impacts could be proven in accordance with the criteria.

After a lengthy discussion, it was agreed to maintain the 5% figure in square brackets in the final draft sent to the conference. It was agreed to monitor the global average sulphur content with a new paragraph in square brackets and a draft conference resolution (MEPC 39/13). In this context, a submission by the UK and the Netherlands (MEPC 39/6/7) contained draft guidelines for monitoring procedures and setting the reference value[81]. The earlier proposal by the group of experts – and its preceding proposals on monitoring with a further reduction if the global average increased above a certain level – did not change the sulphur limits of the draft. This was something that was explicitly agreed on: "there should be no linkage between the results of monitoring and reduction of the global cap" (MEPC 39/13, para. 6.52). No scientific arguments were reported on this decision (ibid.; MEPC 39/WP.11).

Nothing was reported on the criteria and procedures for special area designation other than concern from several delegations on the spread of special areas in the world in which the committee agreed that unwarranted special areas would be prevented with strict application of the criteria and procedures (ibid.). Designation of the North Sea could not be agreed on at this last session since additional information was needed due to changes in the revised criteria and

[80] Antigua, Barbados, Bahrain, the Bahamas, Barbuda, Brazil, Ecuador, Ethiopia, Hungary, Liberia, Maldives, Mexico, Peru, Romania, Singapore, Tunisia, Turkey, Vanuatu and Venezuela. Four of the eight initial countries were absent in the new joint submission.

[81] As well as application of the now abandoned trigger mechanism.

procedures at MEPC 38. This additional information could not be finalized before MEPC 39 and would thus be sent to the conference (MEPC 39/13; MEPC 39/6/20). The Baltic Sea Area was considered sufficiently justified for designation with additional information submitted by the BSS. Almost all the scientific arguments and information in the submission by the BSS (MEPC 39/6/24) were repetitions of their previous background document. Of the new information, analysis within the EU's Acidification Strategy had found that its target for the whole of Europe would not be reached with the highest technically feasible reductions of land-based sources. SO_x emissions from ships had been significantly underestimated according to a PhD project from the Carnegie Mellon University in the US. It was found that SO_x emissions from ships represented about 7% of the global fuel consumption sources and about 25% of SO_x emissions from petroleum sources. It was further emphasized that a designation of the Baltic Sea and North Sea Areas would result in a 50% reduction of the annual SO_x emissions from ships within a deposition contribution distance of land (ibid.).

5.7.2 Adoption at the 1997 Conference of Parties to MARPOL, 15-26 September

With a final draft Protocol to MARPOL in place, it was time for adoption at the 1997 Conference of Parties to MARPOL 73/78. Scientific discussions were unreported (MP/CONF.3/RD/1-8; MP/CONF.3/WP.4) and only a few submissions contained scientific arguments and information. On the global cap, the scientific arguments in submissions were for attempts to find a global solution at least in the long term. Like the submission at MEPC 39, BIMCO (MP/CONF.3/10) proposed a 3% global cap without SECAs and with the same argument (though it was noted that the MEPC target would only be reached with 1.5%). A submission by ICS (MP/CONF.3/17) provided some scientific arguments. One was that SO_x emissions would continue to be detrimental to the world's atmosphere in areas outside SECAs, which was an inconsistency with the Assembly resolution. It also introduced two environmental aspects: (1) SO_x emissions generated outside the SECAs would inevitably drift in, and (2) there was a possibility that ships would go around the edges of SECAs with conventional fuel and then take the shortest route across the SECA to its destination. . By establishing a global standard, the objectives of the Assembly resolution would be achieved. It was proposed that the global cap be set at 3.5% with a subsequent stepwise reduction starting with 3%. With this approach, SECAs were considered unnecessary.

Greece made a proposal during the conference (MP/CONF.3/32) of a stepwise reduction of the global cap by 1% every five years after entry into force: from 4.5% down to 1.5%. SECAs with 1.5% limits were to be used during the period until the 1.5% global limit had been reached. The use of SECAs would thus be a short-term solution and unnecessary in the long term. The argument was that the previous positions on the issue had been focusing on the short term, i.e. using special areas as a measure to protect the environments of many concerned countries, but that there was only one atmosphere. The proposal would be an effective solution to problems of air pollution in both the short and the long term.

A 5% global cap still remained in square brackets for the major part of the conference, however, and no stepwise reduction was agreed on. It was not until the second to last day of the Conference that unanimous agreement was reached on a 4.5% global cap. No scientific reasons were given. It was also agreed to monitor the average sulphur content by adopting Regulation 14(2) and a Conference Resolution 4 (MP/CONF.3/RD/1-8; MP/CONF.3/WP.4; MP/CONF. 3/34; IMO, 1998b).

The NSS submitted a more detailed proposal and background document (MP/CONF.3/16) to designate the North Sea Area as a SECA. It recognized that the draft criteria implied a restriction to only declare coastal areas of the North Sea (e.g. 100 nm from land), though the whole North Sea Area (as in MARPOL Annex V) was proposed to avoid changes in traffic patterns. A large part of the document concerned acidification effects in general, sulphur depositions and critical loads in Europe, as well as repetition from MEPC 37/INF.19. Of the new information, it was stated that about 80% of emissions in the North Sea were deposited on land due to long-range transport and a northeast wind. It then presented analysis of new data by Lloyd's Register, which was considered to be the most reliable estimate of ship emissions at the time. The previously estimated 174 kt of SO_x emissions from ships in the North Sea for 1990 was now 385 kt, which corresponded to 2-7 times the national emissions in the area the same year. On the EMEP maps, the biggest relative contribution to deposition compared with land-based emissions was found near the English Channel (25%), followed by areas along the eastern coastline (10-25%). A contribution of about 5-10% was found in extensive areas such as large parts of Sweden and Norway. Due to a reduction of 27% from land-based sources during 1990-1994, these contributions could have been underestimated. Without action, the land areas where ship emissions contributed 10-25% would be doubled in 2010. It was concluded that this analysis showed a significant contribution to critical loads. In addition, the NSS highlighted that there was evidence of a contribution from ships in the area west of the UK (including the Irish Sea) to environmental damage in the UK. For these reasons, a proposal for SECA designation was made by the UK (MP/CONF.3/24). The proposal contained preliminary information. A detailed proposal would be submitted to MEPC 41. A North Sea SECA was not considered enough to protect the UK environment. The arguments included a 3.3% contribution of deposition in the UK, a possible increase to 5.8% in 2010, and a concern that a North Sea SECA would result in changed traffic patterns with increased emissions in the UK.

The 1.5% limit in SECAs was eventually adopted without reported discussions, and the Baltic Sea Area was designed a SECA. The North Sea Area was not designated, though a need to take actions against acidification in Europe was recognized. Conference Resolution 5 was drafted in a proposal by the NSS after a designation had been rejected by the conference. The resolution recognized the concerns of several States on the contribution of ships in the North Sea to sulphur deposition and its damaging effects. It thus invited the MEPC to consider the conference proposal for designating the North Sea as a SECA in accordance with the criteria and to take the necessary steps for implementing measures as soon as possible. The adopted protocol of 1997 also included a reference to the precautionary principle in its preamble without reported justifications for the measures against the principle (MP/CONF.3/RD/1-8; MP/CONF.3/WP.4; MP/CONF.3/29; Corr.1; MP/CONF.3/34; IMO, 1998b).

6 Investigating the Role of Economic Interests

This chapter investigates the reported economic arguments, supportive information and economic discussions. The supportive information is primarily focused on figures of costs and benefits and on supply and demand of fuel oil markets. The chapter does not go as far back in time as in the previous chapter. When the issue reached the IMO in 1988, the proposals by the NSS and the BSS to include air pollution from ships in the future work programme and to deal with the issue of fuel oil quality were accepted without reported economic discussions (MEPC 26/25). At MEPC 27, when a proposed action plan for fuel oil standards and the inclusion of air pollution and fuel oil quality in the long-term work plan were agreed on, costs and benefits were only mentioned as something that were needed to be taken into account (MEPC 27/16; MEPC 27/6/2; 27/6/7; 27/WP.3). The economic contents of the process did not appear until MEPC 29 in 1990. I thus start by investigating MEPC 29.

6.1 1990-1991

6.1.1 MEPC 29, March 1990

As shown in the previous chapter, MEPC 29 was the session in which the issue of air pollution was viewed as a significant issue for the IMO to deal with as a high priority. The committee merely noted that reducing the sulphur content in fuel oils would result in cost impacts on the shipping industry (MEPC 29/22). Nevertheless, a cost impact study had been submitted by the State of Kuwait (MEPC 29/18/5). The submission first highlighted that the sulphur content in marine fuels significantly depended on the source of the crude oil and thus varied in different parts of the world. In the Arabian Gulf area, sulphur contents of crude oil were higher than in, for example, the North Sea Area. A reduction of the sulphur content to 1% would result in a financial impact on States producing crude oil with high sulphur contents. This would have negative impacts on the shipping industry and the oil-producing developing countries. The study had been conducted in Kuwait and addressed the cost impact of reducing the sulphur content in marine fuel oils. It highlighted that most refiners producing marine fuel oils had limited desulphurization capacities, which meant that any reduction of the sulphur content would require investment in desulphurization plants. A table was presented that showed the desulphurization costs for marine fuel oils produced from crudes exported from Kuwait. Based on a sulphur content of 4%, reductions to 3%, 2% and 1% would result in total costs of 10.6, 15.6 and 19.5 USD per tonne of fuel oil respectively. It was concluded that these costs would probably cause a price increase in bunker fuel oils in the Arabian Gulf area of the same magnitude (11, 16 and 20 USD/tonne). The study recommended keeping the current sulphur content limits of 4-5% to avoid a substantial bunker price increase, and in turn "a very negative impact" (MEPC 29/18/5, Annex, p. 1) on industries within marine transport in developing countries. Kuwait stressed that the MEPC needed to take these aspects into account (MEPC 29/18/5). Another similar argument against a strict global sulphur content was found in the report of the session. The delegation of Venezuela had stated that since the sulphur content in fuel oil is dependent on the sulphur content of the crude oil used, it would be impractical with a global limit of 1% (MEPC 29/22).

The BSS (MEPC 29/18/1) had a more positive view. It was noted that desulphurization of HFO in refineries was difficult and considered a costly method to reduce SO_x emissions from ships. Most HFO with low sulphur content would thus have to be based on the origin of the

crude oil with low sulphur content. Due to the limited availability of these fuels, blending was considered a possible option however. Notwithstanding an environmental reason, it was in this context that the submission suggested a sulphur content limit near 0.8% as it would be beneficial for ships designed to burn HFO. Despite being a costly option, the BSS also highlighted the possibility of using distillate fuels, which would come with the benefit of reduced maintenance costs.

The availability of *low-sulphur fuels* (LSF) and the economic consequences of reducing the sulphur content were also highlighted in the two studies submitted by Norway. The DNV study (MEPC 29/18/6) briefly assessed the availability of fuels by their sulphur contents. It was emphasized that known resources of crude oils with low sulphur contents were limited in terms of their volumes and their geographical distribution. On the basis of samples during bunkering in various countries, the study only found three countries (Argentina, China and Nigeria) that delivered LSF with less than 1% sulphur content, and nine countries with sulphur contents of 1-2%. However, the total HFO consumption by the world fleet was considered small compared with the total world consumption of fuel oils (about 4%). It was thus concluded that worldwide production of LSF could theoretically supply the whole shipping industry. The distribution of this oil to all ports for bunkering was considered the main constraint however, and a comprehensive distribution scheme would be needed. Desulphurization costs were only briefly mentioned in a list of reduction measures. Considerable fuel cost increases would be likely as a consequence of refineries not having suitable desulphurization processes to meet new sulphur content limits, though the technology as such was already in use by the refineries. On the feasibility of establishing stringent sulphur limits, the study recommended further studies to address problems such as increased fuel costs and the availability of LSF (MEPC 29/18/6). The Marintek study (MEPC 29/18) showed a reduction potential of 20-90% SO_2 from changing to LSF – here distillate fuels – at a total cost for a ship of 0.0017-0.0024 USD/kWh (based on the price difference between MDO and HFO in 1989 of 88 USD/tonne) (MEPC 29/18).

6.1.2 MEPC 30, November 1990

Few economic arguments were reported at MEPC 30, and only one submission included economic arguments. The UK (MEPC 30/14/7) presented information on various fuel oil quality aspects. It was highlighted that a reduction of the sulphur content in marine fuels would require desulphurization in refineries around the world due to the low availability of LSF. The UK explained that this low availability was the result of quality demands for land-based fuels and insufficient crude oil sources with low sulphur contents. It was stressed that extensive use of the available sources by shipping would thus meet considerable resistance. It was concluded that radical changes in the manufacturing, purchasing and supply of marine fuels could be expected from any significant fuel oil quality restrictions. It thus questioned fuel oil quality regulation as the only policy option for reducing air pollution from ships.

This was the session at which a target level of 50% of the present emission level of SO_2 was agreed by the target date of 2000 after proposals from the NSS (and the Commission of the EEC) (MEPC 30/14/2) and the BSS (MEPC 30/14/6). As described in the previous chapter, these proposals also included regional measures for ships for specific areas, and an exhaust gas strategy was agreed by the committee that included these regional measures as an alternative to universal regulations. The NSS and BSS submissions did not include any economic arguments for regional measures. Nevertheless, some economic aspects were included in connection to the exhaust gas strategy. The delegation of Venezuela suggested

that the instruction of the working group at the session would include an analysis of the financial implications for oil-producing developing countries and an analysis of alternative measures. The group was thus instructed to take into account economic and technical implications of measures in the exhaust gas strategy, but the specific focus on developing countries was not included (MEPC 36/22; 36/WP.11). The group could not consider the economic and technical implications in detail, however, due to the lack of information. In this context, the delegation of France stated that it would be able to adopt a sulphur content limit of 2% after taking into account economic and technical aspects.

As described in the previous chapter, the committee took full account of the views of a working paper (MEPC 30/WP.3) by the Netherlands (MEPC 36/22; 36/WP.11). It proposed, among other things, assessing the impacts of the proposed measures, which included consideration of costs and benefits. The Netherlands stated in its paper that it had undertaken a study of these aspects, which included the Rotterdam bunker fuel market. It further highlighted two areas in need of additional information. The first was costs and constraints on reducing the sulphur content in bunker fuels including in conjunction with land-based reductions and scenarios of supply and demand changes. A second area in need of additional information was the impacts on the refining industry of a stricter sulphur content limit, including aspects such as regional differences in availability of fuel oils, effects on the relationship between supply and demand, etc. (MEPC 30/WP.3). The BCH sub-committee was instructed to deal with these issues (MEPC 30/24). No economic discussion was reported on the work with a first draft text of the Assembly resolution on air pollution from ships (MEPC 36/22; 36/WP.11). Nevertheless, the draft text included a section in which the members expressed their mindfulness on the necessity to assess available information with regard to "technical and economic impact on the whole of the industry" (MEPC 30/24, Annex 13; Resolution A.719(17), 326).

6.1.3 MEPC 31, July 1991

The removal of target levels and dates from the draft resolution at MEPC 31 was proposed by the delegation of the US, which emphasized that no decisions on targets should be taken before a technical study had been carried out by the BCH. No other argument was given on either the proposal or the agreement by the committee, though the preceding presentations of submissions included economic discussions. The delegation of France presented a submission[82] that showed the results of a study of the economic implications of possible refining processes. The costs of sulphur content reductions had been estimated to be identical with the figures presented by Kuwait at MEPC 29 (MEPC 29/18/5). It was stressed that careful consideration of the costs of reducing the sulphur content in residual fuels was necessary. Kuwait's views were supported by Japan and Venezuela. Japan shared the same concern over the feasibility of implementing fuel oil requirements, while Venezuela stressed the importance of carefully studying impacts on the whole shipping industry. In the same context, the delegation of the Netherlands announced that a major study was being conducted on various consequences of desulphurization (MEPC 31/21; BCH 24/7/7).

Sweden (MEPC 31/13/4) proposed a global sulphur content limit of 1.5% as a first step, while the earlier proposed 0.8% sulphur content by the BSS (MEPC 29/18/1) was viewed as a long-term target. This was due to economic reasons. In contradiction to an immediate 0.8% limit, a 1.5% limit "could be achieved without too heavy burden on the refining industry" (MEPC

[82] MEPC 31/INF.6 – written in French and excluded for investigation

31/13/4, p. 3). This would promote technological developments on desulphurization and make such techniques less costly when they become common practice. Germany (MEPC 31/13/3) proposed a new paragraph of economic character in the preamble to the draft assembly resolution in which the members expressed their agreements: "BEARING IN MIND the international character of shipping and the supply of marine fuels, which should exclude national, regional or local restrictive regulations" (MEPC 31/13/3, p. 4). No economic arguments were given on this paragraph, however, and the draft was not amended accordingly. Moreover, several notifications had also been made at this session, primarily by the Netherlands and OCIMF, that a number of studies on bunker markets and implications had been initiated or were ongoing with results being available in the near future. The committee further instructed the BCH to deal with "economical/technical implication of possible measures for sulphur oxides and nitrogen oxides reduction" (MEPC 31/21, para. 13.23).

6.1.4 BCH 21, September 1991

At BCH 21, the discussion on SO_x emissions was based on delegations introducing their submissions in plenary (BCH 21/15). The delegation of Japan introduced its submission (BCH 21/11/6) showing the results of an ongoing study on the demand and supply and economic implications of LSF. It explained that desulphurization was a difficult process that required an exclusive refining system with "tremendous expenses" (BCH 21/11/6, Annex, p. 3) for construction coupled with high operational costs. On the operational costs, it was stressed that Kuwait's earlier figures (MEPC 29/18/5) were based on a 20-year depreciation period of a plant. Assuming eight years instead would result in a cost increase of 60 USD per tonne[83] for a sulphur content reduction down to 1% (Kuwait estimated ~20 USD) and 30 USD per tonne[84] for 2% (Kuwait estimated ~11 USD). If the whole cost was to be passed on to the bunker fuel price, it would increase by 50% from the price level at the time. The high costs of desulphurization meant restrictions in the required desulphurization capacity for a global sulphur content standard. A trial model calculation had found that about 70% of the quantity of fuel oil in the world could be desulphurized and that 56% was required to reduce the sulphur content from 3% to 1.5%. Such a limit was thus considered feasible in theory but would not work in practice. In particular, the quantities permitting desulphurization varied significantly in different regions of the world – some less than 56% – which indicated that a 1.5% sulphur content could not be reached globally (ibid.; BCH 21/INF.28).

Japan further feared that low sulphur content limits would disturb the global supply and demand balance of oil in general. The high costs of desulphurization meant that refiners would instead choose low-sulphur crude oils as a basis for producing bunker residual fuels. This which was feared to result in a drop in crude oil supply and thus with "extremely large" (BCH 21/11/6, Annex, p. 9) impacts on crude-oil producing States. It could as well have "extremely large" (ibid.) impacts on the global crude oil market by changing the supply structure and bringing big price changes to crude oil. A thorough examination including the feasibility of action was emphasized. It was concluded that a global reduction of the sulphur content would result in "an excessive burden" (ibid.) on the refinery industry, increased freight costs for shipping and "a serious influence over the crude oil market" (ibid.). Since many difficulties would appear if an 'inappropriate' target level was set, Japan stressed that was "necessary to take realistic measures based on these realities" (ibid., p. 10). It was from

[83] Original: ton
[84] Idem.

these economic arguments and supportive information that Japan proposed to address SO_x emissions separately as a global problem and an additional problem in specific areas.

As showed in the previous chapter, a communication (BCH 21/11/5) from the IEA of the OECD emphasized that no decisions were to be taken before the results of various studies. These ongoing studies included economic implications and costs and benefits of proposed measures, and were undertaken primarily by oil industry associations such as CONCAWE and the IPIECA as well as the Netherlands. The reason for concern was the economic implications being raised by some of the IEA member States. The measures proposed at the IMO would require "very significant additional refining investment" (BCH 21/11/5, p. 1). The document expressed that the relative cost-effectiveness of possible measures was unknown. In the discussions, the delegation of France pointed out that the submitted papers on industry implications correctly showed high costs but did not address the advantages of using LSF, e.g. less tear on engines, potentially less maintenance and energy savings. The delegation of the Netherlands highlighted that these benefits amounted to about 5 USD per tonne of fuel. The costs, however, would be of the magnitude reported in the earlier submission by Kuwait (MEPC 29/18/5) or much higher, as indicated by the Japanese submission.

In addition to the above, Norway (BCH 21/11/2) provided an overview of possible measures, which was mostly a summary of documents considered at the IMO. The availability of LSFO and the costs of desulphurization were considered the constraints of reducing SO_x emissions from ships. The sources of high quality fuel were too small to satisfy the needs on land and for ships. More environmental restrictions on fuel oil quality was considered reasonable, but cautious was emphasized so as not to take steps that could have negative effects on other applications of fuel oils, e.g. in developing countries. It thus concluded that a first step would be to request industry advice on the issue of high sulphur contents in marine fuels. The discussions at BCH 21 ended with an expressed need for further considerations and information, in particular on costs and benefits of desulphurization and the scope of application, i.e. global regulation or restricted to certain areas (BCH 21/15).

6.2 1992: Towards a Regional Approach

6.2.1 MEPC 32, March 1992

The relevant discussion at MEPC 32 concerned two submissions that were then referred to the BCH (MEPC 32/20). OCIMF (MEPC 32/12/1) included the first interim report of the CONCAWE (1993) study. Although the study assessed both the costs and environmental benefits of reducing sulphur emissions from ships in Northern Europe, this interim report did not include any results with economic aspects. Nevertheless, OCIMF expressed the view that global control of ship emissions could not be justified by benefits or costs. The representative of OCIMF further raised the question of whether guidance was needed from the MEPC on the costs and benefits of desulphurization, though the committee decided that the BCH was responsible for this consideration (MEPC 32/20). INTERTANKO (MEPC 32/12/2) highlighted that the abatement costs would fall on the oil industry and oil tanker owners, with impacts such as higher bunker prices and operating costs. It was explained that the costs of reducing the sulphur content from an average of 3.5% had an exponential variation. A limit of 1% would cost 70% more than a limit of 2%. This was due to the requirement for new technology when reducing the sulphur content by more than 2.5%. INTERTANKO would

support the 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).

6.2.2 A Regional Approach at BCH 22, September 1992

As repeatedly highlighted in this thesis, the BCH changed the focus towards regional control at BCH 22.[85] The BCH instructed a working group to consider regional measures without reported reasons. The preceding plenary discussions included cost-benefit aspects and the question on global versus regional special area regulation, but it was only mentioned that members expressed their views based on their respective submissions. The economic arguments did not show the same clear division of arguments as in the previous chapter. The following thus presents the submissions per member, followed by the discussions in the working group to gain further insight into the economic discussion on global versus regional measures and the developed 'regional concept'.

6.2.2.1 Submissions

Japan

Japan's first submission (BCH 22/7/4) repeated its view (in BCH 21/11/6) that the issue should be treated separately as a global problem and an additional problem in specific areas, which was motivated by the many difficulties of a global sulphur content limit due to the limited supply of LSFO. The second submission (BCH 22/7/8) summarized its submitted information papers, of which two are relevant in this chapter (BCH 22/INF.11,12). The central argument in the summary was the above on treating the issue separately and that establishing special areas was the solution. The economic arguments of the submissions should thus be treated in that context. The first information paper (BCH 22/INF.11) showed the results of a continuation of the DNV study at MEPC 29 (MEPC 29/18/6) to reassure the state of the supply. As shown before, the sulphur contents in bunker fuels varied by region, which was shown in two tables and one figure. Of the 47 supply points in the world, only two were found to supply LSFO with ≤ 1% sulphur content, representing about 3% of the total bunker supply volume. Twenty-nine points supplied the bunker with sulphur contents over 3%, representing about 68% of the total volume. It was stated that a 1.5% sulphur content limit would require desulphurization at as many as 43 supply points. This would affect the supply and demand relationship for oil in general.

The second information paper (BCH 22/INF.12) showed the results of an analysis of potential desulphurization levels based on the global supply conditions in BCH 22/INF.11. This was the trial model calculation shown in BCH 21/11/6. In relation to the earlier submission, it was further explained that when the ratio of fuel oil capable of desulphurization goes below 56% it becomes impossible to desulphurize down to 1.5%. With the supply conditions found in INF.11, it was concluded that it would be impossible to desulphurize bunker fuel oil down to 1.5% sulphur content in half of the world's regions (Central and South America, Asia, Europe and Africa). Japan stressed that regional supply shortages could be expected and – as feared in BCH 21/11/6 – "very negative" (BCH 22/7/8, p. 8) effects on the global relationship between the demand and supply of crude oil. It was further stated that such negative effects could be undesirable for energy policies in countries based on oil for ensuring a stable energy supply.

[85] Although the Correspondence Group on Air Pollution from Ships was the first to explicitly report on regional versus global regulations was, the report has little to contribute to this chapter. The only economic aspect reported was that desulphurization was expensive and would lead to a rather sharp bunker price increase. This was stated in a foregoing scientific argument for the preference for a regional solution by some members.

In similarities with BCH 21/11/6, the summary stressed that this is what to expect from an inappropriate target for the sulphur content, and it referred to a 1.5% limit as an inappropriate target. It further stressed that these aspects should be considered in the discussions. It had to be recognized that the choice of measures not only consisted of environmental aspects but also affected other policy areas and was strongly influenced by economic and technological factors (BCH 22/INF.12; 22/7/8).

OCIMF

OCIMF (BCH 22/7/9) believed that environmental regulation should be guided by well-founded studies, including cost analysis. In particular, the impacts of producing LSFO needed to be considered, taking into account the energy-consuming desulphurization process, which could accelerate the depletion of global petroleum reserves if it were required to be widely applied. It was stated that decisions on SO_x emission control and its geographical application should not be taken until careful considerations of studies with cost-benefit analysis. It further expressed that the significant funds required for a global sulphur content limit could be used for more urgent environmental issues. OCIMF thus opposed a global limit and proposed a special area approach.

Submission BCH 22/7/12 showed that a major focus of the CONCAWE (1993) study had been to assess possible impacts on Western European refineries from sulphur content requirements. In a European control scenario, CONCAWE had studied the implications of a 1.5% sulphur content limit for all European bunker fuel oils. A regional control scenario addressed the implications of a 1% limit applied to an assumed bunker volume representing 30% of the total European bunker fuels. The results highlighted in the annexed report first showed that most refiners saw little or no possibility of using more low-sulphur crude oils in the European refineries. CONCAWE thus considered it unlikely that any significant reduction of the sulphur content in European bunker fuels would be achieved by such an approach. A reduction in the sulphur content had to be made through investments in desulphurization processes at the 23 primary European bunker refineries, though there was some small potential to use low-sulphur crudes in minor bunker refineries. [86] On the European control scenario, it was found that reducing the sulphur content of all European bunker fuels down to 1.5% would require a capital cost of 5.6-8.2 billion USD (calculated for the year 1991) and result in a price increase of bunker fuels of 53-76 USD per tonne. On the regional control scenario, it was found that reducing the sulphur content of 30% of European bunker fuels down to 1% would require a capital cost of 2.1-3.5 billion USD (for 1991), which implied a price increase of bunker fuels of 67-95 USD per tonne. OCIMF concluded that these sulphur content limits were not justified in relation to the "extremely high costs" (BCH 22/7/12, p. 1) and the minimal reduction of sulphur burdens (see the previous chapter).

The Netherlands

The Netherlands distributed a report at the session in limited copies that was neither found in the archives nor referenced. It also submitted a brief summary (BCH 22/INF.7). The report addressed technical, financial and market aspects of desulphurization. It concluded that desulphurization was technically feasible but rather costly with regard to bunker fuel prices at the time, which were 65 USD per tonne in December 1991 and 84 USD in June 1992. It was found that the costs of reducing the sulphur content down to 0.5-1% ranged from 20 to 83 USD per tonne of bunker fuel oil. This wide range was explained to be derived from different opinions on how the capital costs would be included in the total costs (e.g. interest rates,

[86] Of the 1989 bunker volumes sold in Europe, 70% was produced in 23 refineries that produced bunker fuels, while 10% was derived from production in smaller volumes by the remaining refineries.

depreciation, etc.). One uncertain factor was whether investments in desulphurization were to be mandatory for all refiners or voluntary. It was emphasized that the benefits of reduced sulphur contents in bunker fuels were not negligible, however, and highlighted reduced maintenance costs, increased calorific value of the fuel, etc. Combined, these benefits were estimated at up to 5 USD per tonne of fuel. Hence, they could partly compensate shipping for the increased bunker fuel costs. It was stated that these findings were largely confirmed by a comprehensive study on the implications on European refining industries of ulphur limits for all types of fuel. The results from this study were submitted in an information document (BCH 22/INF.33).

The information document provided a summary note on the study from a presentation at a symposium in The Hague with 15 countries; oil -, power-, gas- and shipping industries; and environmental organizations. The study had been commissioned by the Netherlands, France, Germany, Italy, Spain and the Commission of the EC to provide a basis for policy discussions on a French proposal containing further sulphur content and SO_x emission control within the EC. Among other things, it highlighted a considerable uncertainty over future fuel oil demand and thus for desulphurization investments. It was considered likely that crude oil producers would increase the price of low-sulphur crudes to reflect the value of the low sulphur contents. When comparing measures on land-based fuels, measures to reduce emissions from refineries and measures on bunker fuels, it was found that the three measures had largely similar costs. It was thus stated that there was "no clear 'most efficient' route to reduce SO2 emissions" (BCH 22/INF.33, p. 3). Nevertheless, the proportion of SO_2 on land derived from bunker fuels suggested that the cost of reducing the sulphur content in bunker fuels was considerably higher than for the other options. The importance of applying the same standards to bunker fuel oils globally as in the EC was highlighted; otherwise the EC bunker market could migrate to areas outside the EC. In general, the responses from the oil industry were positive of the study's conclusions.[87] They emphasized a flexible approach with focus on cost-effectiveness. On the summming-up of the symposium, it was noted that consensus between the oil industry and the study results had been reached on the extent of investments and economic impacts of measures.

The UK

The UK's submission (BCH 22/7) stressed that the use of critical loads would result in the most cost-effective way of reducing SO_x emissions from ships. The argument was preceded by a clarification that it was possible to reduce the sulphur content but that desulphurization was a costly process. It then presented critical loads and their use to achieve the most cost-effective strategy. LRTAP had agreed to abatement with the most cost-effective strategies, and critical loads would serve as guidelines for such strategies. With the help of maps that showed critical loads and depositions, the most cost-effective abatement policies could be chosen. The UK stressed that reducing the sulphur content of bunker fuels for all ships may not be the most cost-effective way of reducing SO_x emissions. It thus emphasized the use of critical loads to determine the emissions limits in the most cost-effective way.

ICS and Liberia

ICS (BCH 22/7/6) raised the shipping industry's view that international regulation was the only acceptable control of ship operations since shipping was an international activity. Nonetheless, it was viewed as necessary in some cases to take into account specific

[87] CONCAWE – who had been involved in the discussions with the author and the sponsors during the study – expressed a "hope that any legislation would focus on the largest contributors to SO_2 emissions" (BCH 22/INF.33, p. 4) with emphasis on minimal contribution from ships.

circumstances that required specific measures. ISC expressed concern over the speed and direction of the negotiations and a fear by the industry that regulations were being developed without enough time for consultation on both the need and the cost-effectiveness of measures. It was further stressed that there could be no confidence on the necessity or cost-effectiveness of the regulations being drafted if a comprehensive cost-benefit evaluation was not conducted. On SO_x emissions, specifically, it questioned how cost-effective regulations could be determined without adequate information on ship emissions compared with land-based emissions (see the previous chapter). Liberia (BCH 22/7/7) could not support the proposed measures and stressed that a technical review addressing global, regional and local aspects was needed. Such a review would include a detailed cost-benefit analysis covering both capital costs and operational costs. OCIMF's economic arguments should be included.

6.2.2.2 Working Group Discussions and the Regional Concept

As described in the previous chapter, the reasoning on the 'regional concept' for control of SO_x emissions was given by a 'group of volunteers' (BCH 22/WP.4, Annex 2). The reported economic reasons for the regional approach were availability problems for the global use of LSFO and that environmental protection in particularly affected areas could be provided without unnecessary burdens for ship operators. It was clarified that the concept of regional control should not lead to proliferation of different standards but instead have uniform application. The only economic reason reported by the group of volunteers for introducing the global cap as a supplement to the regional concept was that it could be helpful in resolving the availability problem of LSF for regional control.

After the regional concept had been presented to the working group members, they exchanged their views on regional versus global measures. "A number of members" (BCH 22/WP.4, p. 3) supported Norway's views that a regional approach would result in heavy burden on both ship operations and national administrations and significantly affect the free movement of international shipping. It could further result in different regional or national rules, and it would complicate international shipping if these were to apply to foreign ships. In addition, FOEI stressed that the costs of enforcement would result in a heavy burden for port States and coastal States and should be taken into account in cost-benefit studies for a regional approach. According to Norway, the above implications would be avoided with a global standard for all flags, which would prevent distortion of the competiveness of the shipping industry. A global approach was the solution that would benefit both the environment and international shipping. The response to these views was expressed by the delegation of the Netherlands – the chairman of the group of volunteers. It was stated that the risk of unilateralism could be addressed through uniform regional standards agreed by the IMO. Emission standards within a specific region would apply to all flags entering that region. A "number of members" (BCH 22/WP.4/Corr.1) agreed with the Netherlands, i.e., they favoured the regional approach proposed by the group of volunteers. The working group recognized the importance of a unified international standard and that a regional approach should not be confused with unilateral action taken without international regulations. The principle of regulating shipping internationally would not be contradicted with the regional approach (BCH 22/WP.4; 22/WP.4/Corr.1; 22/14). In addition to these discussions, the delegation of the Bahamas suggested that the paragraph on global capping in the working group annex on the regional concept would be placed in square brackets, though no brackets were found in the annex. The argument was an expressed need for consideration of economic implications even for a relatively high cap of 3.5%, with emphasis on whether it could "unfairly penalize domestic

shipping in some oil producing countries" (BCH 22/WP.4, p. 4). The BCH later agreed to further consider the regional concept (ibid.; BCH 22/14).

6.3 1993-1994

6.3.1 MEPC 34, July 1993

No discussion took place at MEPC 34[88], though some submissions were noted and referred to the BCH (MEPC 34/23). OCIMF's submission (MEPC 34/3/1) contained a study undertaken by IPIECA, which comprised a forecast on global supply, demand and fuel oil qualities until the year 2000 linked to the costs and benefits of a 3.5% global cap. On the basis of samples on delivery in over 100 ports around the world, fuel oil quantities supplied in the world's regions were presented by their sulphur contents. Fuels with a sulphur content above 3.5% totalled about 22 million tonnes for the world in 1990, which represented 20% of the total bunker quantities. About 4% of the total had a sulphur content of 1.5% or less. In a first scenario, all bunkers with a 1.5% sulphur content would be converted into fuels for land use and all incremental bunker demands after 1991 would have to be supplied from high sulphur crude oils in the Middle East. A second scenario included crude oil supply from the Middle East with a variation in sulphur contents. Combining these scenarios, bunker fuels above 3.5% were expected to increase to 31% of the total quantities. To guarantee a 3.5% sulphur content limit, the suppliers would have to apply a target of 3.3% when blending due to the margins of test methods. The expected proportion of bunkers above 3 % for the year 2000 was about 60%; hence the quantities that required desulphurization were large and increasing.

Based on these conditions, the global investment costs of a 3.5% cap were estimated between 1.4 billion USD and 2 billion USD (representing scenario 2 and scenario 1 respectively). In addition, the annual costs would increase by 470-650 million USD. This would result in a price increase of about 14 USD per tonne of bunker fuel. Assuming that only 25% of ship emissions reach land – also in other regions than Europe – the cost of a 3.5% global cap would be at least 12,000 USD per reduced tonne of sulphur deposited on land. OCIMF's view was that a global cap was not a cost-effective method to control SO_x emissions and it supported work on "rational regional or local controls" (MEPC 34/3/1, p. 1) for areas that demonstrated cost-effectiveness.

OCIMF further distributed the full report of the CONCAWE (1993) study and, once again, summarized it (MEPC 34/INF.36). A few things are worth noting from the final report. The European control scenario in CONCAWE (1993) not only focused on a 1.5% sulphur limit in Europe but also on a 2% limit. The 1.5% limit was based on the IMO proposal in accordance with the 50% reduction target, while the 2% limit was based on the French proposal to the EC briefly mentioned in BCH 22/INF.7. The capital costs for the 2% limit would be 4.2-6.4 billion USD, with a bunker price increase of 35-52 USD per tonne. Notably, the estimated bunker price increase for the 1.5% limit had been lowered in CONCAWE (1993) without explanation: 46-68 USD per tonne compared with 53-76 USD per tonne. The regional European scenario also had a lowered estimated bunker price increase: 58-85 USD per tonne compared with 67-95 USD per tonne. No explanation for the higher bunker price increase for the regional European scenario compared to the European was found in the report. It also discussed general future demands for residues and distillates and highlighted uncertain

[88] The preceding session, MEPC 33, had no reported economic consideration (MEPC 33/20).

strategies of refineries in choosing between investing in desulphurization of residuals and converting residuals into distillates. In general, a significant decline in the demand for residuals was predicted for the coming decade. It is also notable that the report briefly mentioned two benefits for the shipowner of using LSFO that would counter some of the increased fuel costs. The first was increased energy of the fuel by 0.8% for each 1% decrease of the sulphur content. A reduced sulphur content from 3.5% to 1.5% would result in fuel consumption savings of 1-2 USD per tonne. The second was savings of 1-1.5 USD per tonne from the ability to use another lubricant. In addition to OCIMF's submissions, Finland (MEPC 34/INF.12) submitted a translated abstract of a study. It stressed the importance of international measures due to the international character of shipping. International measures would prevent disturbed competiveness of Finnish ships.

6.3.2 BCH Correspondence Group on Regional Control Options

The report of the Correspondence Group on Regional Control Options (BCH 23/7/4) included some economic reasoning behind choosing a regional approach, the concept of global capping and the use of a combined approach. On choosing a regional approach, it was considered unlikely that there would be enough support for a stringent global sulphur content limit as this would involve high costs and a risk of seriously disrupting the residual fuel market. The regional approach would have global characteristics. Following the principles of 'special areas', all designated regions would have the same standards that would apply to all ships covered by MARPOL. Uniform standards for all flags would prevent regulations with a burden that was too high for international shipping. As mentioned in the previous chapter, individual countries' concerns would not be sufficient justification to designate an area. The reported reason was that the establishment of areas with stricter regulations affect the interests of other countries. With the purpose of ensuring "that a country's determination is reasonable and necessary" (BCH 23/7/4, p. 8.), guidelines with criteria for designating such areas would be developed in similar ways as to those for the concept of special areas under MARPOL. The criteria would contain socio-economic reasons and cost-effectiveness, including if it were more cost-effective to reduce ship emissions than land-based measures. It was further argued that an integrated approach with regional measures and a global cap of about 3% would provide some environmental protection "at acceptable cost levels" (ibid., p. 6). It was noted that a 3.5% cap would still result in a cost increase of about 14 USD per tonne of bunker fuel, according to OCIMF (i.e. the IPIECA study). The presented economic advantages and disadvantages of the regional approach and a global cap are given in Table 6.1. A 3% global cap and a 1.5% special area limit were placed in square brackets in the proposed draft regulation. It could not conclude on whether an increase of local and unilateral measures could be avoided by "universally agreed regional measures" (ibid., p. 1).

Table 6.1. Economic Advantages and Disadvantages of Regional Measures and a Global Cap (BCH 23/7/4)

	Economic advantages	**Economic disadvantages**
Regional sulphur limits	• Slightly reduced maintenance costs	• Higher costs of LSFO • Possible availability problems of LSFO • Operational burden of technical problems on board, such as storage problems
Global sulphur cap [3%]	• Limited implications for refineries due to the limit being near the global average sulphur content	• The sulphur outlet of refineries would be limited. This would cause market shifts and could result in cost increases.

6.3.3 BCH 23, September 1993

The outcome of the correspondence group formed the basis for the working group at BCH 23[89], but there were also two relevant submissions. OCIMF's submission (BCH 23/7/5) first positively highlighted the agreement to consider regional control at BCH 22 and the work of the correspondence group. This was put in relation to the costs and increased awareness that it may not be necessary with such costly global action. The cost figures of the IPIECA study were referred to as support to the argument that it was not necessary with a global cap, and it was underlined that a 3% cap would result in significantly higher costs than these figures. These required funds could be better spent, according to OCIMF. It further had the view that reducing land-based emissions was the most cost-effective method to reduce impacts from SO_x. OCIMF ended by expressing its support for uniformly applied local or regional control. It did not support that member States "and their citizens" (BCH 23/7/5, p. 3) would spend "huge sums of money" (ibid.) to finance global measures without clear environmental benefits. The second submission was by Saudi Arabia (BCH 23/7/6), who stated that the costs were very high in relation to the environmental improvements that the proposed draft regulation would provide. It was thus not considered feasible with global application, though regional application would be useful for both environmental and economic aspects. It should be noted that MEPC 34/3/1 (the IPIECA study) and MEPC 34/INF.36 (the CONCAWE study) were particularly listed in the working group report (BCH 23/WP.3).[90]

As seen in the previous chapter, the working group left strict global measures behind due to the lack of support and focused on either regional measures or the combined approach. On the evenly divided opinions on whether global capping should be used, there were notably several economic arguments against a global cap, but no reported economic argument in support of a global cap. The delegations that did not support a global cap emphasized high costs and negligible environmental benefits. They also referred to Assembly Resolution A.500(XII)[91], which included a recommendation to take into account "the costs to the maritime industry and the burden on the legislative and administrative resources of Member States" (Resolution A.500(XII), para. 3) with regard to new regulations. Despite the compromise proposal on monitoring and applying a threshold-trigger mechanism as shown in the previous chapter, the BCH was unable to draft SO_x requirements (BCH 23/14). No economic aspects were reported on the criteria for special area designation in the two reports of the working group (BCH 23/WP.3; BCH 24/7/1).

After the consideration of the first working group report, the delegation of Venezuela expressed that a global cap would result in a change to the production process for petroleum and its derivatives, which would have "a far-reaching impact" (BCH 23/14, para. 7.40) on Venezuela's economy and on consumers on a global scale. It thus did not support a global cap and emphasized examination and analysis of applying regional measures. The report further highlighted that Venezuela was a traditional petroleum product exporter and an OPEC member. The delegation of Egypt also had earlier – in connection with the issue of fuel oil quality – drawn attention to the industry implications with the emphasis on the costs of reducing the sulphur content of bunker fuels.

[89] The first intersessional meeting of the BCH Working Group on Air Pollution was held before BCH 23 (July 1993), though no SO_x discussions were found in the report (BCH 23/7/7).

[90] Of further submissions, the US (BCH 23 /7/8) referred to the Assembly Resolution on air pollution (A.719(17)) in brief comments on the draft regulations by the first correspondence group (before BCH 22). The highlighted part of the resolution was the inclusion of assessing economic impact for the whole industry.

[91] The resolution set the objectives of the IMO in the 1980s.

Further in the plenary, the observer of FOEI highlighted the social costs of acidification. 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. On the other hand, the World Watch Institute had estimated that 30.4 billion USD of annual losses from forest damage in Europe were derived from sulphur deposition alone. FOEI thus stressed that acidification was already causing huge cost figures for society. The delegation of the Bahamas added that shipping was merely one of the contributors to these problems, though it supported FOEI and both emphasized that these costs should be taken into account in cost-benefit discussions at the IMO (BCH 23/14; BCH 24/7/7). A later statement by the delegation of Sweden criticized the presented cost figures during the process as "deliberately high and lacked objectiveness" (BCH 23/14, para. 7.62.2). It also expressed hope of cooperation to find a solution that would prevent the possibility or necessity of some countries taking unilateral action. Several delegations supported these views.

6.3.4 BCH Correspondence Group on the Regional Approach

The report of the Correspondence Group on the Regional Approach (AP/WG 2/3) did not provide any economic arguments for the reported polarization of views on global capping between proposals A (3.5%) and B (delayed trigger method) (see the previous chapter). The question of delineation also had a polarization of views with either 12-15 miles or 200 miles from the coast, though no economic arguments were presented. Nevertheless, a few economic aspects were included in the draft regional approach. The primary criteria for special area designation did not include economic aspects, though additional factors that could strengthen the arguments for a special area designation did. These included whether there were threats to the value of a region and whether it was more cost-effective to reduce ship emissions than land-based measures (previous correspondence group criterion). The delineation part also included taking into account economic impacts on both shipping and international trade. In addition, the required general description of a particular area in the required background report had to include the social and economic value of the region.

6.3.5 2nd Intersessional Meeting of the BCH Working Group, February-March, 1994

The submissions at the second intersessional meeting did not include economic arguments, and neither did the reported intense discussion on global capping (discussions centred around 4-5%) (BCH 24/7/6). In the discussion on scientific evidence for special area designations described in the previous chapter, the proponents of scientific evidence also thought it was important to consider the costs and referred to Assembly Resolutions A.500(XII) and A.777(18)[92]. Regarding the issues on designating the Baltic Sea Area and the North Sea, no economic arguments were found (BCH 24/7/6). Of further relevance here, the representative for the EC informed of a proposed directive that could include a maximum sulphur limit of 3% in the EU and 1.5% in special areas. A wish for coordination of this legislative process with the IMO was expressed, though if no IMO legislation with acceptable sulphur limits was in place by 1995, the EU could take its own measures (BCH 24/7/6).

[92] This resolution addressed the work methods and organization and merely invited the attention of committees to the recommendation in A.500(XII).

6.3.6 MEPC 35, March 1994

No economic arguments were found in the documents for MEPC 35, though the BSS proposal to declare the Baltic Sea Area as special area was further discussed, and the Swedish delegation commented on the fact that a designation was not agreed on. It stated that there had been no success at the IMO at this stage and that it would thus seek for a regional agreement for the Baltic Sea Area. It further had the view that the MEPC was co-responsible for this action that Sweden now had found to be necessary (MEPC 35/21).

6.3.7 BCH 24, September 1994

As with the second intersessional meeting, no economic arguments were reported for the intense discussions on global capping at BCH 24 (5% in majority and a compromise of 4.5%). Nevertheless, economic arguments were given in the formal proposals of the discussed limits (BCH 24/15; 24/WP.2; 24/WP.7). Spain (BCH 24/7/8) proposed a 4% global cap. The submission provided a list of the costs in Europe of different sulphur content limits for the year 2010 based on the IPIECA study and CONCAWE (1993). The revised lower bunker price figures of CONCAWE (1993) were not taken into account. It was expressed that cost-benefit considerations had to be applied before taking any decision, and that it should be a basic principle at the IMO with regard to the socio-economic situation of the world. With these economic aspects, Spain's policy was no global cap and a preference for special areas, but it changed its policy to prefer a 4% cap as a compromise solution that would fit its cost-benefit criterion. It would "help to reduce SO_2 emissions without significantly harming" (BCH 24/7/8, p. 5) the producers and users of fuels and crude oils with high sulphur contents.

Singapore (BCH 24/7/14) proposed a 5% global cap. It stressed that any measure to reduce SO_x emissions has to have a significant cost-benefit payoff. Based on data from the oil industry in Singapore, a study had estimated that bunker prices would increase by at least 35% from a sulphur content reduction from 4.5% down to 3.5% due to the costs of desulphurization. Estimated figures from earlier submissions by Kuwait (MEPC 29/18/5), France (MEPC 31/INF.6), Japan (BCH 21/11/6; 21/INF.28) and OCIMF (the IPIECA study: MEPC 34/3/1) were then highlighted. Singapore's position of a 5% sulphur content was further clarified by referring to Assembly Resolutions A.500(XII) and A.777(18), as well as the resolution on air pollution A.719(17), which all included taking economic implications into account. It also explained that the marginal environmental benefit from a 3.5% or 4% global cap would not justify the high costs and that the required funds could be used for more urgent environmental issues.

A special heading in the session report was devoted to OCIMF's presentation of the second CONCAWE study[93], which had been summarized in an OCIMF submission (BCH 24/7/13). The full report (CONCAWE, 1994) was handed out during MEPC 36, though it is briefly reviewed here together with OCIMF's submission. As described in the previous chapter, CONCAWE (1994) aimed to provide data for assistance in designating special areas. Based on the results of emission dispersion and deposition modelling (for the English Channel and the Southern North Sea), the report also included an assessment of the relative cost-effectiveness of emission reduction. A reminder from the previous chapter is in place. CONCAWE had found that in-port emissions represented a higher proportion of the sulphur deposited on land than those from ships out at sea. Based on an assumption that the reduction

[93] OCIMF had submitted an interim report (AP/WG 2/3/1) at the second intersessional meeting, though it did not include any economic aspects.

cost per unit of fuel consumed was constant independent of where a ship was operating, it was concluded that it was more cost-efficient to reduce in-port emissions were in order to achieve a given reduction of deposition. It was found that the relative costs for reducing emissions in ports were 10-20% of the costs for reducing emissions outside territorial waters and 15-50% within territorial waters. At least this was the case for the four grid squares with the highest proportion of ship emission deposition on land (also representing the areas where in-port emissions contributed most). The corresponding figures for reductions within territorial waters in other areas with over 10% contribution from ships to land deposition were 30% compared with the reduction outside territorial waters (represented the areas where emissions within territorial waters contributed the most). For areas with a lower contribution, the corresponding figure was 50%. OCIMF (BCH 24/7/13) stated that a focus on regulating in-port emissions was the most cost-effective way to reduce sulphur depositions derived from ship emissions.

In addition to the above submissions, the Secretariat had compiled a document (BCH 24/7/7) that very briefly summarized the key documents with economic considerations submitted so far in the process. This document was a response to expressed concerns over the cost-effectiveness of measures at MEPC 35. Estimated costs per capping level provided by OCIMF were presented. These figures are reproduced in Table 6.2 (adapted). The Secretariat did not only highlight the contents of Resolution A.500(XII) and A.777(18) but also emphasized that the costs to the maritime industry and the burden on member States (as well as the compelling need) should be considered before the MEPC took its final decision. This should be based on information provided by members, including the submissions summarized in the document.

Table 6.2. Estimated Costs per Capping Level According to OCIMF (adapted from BCH 24/7/7, pp. 3-4)

Cap level	**Cost**
Global sulphur cap	
1.5%	20 billion USD
3.5%	1.4-2.0 billion USD
5.0%	0
Regional cap in Northwestern Europe	
1.5%	5.6-8.2 billion USD
2.0%	4.2-6.4 billion USD

With regard to the discussion on special areas at BCH 24, not much was reported. This was also the case for the second report of the correspondence group (BCH 24/7/9). Nevertheless, the documents revealed that cost-effectiveness had been a particularly debated issue. The second report of the correspondence group had received comments from its members on whether the cost-effectiveness of reducing other sources than shipping should be considered (BCH 24/7/9). When the issue reached the drafting group at BCH 24, the draft document on criteria and procedures was amended with cost-effectiveness as an additional criteria-category in square brackets. This category included the previous part on cost-effectiveness in relation to other sources.[94] In addition, the text had been reformulated so that it was now a criterion for designation as follows (BCH 24/WP.7, Annex 1, para. 2.5 / 2.4.2):

[94] Originally in the additional factors that could strengthen the possibilities for designation

> *Mandatory reductions in shipboard air emissions should not be considered unless the target level* […] *cannot be achieved by land based measures alone* […] *and/or when shipboard measures are as cost effective as comparable land based measures.*

This was then discussed in plenary, where some delegations opposed this new criterion, but the majority of delegations who took the floor preferred it. Hence, no consensus was reached and the BCH kept the text in square brackets (BCH 24/15). At the end of the agenda item, the delegation of Norway gave a statement on the lack of progress on SO_x emission regulations, and criticized the focus on the oil industry. It further expressed grave concern that unilateral measures would be taken, which it viewed as a possibility due to the lack of progress.

6.4 1995-1996

6.4.1 MEPC 37, September 1995

No economic arguments were reported on the discussions at MEPC 37[95] despite many views being expressed by a large number of delegations on global capping (a majority favouring 5%) (MEPC 37/22). Nevertheless, there were plenty of economic arguments and supportive information in submissions and statements given when presenting the submissions.

The Bahamas, Liberia and Panama

The delegation of the Bahamas presented a joint submission with Liberia and Panama (MEPC 37/13/3). They stated that most member States had now recognized that it was neither cost-effective nor possible to address acid rain by a global sulphur cap for marine fuels. The submission highlighted conclusions from CONCAWE (1993) and stressed that the very small environmental improvements in Northern Europe would be achieved by "unacceptable and unfair consequence of extraordinarily high costs being imposed on many oil producing and oil refining countries in other parts of the world" (MEPC 37/13/3, p. 1). Although the costs of a compromised cap of 4% would be much smaller than for a 1.5% global limit, the costs "would be quite real to those members affected and they will be borne disproportionately by those members" (ibid., p. 2). The three States did not believe that it was proper IMO action to "impose a real financial hardship on some of its member States when there is no environmental benefits to be gained by doing so" (ibid.). The delegation of the Bahamas used different words in its statements, e.g. some members should not be 'penalized' (MEPC 37/22/Add.1, Annex 15, p. 1). Moreover, a potential future rise of the sulphur content was considered too small to justify these costs. The precautionary principle was also referred to with regard to a cost-effective solution not being in place. The three States did not support a global cap and were against establishing large special areas. It was considered far more cost-effective to reduce land-based sources and ship emissions near affected areas than to reduce ship emissions out at sea. Special areas should thus be restricted to selected ports or certain areas close to shore, which would provide deposition reductions at reasonable costs. The delegation of the Bahamas did express support for a global cap of 5%, however, and clarified that special areas should be limited to 12 nm from the shore (MEPC 37/22/Add.1).

[95] MEPC 36 was held during October-November 1994. No economic arguments were reported or found in submissions besides OCIMF's repeated summary (in MEPC 36/9/1) and distribution (in MEPC 36/INF.9) of the CONCAWE (1994) report (MEPC 36/22).

A Group of States

A group of States consisting of Austria, Bahrain, India, Mexico, Singapore, Salomon Islands, Vanuatu and Venezuela submitted their joint views (MEPC 37/13/21). Their position and the content were very similar to Singapore's submission at BCH 24 (BCH 24/7/14). Figures were highlighted from the Japanese study at BCH 22 (BCH 22/INF.11) which, among other things, showed that fuels over 4% were supplied in Singapore and Mexico. It was underlined that "any global cap of less than 5% will not result in 'equal misery' for all" (MEPC 37/13/21, p. 2), with emphasis on severe impacts on States exporting or processing high-sulphur crude oil and large flag States. Similarly to Singapore (BCH 24/7/14), it stressed that any measure to reduce SO_x emissions has to have a significant cost-benefit payoff. In this regard, it referred to Assembly resolution A.777(18) (and thus also A.500(XII)). The study conducted and highlighted by Singapore in BCH 24/7/14 was further highlighted with presented cost-estimates of different sulphur content reductions. These figures are given in Table 6.3 below.

Table 6.3. Estimated Costs/Bunker Price Increases for Different Sulphur Content Reductions (MEPC 37/13/21)

Sulphur content reduction	**Average incremental cost / tonne** (bunker price of 80 USD / tonne)
From 4.5% to 4.0%	6 USD
From 4.5% to 3.5%	28 USD
From 5% to 4.5%	15 USD
From 5% to 4.0%	15-30 USD
From 5% to 3.5%	25-50 USD

The capital costs from the IPIECA study (MEPC 34/3/1) were also highlighted. According to the group of States, these figures showed that any global cap below 5% would result in higher bunker prices and, in turn, increased freight costs, which would result in increased prices of consumer goods. Similarly to Singapore, the group of States had the view that the benefits of a 3.5-4% global cap were marginal and did not justify the huge costs. The required funds could be used for more urgent environmental issues. Such regulation was also not considered to be in line with Assembly Resolutions A.777(18) and A.500(XII). Reference was also made to A.719(17) (air pollution from ships) on assessing economic impacts. The group of States proposed not establishing a global cap or a 5% cap. It also believed that it was more cost-effective to reduce land-based sources, but that small areas with high shipping traffic could be regulated locally or regionally if such measures were justified on the basis of costs.

The Baltic Sea States

The BSS submitted their background document for special area designation of the Baltic Sea Area (MEPC 37/13/7). Before presenting the document, the submission stated that the BSS had been advocating a global solution to not place unnecessary burden on the international shipping industry. In the context of a lack of support for a global approach and the emergence of the special area approach, they had decided to designate the Baltic Sea Area as such a special area. As seen in the previous chapter, the background document contained many aspects on the basis of the draft criteria and procedures. The BSS had a firm opinion that the criteria were fulfilled for designation. Let us take a closer look at the economic contents.

Under the category 'social, ecological and economic values', the economic importance of fish resources and the necessity of healthy marine environments for recreational activities were highlighted. Under environmental effects, the annual cost of liming due to acidification in Sweden alone was estimated at 25 million USD. It was underlined that the total economic losses from acidification were difficult to estimate but that billions of SEK were spent

annually on measures against declining catches of fish and crayfish, corrosion of buildings and cultural heritage, as well as acidified forests and drinking water. It should be noted that these figures represented problems derived from all emission sources. On the additional strengthening arguments for designation, severe effects on fishing in inland waters and coastal areas were highlighted. Both commercial fishing and angling were considered to be highly important for several areas. Acidification was considered a serious threat to the attractiveness and value of the whole region's fishing lakes and coastal areas. The annual cost of corrosion damages was over 700 million SEK in Sweden. It had been shown from practical experience in Sweden that reducing ship emissions using LSF had been more cost-effective than reducing emissions from land transportation and other land-based sources further. The additional fuel cost for Scandinavian ferries burning bunker fuels with 0.5% sulphur content had been shown to be 15 USD per tonne of fuel. The reduction cost per kg of sulphur varied between 0 and 20 SEK. The BSS thus saw no economic reason to exclude shipping from taking necessary measures. In addition, the Task Force on Integrated Assessment Modelling under the LRTAP convention had concluded that reducing ship emissions was cost-effective compared to measures on land. The estimated implementation costs of the second sulphur protocol were further reported to be about 16 billion USD (MEPC 37/13/7).

Of further relevance, the delegation of Sweden was particularly critical of economic self-interests with an intervention on another issue: the entry into force criteria of the new Annex VI to MARPOL. Although this is not within the scope of this thesis, its following view could be put into the context of the sulphur content discussions (MEPC 37/22, para 13.11):

> *Sweden further underlined that the times in which the ethic of pure self-interest dictate policy were gone and that an era of mutual inter-dependence had been entered. If self interest would prevent IMO from fulfilling its obligations regarding air pollution, progress would inevitably occur outside IMO and other agencies and institutions would certainly not mind doing the Organization's job for it.*

Norway (also representing the North Sea States)
On the global cap, Norway (MEPC 37/13/6) merely stated that a 5% cap would result in pressures for regional / unilateral solutions. Instead, it supported a maximum 3.8% limit (see the previous Chapter). On special areas, the Norwegian submissions concerned a proposal to designate the North Sea (MEPC 37/13/6/Add.1) along with a background document presenting arguments for designation (MEPC 37/INF.19). Norway considered that the criteria had been fulfilled with the background document, but it did not evaluate the information against the criteria and not many economic arguments were given. It was stated that the most effective way to reduce sulphur depositions in a sensitive area would be to reduce emissions close to such an area. Taking the reduction of sulphur deposition in Norway as an example, the document reasoned that it would be more cost-effective to reduce emissions from ships in the North Sea than to reduce emissions in countries such as the UK or Belgium, though this was based on the assumption that the marginal abatement costs were the same for these sources. It was further noted that this was not inconsistent with the conclusion by CONCAWE (1994) that it was more cost-effective to reduce in-port emissions than those of ships out at sea, with regard to protecting selected areas.

ICS
ICS (MEPC 37/13/14) referred to Assembly Resolution A.777(18) (and thus to A.500(XII)). There could be a need for special areas, but ICS was concerned for economic and practical reasons. Special areas could disrupt smooth ship operations, mainly due to technical problems

with the required fuel switch, which could result in engine failures. It further stressed that regional control could result in serious implications for ship operations due to different emission standards at international, regional and national levels. It thus stressed the need for internationally agreed regulations and procedures for special area designations to prevent regional or national authorities from declaring special areas on their own. An international agreement was not only considered essential to prevent unilateral action but also to avoid distortion of competitiveness within the shipping industry. It further supported the idea of a global sulphur cap (unspecified limit).

IAPH

The *International Association of Ports and Harbors* (IAPH) had two relevant submissions. The first (MEPC 37/13/16) strongly emphasized that the criteria for special area designation should include cost-effectiveness, and thus suggested removing the square brackets from the draft criteria and procedures. The second (MEPC 37/13/17) reasoned that an ideal global regulation would be at a level of 0.5-1% sulphur content, though this would result in financial difficulties for the oil industry, which in turn would affect the shipping industry with increased fuel costs. This would result in increased freight rates and negatively affect competiveness in relation to other transport modes. IAPH was particularly concerned about a possible distortion in the competitiveness between ports within and outside special areas if such areas were to be established. It was also noted that the competiveness of shipping could be distorted. It thus opposed regulating sulphur emissions in special areas and stressed that the IMO should develop a strategy that would eliminate the need for special areas. A global cap was the solution and it should be at a level close to the global average sulphur content at the time, with a regular review in the long term.

Germany

Germany (MEPC 37/13/26) had the view that a 3% cap should be established, but taking into account the "temporarily practical and financial problems to some refineries or countries" (MEPC 37/13/26, p. 3), an interim cap of 3.5-4% was proposed for a suggested period of five years. On special areas, it was underlined that the delineation was of most importance due to the international character of shipping. Competitive distortion in both shipping and between ports had to be avoided. The delegation of Germany added that regional and unilateral actions could not be avoided if acceptable IMO standards were not established.[96]

6.4.2 MEPC 38, July 1996

At MEPC 38, the draft criteria and procedures for special areas (now named SECAs) were revised by a group of experts. The economic contents were moved from the criteria (initially additional strengthening factors) to procedures for assessment and adoption. The new draft stated that the relative costs of reducing ship emissions to decrease depositions in relation to land-based measures should be taken into account in the IMO's assessment of a proposal to designate a special area. The assessment should also take into account economic impacts on international shipping (MEPC 38/WP.12). In the discussions on delineation of special areas, it was underlined that the competiveness of ports should be taken into account. No economic arguments were reported for the designation of the Baltic Sea Area. As before, no economic arguments were reported for the discussions on global capping. Although new proposals

[96] In addition to the above submissions, OCIMF (MEPC 37/13/4) stated that it could not support any global cap established by the IMO. The argument was that no limit below the existing 5% ISO standard could be justified based on the available and submitted environmental and cost data.

emerged on a gradual long-term reduction[97], the 5% limit remained in square brackets. Nevertheless, the 5% majority had been broken with evenly divided views between a 5% cap and a lower figure (unspecified) (MEPC 38/20). As with the previous chapter, we can only turn to the submissions in the search for an insight into this turn in positions.

As shown in the previous chapter, a submission by Norway (MEPC 38/9/2) presented a written communication from the chairman of the Executive Body to LRTAP addressed to the secretary-general of the IMO. An analysis for the preparatory work on the second sulphur protocol had indicated that the agreed targets could be achieved cost-effectively by reducing ship emissions. As with the background document of the NSS, it was stated that the most effective way to reduce sulphur depositions in a sensitive area would be to reduce emissions close to such an area. It would also be more cost-effective to reduce emissions from ships close to a sensitive area than to reduce land-based sources.[98]

FOEI (MEPC 38/9/6) first stated that a balance between shipping industry interests and environmental interests had been reached in other issues by the IMO, but that it had been impossible to apply a meaningful approach to sulphur regulations due to oil industry interests. It was stated that the lack of majority on a global cap lower than the average sulphur content could only be explained by the influence of the oil industry. The reasoning was that a strict global sulphur limit would merely result in marginal increases in the costs for shipping and not distort the international competiveness since it would be applied globally. Benefits of using LSFO were also highlighted, e.g. higher energy content of the fuel, decreased use of costly lubricants, cheaper fuel systems, less wear on engines, less manpower, etc. It was stressed that if HSFO was not completely removed, these benefits would not be fully utilized. While the shipping industry was considered to have little to fear and instead could expect these benefits, the oil industry could lose its market for high-sulphur products, which was on the way to disappear on land. The regional approach would instead result in significant commercial implications for the shipping industry and competitive distortion. Fuel switching would require expensive retro-fitting for dual fuel storage and supply systems. It was also stated that enforcement of special areas would be both costly and ineffective compared with a global cap. Without effective enforcement, some operators would burn the cheaper HSFO to gain a competitive advantage. FOEI also highlighted the social costs of acid rain by repeating what was stated at BCH 23. As shown in the previous chapter, it preferred a global cap of 0.5-1%, though it recognized that agreeing on such a cap would take some time and proposed a cap that was just below the average but with a timetable for further steps of reduction. Preliminary special areas could be established and then be replaced with a strict global limit. Such an approach would benefit both environmental interests and the shipping industry.

WWF's submission (MEPC 38/9/13), which intended to apply the precautionary approach to the sulphur issue (see the previous chapter), also included economic aspects. Deciding the level of a global cap was thought to be mostly an issue of market availability and cost-effectiveness. WWF thus stressed that problems with availability of LSFO would only be temporary and that the market would eventually meet the demand.[99] The guidelines on the precautionary approach included a requirement to consider the cost-effectiveness of different policy options. WWF stressed that such analysis would have to include a weighting of the costs of fuels against the long-term social costs of environmental impacts. It was also

[97] See the previous chapter.
[98] Based on the assumption that the marginal abatement costs were largely the same
[99] WWF also claimed that there was no documentation on the availability of the fuels required to achieve a 1.5% global sulphur limit.

underlined that no definition of cost-effectiveness was included in the guidelines. WWF proposed that a cost-effective measure would be a measure that "eliminates or reduces the risk to the maximum extent possible, unless the measure is clearly unreasonable (economically) when viewed on an industry-wide basis" (MEPC 38/9/13, p. 4). The MEPC should thus focus on the lowest sulphur content limit that was technically feasible and then decide on whether it was unreasonable on an industry-wide basis. If other measures existed that were not cost-effective, the MEPC should explore how cost-effectiveness could be achieved with different forms of incentives. It was emphasized that a 1.5% global cap would ensure a level playing field where the cost burdens were shared equally, which would make it reasonable on an industry-wide basis. It was also thought that this could generate a supply that could meet the demand. If the required fuels where not available on the global market, a market for these fuels would simply be created by the demand. As LSFO was not considered instantly available for to meet a global 1.5% limit, WWF suggested a phase-in period for such fuels of about two to three years. An interim cap of 3-3.5% was proposed, but coupled with a phase-in schedule for a lower cap (including technical and economic support for developing countries).

In addition to the above submissions, the UK (MEPC 38/9/7) underlined that failure to reach a strict global cap could result in increased regional/unilateral measures, and that the EU was already considering a proposed directive. If this proposal was adopted, it would restrict the sulphur content of fuels within the EU to 3.5%. In this context, it repeated its position on a delayed trigger mechanism. The Russian Federation (MEPC 38/9/5) proposed an exemption of ships with restricted voyages within SECAs (in total 144 hours) to be determined by the responsible national authorities. This was proposed due to economic and practical reasons related to the required fuel switch. Moreover, 19 States[100] (MEPC 38/9/11) now supported a 5% global cap based on the same economic arguments as the submission by eight countries at MEPC 37 (MEPC 37/13/21).

6.5 1997: Final Drafting and Adoption of the Combined Approach

6.5.1 MEPC 39, March 1997

As seen in the previous chapter, the global capping discussions at the final MEPC session were similar to the end of MEPC 38: maintaining a 5% limit in the final draft but split views on a lower figure (MEPC 39/13).[101] A proposal of a single global regulation by BIMCO (MEPC 39/6/21) was considered. It underlined that if the IMO fails to provide standards that are acceptable worldwide, regional requirements could be established, which would result in severe operational problems for shipping. BIMCO proposed a 3% sulphur content limit to be applied not only to the fuels used by ships but also to the fuels supplied. It further did not favour the delayed trigger mechanism, which it viewed as expensive and time-consuming. As seen in the previous chapter, the Committee did not agree with the proposal. Instead, the submissions by Australia, Singapore and Vanuatu (MEPC 39/6/9) and the State of Bahrain (MEPC 39/6/17) gained significant support (a 5% global cap and 1.5% in SECAs). Their only relevant economic arguments were an emphasis to consider the costs presented by the group of 19 States at the previous session and a need for uniform standards for all special areas.

[100] Antigua, Barbados, Bahrain, the Bahamas, Barbuda, Brazil, Ecuador, Ethiopia, Hungary, Liberia, Maldives, Mexico, Peru, Romania, Singapore, Tunisia, Turkey, Vanuatu and Venezuela

[101] This session further placed both the new draft Regulation 14(2) and the draft Conference resolution on monitoring within square brackets. This was due to concerns from a number of delegations on financial and administrative implications of monitoring the sulphur content.

A waiver on the SECA regulations was introduced by the working group as an additional paragraph in square brackets. The waiver postponed the effect of the SECA regulations by one year for ships entering a SECA from the outside (MEPC 39/13; 39/WP.11). This was a compromise that originated from a proposal by the Russian Federation (MEPC 39/6/19). As with its earlier proposal at MEPC 38 (MEPC 38/9/5), the reasons were economic and practical related to the required fuel switch. The Russian proposal was sort of a mix between its earlier proposal and the agreed paragraph: an exemption of three years for ships with restricted voyages within SECAs (in total 144 hours) to be determined by the responsible national authorities. No economic aspects were reported on the criteria and procedures, except for concern from several delegations on the spread of special areas in the world in which the committee agreed that unwarranted special areas would be prevented with strict application of the criteria and procedures (MEPC 39/13; 39/WP.11).

As mentioned in the previous chapter, a designation of the North Sea as SECA could not be agreed on since additional information was needed and would thus be sent to the conference (MEPC 39/13; MEPC 39/6/20). The Baltic Sea Area was considered to be sufficiently justified for designation with additional information submitted by the BSS, though it was placed in square brackets in the regulation (MEPC 39/13). The new information by the BSS (MEPC 39/6/24) primarily focused on the development of an acidification strategy within the EU, which aimed to identify and propose cost-effective emission reductions to achieve the objective of no exceedance of critical loads within the EU. The strategy was based on an analysis with different scenarios. It showed that measures to reduce SO_x emissions from ships in the Baltic and North Seas, as well as in parts of the Atlantic Ocean, were more cost-effective than only reducing emissions within the EU member States. The total abatement costs would decrease by 25% if focusing on these ship emissions. It was thus considered a cost-effective method to reach the deposition targets. The BSS underlined that such measures required measures outside EU jurisdiction; hence the necessity of reaching agreement within the IMO was highlighted. The MEPC further noted information from the European Commission regarding the acidification strategy and that the use of LSFO for ships was a cost-effective method to reduce European acidification (MEPC 39/13).

6.5.2 Adoption at the 1997 Conference of Parties to MARPOL, 15-26 September

Economic discussions were unreported at the 1997 Conference of Parties to MARPOL 73/78. Nevertheless, some submissions were noted (MP/CONF.3/RD/1-8; MP/CONF.3/WP.4). A submission by ICS (MP/CONF.3/17) expressed a concern over far-reaching impacts on the shipping industry with a disproportionate burden on some parties. The required use of more expensive fuel in SECAs would result in a significant burden on ships entering such areas on occasions. The availability of such fuels could be limited outside SECAs, and all ships entering a SECA would have to carry a supply of the more expensive fuel for switching. In this context, ICS highlighted the increased risks of engine breakdowns and other problems of engine reliability and performance, loss of deadweight capacity due to fuel storage, as well as the administrative burdens of administrations with regard to enforcement at the right timing of the fuel switch. More SECAs could be established and this would mean that all ships in international trade would have to handle two different fuels. It was underlined that the responsibility of conserving the atmosphere was for all but that the burden of measures would be borne almost completely by international shipowners, which ICS considered unfair. According to ICS, the majority of shipowners held the view that a single global standard would prevent these problems. It was proposed that the global cap would be initially set at 3.5% with a later a stepwise reduction starting with 3% and that no SECAs would be

established. This approach would give sufficient time to gain experience and adapt technology and would prevent complications for ship operations and reduce the costs of enforcement. With regard to oil industry implications, ICS stated that "the major oil companies have indicated that they can meet any refining or blending requirements – although this would be at a cost" (MP/CONF.3/10, p. 3). The effective date of the global cap would need to take into account the adaptation of the bunker supply industry however. Incentives for the shipping and oil industries could be provided by governments for an earlier date.

Like its submission at MEPC 39, BIMCO (MP/CONF.3/10) proposed a 3% global cap without SECAs and with the same arguments. It further highlighted some old cost estimates in a short reasoning of choosing a sulphur limit from the initially considered 1.5% global limit to the proposed solution. Greece also made a proposal during the conference (MP/CONF.3/32) of a stepwise reduction of the global cap (see the previous chapter). The only economic argument presented was that this approach would provide a significant time period for the oil industry to adapt. Nonetheless, a 5% global cap remained in square brackets for the major part of the conference and the conference adopted a 4.5% global cap (MP/CONF.3/RD/1-8; MP/CONF.3/WP.4).

With regard to special areas, the NSS submitted a more detailed proposal and background document (MP/CONF.3/16). As with the additional information by the BSS (MEPC 39/6/24), the economic aspects mainly concerned the acidification strategy and its background analysis, which had been conducted by the *International Institute for Applied Systems Analysis* (IIASA). Calculated abatement costs from IIASA reports were showed for three scenarios in tables. The first scenario was a reference scenario and the second represented a 50% reduction of acidification in unprotected areas. The third included a use of fuels with 1.5% sulphur content in the Baltic and North Seas as part of reaching the 50% target. The annual costs of using LSFO in these areas were estimated at about 75 million USD[102], while the annual costs of reducing land-based sources to gain the same environmental benefits were estimated at about 1 billion USD. It was stated that the assessment clearly showed that a 1.5% sulphur content limit in the North Sea (as well as the Baltic Sea) would reduce acid deposition at a far lower cost than for land-based measures. It was thus concluded that the assessment clearly showed the rationale for reducing ship emissions in the North Sea as part of a cost-effective approach. Of further relevance, the NSS report also stated that the future reductions of the second sulphur protocol had been estimated to result in savings of 8 billion USD due to decreased damage to buildings. As shown in the previous chapter, a proposal was also made by the UK (MP/CONF.3/24) to designate the area west of the UK, though it did not include any economic aspect.

The SECA regulations were eventually adopted with a 1.5% limit, but the weaver paragraph was slightly amended after considering four alternative versions. In broad terms, the adopted paragraph was consistent with the draft version. The alternative versions were not found in the investigated documents. As seen in the previous chapter, the Baltic Sea Area was designated as SECA, and Conference Resolution 5 was adopted to consider the conference proposal for designating the North Sea after a designation had been rejected by the conference (MP/CONF.3/RD/1-8; MP/CONF.3/WP.4; MP/CONF.3/34).

[102] The analysis was based on the assumption that the full potential to use available LSFO was used.

7 Analysis and Discussion

This chapter has five sections. The first two analyses and discusses the empirical findings in Chapters 5 and 6 respectively, with explanations sought for each research question through the two conceptual lenses. The third section discusses connections and differences in explanations. The fourth section discusses theoretical and methodological implications. The chapter ends with a fifth section on research contributions.

7.1 Explaining by the Role of 'Science'

The following analyses and discusses the results presented in Chapter 5. Explanations are searched for, for each research question through the first conceptual lens on the role of science in policy-making. It focuses on Sociology of Scientific Knowledge (SSK) and the under- and over-critical model (see more in Section 3.2).

7.1.1 Why Change the Focus to Regional Measures at the BCH?

As highlighted in the introduction of this thesis, the BCH took an explicit policy direction towards regional regulations by developing a framework on regional requirements for SO_x emissions from ships. How was this regional move scientifically motivated in relation to the MEPC target of a50% emission reduction globally, and why did the MEPC agree on a global target in the first place? In the search for explanations, we need to start with the concept of framing. Framing the issue of SO_x emissions from ships has two initial dimensions. The first is the historic background of long-range transboundary air pollution and the regulation of land-based sources. Acidification from SO_x emissions was framed as a large-scale regional problem requiring international action. The impacts were found mainly in Northern Europe, and the LRTAP regime became regional and primarily European-centred. EMEP evolved into a European research community bound to the LRTAP regime, sharing the same perspective and producing a common research pool mostly centred on European emission data, i.e. an epistemic community had been established (see Section 3.2) (Lidskog and Sundqvist, 2002; 2011). Thus, prior to the studied IMO process, the shown impacts, the framing, the international cooperation, the actions, the knowledge and the experiences were all regional and European-centred. In the middle of this regional issue were the NSS and the BSS. They were the first actors to frame the policy issue of air pollution from ships, and SO_x was a significant part of this framing: air pollution was connected to fuel oil quality. The framing of the issue for political action thus started outside the IMO in other institutional settings at regional levels. When the NSS and the BSS introduced this issue to the IMO, it was not framed as a regional problem as before on land-based emissions, but as a global issue requiring international action. The second dimension to framing the issue of SO_x emissions from ships is the nature of the IMO, an international organization responsible for global measures for a global shipping industry. Hence, the issue of SO_x emissions from ships was framed by the NSS and the BSS as a global problem connected to the quality of bunker fuels.

7.1.1.1 Early Acceptance in an Uncritical Policy Environment

At the first two sessions of the process, the MEPC accepted the framing by the NSS and the BSS and recognized that the IMO was the international organization to address both fuel oil quality and air pollution, as well as develop global measures. This recognition was based on

the framing presented by the NSS and the BSS without much support from scientific claims. The submissions and scientific arguments were dominated by the NSS and the BSS, though new actors soon arrived on the scene. Scientific arguments and submitted information increased, but the content of the submissions and discussions were dominated by framing, policy views and supporting scientific arguments. The factual claims were few, and often presented without references. At MEPC 29, two Norwegian studies changed this trend, and the Marintek study would become a frequent reference in the process. This time, Norway's framing of air pollution from ships as a significant problem was supported by scientific studies – or rather factual claims made by a governmental institution and a classification society: Marintek and DNV. This session was also when air pollution was framed as an urgent international problem requiring global action by the IMO. In addition, the agenda item included both air pollution from ships and fuel oil quality, which indicates a framing by the MEPC that recognized the interconnections of air pollution and fuel oil quality. Taken together, the framing by the NSS and the BSS were simply accepted by the MEPC. At MEPC 30, the NSS and the BSS once again played significant roles to the outcome with their proposals of a 50% reduction target by the year 2000.

Why did the participants at these sessions accept the initial framing? What explains this shared belief of the problem and the need for action? Two findings of SSK are central: (1) the concepts of uncritical (science-accepting) and critical policy environments, and (2) that science only influence policy under certain social conditions. The acceptance of the proposals and framing by the NSS and the BSS the MEPC suggests that this first stage of the process had an uncritical policy environment that accepted scientific claims (of a significant emission contribution from ships). Social conditions highlighted by SSK include the question of which actors or institutions are given moral and scientific authority. For this case at the IMO, I argue that the early parts of the process recognized LRTAP and its epistemic community EMEP as the institutions with such authority. This argument is based on the acceptance of the framing by the NSS and the BSS, coupled with the special influence of LRTAP and EMEP by their submissions and participation at IMO sessions. Since the LRTAP regime was established under the UNECE, recognition of the problem existed within the UN, though not of global nature. The BSS and the NSS were also parties to and a driving force within LRTAP and included the countries most affected by acidification. As an example, EMEP could have played its part at MEPC 30 indirectly through information submitted by the IMO Secretariat (MEPC 30/INF.17). The submissionshowed that an EMEP workshop had concluded that different calculation methods based on oil consumption as basis had showed rather similar results and could be used as a basis for assessments. Although, this can be viewed as an example of the uncritical policy environment, it can just as well be related to the concept of epistemic communities. Norway submitted studies to the MEPC that the EMEP workshop accepted and uncritically highlighted in its report as Norway was a driving party of LRTAP and strongly connected to the epistemic community EMEP.[103] Social conditions thus played its part of accepting the problem despite weak scientific support; hence there was an uncritical policy environment at the MEPC at the time. This resulted in the target at MEPC 30 to halve SO_x emissions from ships by the year 2000.

7.1.1.2 Gradual Changes and Partial Explanations

Why did the above global ambitions change towards regional control? One factor is that the NSS and the BSS themselves changed their policy to include regional measures in the same

[103] E.g. a host for the 'EMEP Meteorological Synthesizing Centre – West' (MSC-W) since 1979 (EMEP, 2014)

proposal as their proposed and agreed global target. Regional measures could be applied in areas such as inland waters, harbours and territorial waters, but perhaps the most significant example is "near coastal zones" (MEPC 30/14/2, p. 1), which implies some sort of special area approach. The BSS further used the term special areas. No scientific arguments were given for their proposal, however, which makes it a factor outside this conceptual lens. Nonetheless, the Japanese delegation stated that decisions on targets without scientific justification. This implies a lack of scientific claims in support of different reduction levels[104]. This is confirmed in this thesis from the investigation of the documents; the reduction target was agreed on without scientific evaluation against different targets. Was the target removed from the Assembly resolution for such reasons? Other than an indication of a lack of information for establishing such a target, its removal is difficult to explain from this lens. Nevertheless, it can be speculated that the Norwegian proposal (MEPC 31/13/2) had a role in this development. It questioned the accuracy of the methods used in studies as grounds for reference levels and years, as well as the targets on NO_x to such an extent that it would further discuss the targets at BCH 21. It is thus possible that this proposal could have contributed to Norway's and other countries' acceptance of removing the targets from the Assembly resolution. No discussion on targets or reference levels and years was found at BCH 21, however, and it thus stands as an unexplained possible factor. Finally, it should be noted that several initiated or ongoing studies were highlighted at MEPC 31. These could have played a part in the decision to remove the targets in accordance with the argument to await further study by the BCH before taking decisions.

Discussions on regional measures were gradually taking over the issue of reference levels and dates. It began at BCH 21 when it was noted that the geographical scope of application needed further consideration. On the basis of the investigated documents, no conclusion could be drawn on the role of the scientific arguments or scientific claims for the expressed need to consider the geographical scope. The submission by the IEA, however, played its part by emphasizing the lack of scientific information and uncertainty, with particular emphasis on whether local measures could provide most of the desired reductions. The IEA emphasized that no decisions were to be taken before the results of the listed ongoing studies. In particular, it highlighted the (then ongoing) CONCAWE study, which would become a sort of cornerstone of the regional approach as the process continued. As a result of the IEA submission, the BCH requested that members submit further information to the next session "in order to facilitate co-operation between Members" (BCH 21/15, para. 11.23).This implies a belief by the policy-makers at the BCH that further scientific information would enable cooperation (and ultimately agreement). SSK and the under- and over-critical models hold different views on this relationship, but let us wait with such analysis until the second research question. In addition to implied local framing by the IEA, the BCH 21 was also the first time clear framing of the issue, as regional or local, could be found in the submissions. In particular, it was the start of Japan as a frequent submitter of scientific arguments for regional and local measures.

A correspondence group was then held and it reported a discussion on regional versus global measures for the first time. In Chapter 5, it was found that the way different actors framed the problem was a significant factor for the way they viewed the scope of actions. It was basically a question of limited impacts in coastal areas versus the long-range transport of SO_x emissions. A majority of the group supported the global approach since it was the only option

[104] It further implies that Japan used the situation of uncertainty as an argument to postpone decisions on the level of reduction.

that would achieve the target. The correspondence group was the basis for the work at BCH 22, yet the BCH chose to develop a regional framework.

7.1.1.3 Changed Framing of the BCH with Scientific Support

One significant explanation for this change in policy direction is a change of the framing by the actors at the BCH compared with previous MEPC sessions. No scientific argument for global measures were found at BCH 22, and the issue of SO_x emissions from ships was framed by the actors (in submissions and reported discussions) as a regional issue, no issue or local at most. Even the necessity for action was questioned, which is notable considering the previous recognitions that air pollution (SO_x included) from ships was a serious international problem requiring international action. It appears not just to be a change of framing by the actors at the time, but a change of framing between the MEPC and the BCH.

Those favouring no measures or local at most used the contribution of ship emissions as arguments. Their keywords were 'minimal contribution'. The main actors were OCIMF and Japan. OCIMF had a strong focus on the CONCAWE study. In addition to the debate on the levels of emission contribution, OCIMF started the scientific debate on how the ship emission contribution should be assessed – the importance of investigating depositions instead of comparing emissions. Based on my own background in environmental science, I argue that OCIMF had a significant point to use deposition instead of comparing emissions, but what OCIMF (BCH 22/7/11) also did was to show a 2% contribution in Norway (representing deposition) instead of 14% (representing national emissions). It thus compared a figure for deposition with a figure for national emissions. Whether this was the intention could only be speculated, but it should be noted that presenting a lower figure for the policy-makers could be interpreted as the ship emission contribution not being significant but instead minimal. Norway and OCIMF were simply measuring different things, but the question is how such figures were interpreted by the majority of the policy-makers and which approach (emissions or deposition) had most policy relevance. At this session, OCIMF's deposition approach had the greatest impact on policy. The results of the CONCAWE study influenced the major flag State Liberia to argue against global measures with local being the only alternative. Shipping interests aligned with OCIMF and used the same scientific arguments. One example of such alignment is that ICS, Liberia and OCIMF (BCH 22/7/6; 7/7; 7/ 9) shared the view that regulations should only apply to main engines, not auxiliary engines, which were stated as being responsible for only 10% of the emissions of air pollutants from ships. This is notable considering their recognitions of the potential local contribution, i.e. in areas close to shore or in ports where auxiliary engines were used.

Japan was particularly active in emphasizing a special area approach, and it presented examples of how such areas could be designated. To show only local contribution, dispersion studies where used by both Japan and CONCAWE/OCIMF. These could be interpreted as SO_x emissions from ships were diluted at sea and not harmful to the environment after 15-20 km from the source, though deposition was not taken into account in such studies, nor the later discussion on retained sulphur. OCIMF favoured a regional solution with special areas, though, at the same time, its main focus was to show no significant contributions at both regional and local levels, and it clearly showed the framing of the issue as no problem, or local at the most. This is part of a strategy to make the geographical application of regulations as small as possible, which is further discussed below for the second research question. A significant factor with regard to the special area approach is the concept of critical loads. The UK used this concept at BCH 22 as an argument for a regional special area approach. As an

LRTAP party, the UK highlighted a background strategy for the upcoming second sulphur protocol to LRTAP and stressed the importance of using the critical loads concept agreed on by LRTAP. The emerging use of the concept of critical loads at the IMO implies epistemic community influence, though LRTAP and EMEP are institutions under UNECE, and influences of different institutions within the UN system are common. This is a topic for further research with other theoretical perspectives however.

7.1.1.4 A Critical Policy Environment and Lack of Data

Many scientific arguments at BCH 22 were counterarguments or used to criticize earlier presented science to support a policy of no global action. This suggests that the policy environment of the process had changed from an uncritical environment in earlier MEPC sessions to a critical policy environment being manifested at the BCH. Almost all scientific content at BCH 22 was about showing a minimum global, regional or even local contribution, and previous studies were criticized and even redone. It is significant that they all focused on Northern Europe and some on Norway in particular. The SSK finding of deconstructing and reconstructing socially constructed factual claims could thus be applied to this process. OCIMF's submissions and the CONCAWE study used the data of Norway's studies, in particular the Marintek study, and deconstructed Norway's factual claims. It then reconstructed the factual claims to build a case for regional measures followed by local measures, and finally none at all, by showing minimal contributions at all levels. Japan also redid the Marintek study but only to confirm its results, expressed as an extremely low global contribution. The Marintek study was thus redone twice. These two studies focused on the same area and used the same data but were interpreted by different actors with different views on policy. Both were presented at BCH 22. Although the first part of the CONCAWE study had been presented before, it was at BCH 22 we could see its effects on policy. Given these developments, a critical policy environment at BCH 22 can be confirmed.

Lack of scientific knowledge was frequently highlighted during the early parts of the process, as well as at BCH 22. Data were lacking on emissions and contributions for the world and studies thus focused on Europe – in particular Northern Europe – where data existed. Notably, these were the areas where the countries concerned about the ship emission contribution were located, and these countries had experiences of reducing land-based SO_x emissions due to acidification impacts. This situation did not result in more research and data gathering for other countries around the world however. Instead, other countries targeted the same areas, which is part of the process of deconstructing and reconstructing factual claims rather than dealing with the lack of data and reducing uncertainties. In addition to reconstructing factual claims, Japan showed its focus on Northern Europe when it introduced possible methods for special area designations. Japan emphasized designations in areas where there were high emissions and high contributions to total emissions. Nonetheless, it chose to focus particularly on Northern Europe – the area with the highest emissions – when its own investigations had shown that ship emissions contributed most in Southern Europe and the Middle East. Special areas enabled emission reductions where they were needed most, and the North and Baltic Seas were specially targeted as such areas. Hence, opponents of global measures targeted the areas of the NSS and the BSS as the geographical application of measures, as impacts had not been shown elsewhere in the world due to the critical policy environment.

Early in the process, there were not only differences in methodology and data between the studies but also in data sources and reference years in each study. Perhaps the most significant problem of the lack of data for decision support has been that the total global emissions were

estimated based on emissions in OECD countries. This puts all figures on the contribution from ships to the total global emissions in question. This can be argued to have been one reason for such figures not being presented or discussed in the later parts of the process. Nonetheless, it can be concluded that the figures on global contribution were accepted early on in the uncritical policy environment and that the figures did not undergo criticism during the critical policy environment. This was due to the figures being low enough to draw a conclusion on minimal global contribution by the actors framing the problem as regional or local at most.

The situation at BCH 22 has many similarities with the over-critical model. Oil industry studies and OCIMF's submissions are examples of Collingridge and Reeve's (1986) theory that stakeholders affected by regulation are likely to be involved in research that critically questions the basis of the research used behind a policy, e.g. look for methodological weaknesses, in order to raise doubts about, for example, environmental impacts and benefits of a proposed policy. The CONCAWE study made a strong case – with support from OCIMF – against the high contribution of ship emissions shown in Norway's earlier studies. This case of low contributions, in turn, made previously rather silent actors argue against global regulations with the results of the CONCAWE study as arguments, taking the big flag State Liberia as an example.

It was in this situation that the BCH started to develop a regional framework for control of SO_x emissions from ships. The factors discussed in this section, when taken together, are all significant explanations of the first research question. In this analysis, I have found that SSK has proven to provide explanations on the first research question based on the empiric material, but the basic premises of the over-critical model can also be confirmed. With this in mind, let us approach the second research question.

7.1.2 Why Adopt a Combination of Stricter SECAs and a Global Cap?

Global capping was introduced at BCH 22 and thus in the critical policy environment and dominant framing of the issue as a regional or local problem (hereafter regional/local framing) and therefore with no need for a global emission reduction. It was thus introduced as a supplemental element included in the regional concept. A regional approach was framed as the leading principle to control SO_x emissions from ships. Given this framing, no global reduction of emissions was intended with a global cap. Instead, it aimed to prevent a possible future increase in the sulphur content of fuels. The results of BCH 22 with a combined approach of regional control and a global cap formed the very basis of the coming discussions of the process. The critical policy environment and the regional/local framing existed throughout the drafting period by the BCH.

The correspondence group on regional control options was then a final turning point towards the regional concept with a supplemental global cap. Much of the content in the report was a mere continuation of BCH 22. The difference is that this group assembled all previous and new arguments into a 'case document' for the regional approach. This term is used here inspired by Collingridge and Reeve's (1986) discussion on scientific 'advocates' who gather 'evidence' of their interests and fight counterclaims to form a technical 'case' for a policy. This should not be confused with the concept of reconstructing factual claims since the report did not include scientific claims. Instead, it presented scientific arguments and counterarguments for the regional approach, weighing the pros and cons into a case for action. The scientific arguments were merely justifications of an already chosen regional approach. In

particular, the concept of critical loads was used as justification. The regional approach would be applied in areas where there was a clear need for measures, and a designation of such areas would require fulfilling specific scientific criteria. Of particular importance with regard to framing was the realization that the target could not be achieved in terms of either quantity or time, and it was suggested that it be reviewed. This adds to the difference in the framing compared with the MEPC. The target was something that the policy-makers at the MEPC had agreed on, but at the BCH it would have to be reviewed. The report emphasized that reference levels and years should still be established, however, though as we look further in the process, we cannot find any such discussion.

Although it left the choice between regional and global measures to be made by the BCH, it should be viewed as a strong case document that led to a policy with no point of return at BCH 23. A single global approach was thus abandoned at BCH 23. As the process continued, the scientific arguments and information focused on supporting different policies on the level of or need for a global cap, as well as the delineation of special areas. A concern of increasing sulphur contents in bunker fuels due to regulation of land-based sources had been used as a scientific argument for regulating ship emissions right from the start of the process, though scientific support was lacking. With the emergence of a global cap, this argument thus became central, but there was still no scientific support for this concern. It became a trend, however, to use the average sulphur content at the time as an argument for various proposals on the level of such a global cap. Findings of the average sulphur contents and trends over time became significant in terms of proving or disproving the benefits of a particular global limit or of its establishment, both for preventing an increase and a reduction of emissions. The figures that gained most support for the global cap were between 3% and 5%, with increased support towards a majority for 5% at BCH 24.

The 1.5% limit for special areas was little debated, but the criteria for such areas, in particular the delineation, were highly debated. When the BCH had ended its work, the MEPC was provided with a draft that contained a 5% global cap and 1.5% in special areas (in square brackets). As the work went on at the MEPC, these figures would remain even at the final draft. This brief summary of the continued process highlights the question on the different framings found between the MEPC and the BCH. During the work of the BCH, we saw that MEPC 33 rejected the BCH proposal to reopen the question on the necessity of action. It referred to the Assembly resolution (A.719(17) on air pollution from ships) and the scientific data behind it. Hence, a reframing of the issue could not be found at the MEPC, and different framings within the MEPC and the BCH at this time are confirmed. Why then did the MEPC finalize a draft with a combination of SECAs and a global cap? How did the role of science evolve in the critical policy environment at the BCH, and how did it develop when the MEPC took over? Did closure come about due to reconstruction? These questions are addressed in the following subsections.

7.1.2.1 Lack of Data, Uncertainties, Resolutions and the Precautionary Principle

The need to review the target, as emphasized by the correspondence group on regional control options in 1993, should be viewed in light of US criticism during the first intersessional meeting. It emphasized a need to evaluate the target levels (all considered pollutants) and stressed that they had not been supported by estimations of environmental benefits. This indicates that scientific information was still scarce at this point in time. An expressed need to evaluate the target against environmental benefits two years after the target further implies that scientific information and the MEPC target had little impact on policy-making at the

BCH. At first sight, the comprehensive bibliography submitted at MEPC 33 implied that available information on air pollution from ships was not scarce at the time and that much had been addressed by science: 171 papers and reports covering 1971-1992 with several published in scientific journals or conference proceedings. On the other hand, the studies included in the policy-makers submissions were the only ones that specifically targeted SO_x emissions from ships. Submissions containing scientific information were not few, however, and they increased as the process continued, which is demonstrated by Chapter 5. Not much of this information was represented in the reported discussions, which made it difficult to analyse the influence on policy-making. Most submissions did not have many scientific references, though there were exceptions, e.g. the CONCAWE reports, the background document for special area designation of the Baltic Sea Area, etc.

The lack of scientific data was further highlighted as the process continued. At the later stages of the process, it mainly concerned the contribution of ship emissions to deposition on land and the long-range transport of SO_x, as well as environmental evaluations of the target and the different proposals on the table. Three Assembly resolutions were frequently referred to in arguments for the need for more data. The first was the Assembly resolution on air pollution from ships (Resolution A.719(17)), which requested that the MEPC and the BCH collect and assess information on emissions to establish reference levels. The other two (Resolutions A.500 (XII) and A.777(18)) emphasized a clear and well-documented demonstration of a compelling need in proposals for new conventions (or amendments), as well as the importance of informed decisions. These two resolutions indicate that the need to demonstrate scientific evidence and to base decisions thereon was part of the IMO's institutional culture and formal procedures. Following Jasanoff (1997), this implies that 'science' had a condition to successfully affect policy-making. This remained as a condition however. Although the references to these resolutions criticized the lack of science-based decisions, they were made by actors questioning scientific claims that showed a need for a global cap as well as by those who saw it as important that scientific criteria constituted a significant part of special area designation, i.e. as a strategy to further restrict the application of measures (see also Section 7.1.2.3). Uncertainty is a concept that is of high importance in this process. The use of scientific uncertainty and the lack of information along with references to these resolutions were not just for the above reasons but were also used as arguments to postpone decisions on strict – primarily global – regulations. These kinds of arguments had already been found in the early sessions. In addition to resolutions, the precautionary principle was frequently referred to and interpreted in different ways depending on the policies of different actors. Proponents of a strict global cap used the precautionary principle to justify action despite scientific uncertainties, with the argument that SO_x emissions were threats of serious or irreversible damage. Opponents instead considered that the available evidence did not show that ship emissions posed such threats.

References to the resolutions show a lack of information as the basis of decisions. Overall, it is not difficult to conclude that the policy-makers faced a lack of information – e.g. on emission quantities, atmospheric dispersion, impacts and reduction benefits – for their policy choices and decisions. Following the discussion in Section 7.1.1.4, I highlight that new studies primarily focused on building cases against previous studies instead of focusing on research areas where information was lacking. The critical policy environment was thus a factor that explains this lack of information. A clear example of the lack of scientific information for decisions and the role of uncertainty in a critical policy environment is the debate on emissions versus deposition. Norway's submission (BCH 23/INF.18) at BCH 23 showed the scientific uncertainties at the time and the complexity of drawing conclusions

from the results in favour of a particular policy on the geographical scale for regulations. It was the first with scientific support for the scientific argument that the transboundary nature of SO_x emissions required global regulations. Nonetheless, the extraordinarily low contribution figure that was presented could be viewed as a counterargument to its conclusion. Another policy-maker could easily have referred to this document with a different conclusion in favour of its policy or used the same data and reconstructed the scientific claims. With uncertainty, the policy-maker decides how to interpret the results, which leads us back to the question of which actors or institutions were recognized with moral and scientific authority.

7.1.2.2 Scientific Authority

In Section 7.1.1.1, I argued that the early parts of the process recognized LRTAP and its epistemic community EMEP as the institutions with scientific authority, and thus, in turn, the member States connected to LRTAP, the NSS and the BSS. According to Jasanoff (1996, p. 181), definitions of what is and is not science are negotiated in policy-making: "Labelling an issue as either 'science' or 'policy' implicitly entails an allocation of power – the power to speak or be heard on the issues in question – and interest groups will fight over these labels". From BCH 22 forward, EMEP still stood as the primary scientific authority, but other actors took advantage of this authority and used emission data provided by EMEP to gain their own scientific authority by the policy-makers. In particular, OCIMF and CONCAWE became the primary actors recognized by their interpretation of these data. As an example, Singapore specifically highlighted a 2% ship emission contribution to the total European emissions at BCH 24 with the formulation: "according to EMEP" (BCH 24/7/14, p. 2, abbreviated). Did Singapore mean the results of CONCAWE (1993) – contribution to depositions in Scandinavia and Northwestern Europe – or was it another study actually conducted by EMEP? This cannot be determined in this thesis, but if it meant the results by CONCAWE, Singapore's submission is written so that the reader interprets that the conclusions from a study by CONCAWE were the words from EMEP. In that case, it shows a good example of the importance of referring to its authoritative status: the data were from EMEP – an epistemic community with authoritative status of interpreting science – though the actual interpreter was an oil industry organization.

At BCH 23, OCIMF argued that it could not accept that there were threats of serious or irreversible damage – as prescribed by the precautionary approach – based on "the best available authoritative scientific information" (BCH 23/7/5, p. 3). This implies that OCIMF held the view that submitted and discussed studies during the process had scientific authoritative status, including studies from industry organizations, governmental agencies and consultants. Given OCIMF's influence in this process, I assume that this view was shared by the actors that shared the same regional/local framing and scientific arguments. When scientific claims approach the policy-making arena, it is the policy-makers that determine which studies and actors are given authoritative status in the policy-making context. This was the case for this process. The status was given to that which supported a particular policy of a specific actor.

7.1.2.3 Framing Even Closer to the Shore

The correspondence group on regional control options initiated the need for criteria – in particular scientific ones – in order to establish special areas. Notably, neither global capping nor the actual regional choice had been subjected to a thorough scientific evaluation. How

then did scientific criteria appear for this particular policy? What were the reasons? No argument was found in the report of the correspondence group, but it was stated that concerns of countries in an area were not reasons enough for designating special areas. This indicates that scientific criteria were to be used for restricting special area designations, which was confirmed at MEPC 39 when the committee agreed that unwarranted special areas would be prevented with strict application of the criteria and procedures. Hence, a clear role of science in this process was as a restriction of regulation and, thus, a restriction of environmental protection. This also provides us with a new picture on the regional approach – a picture more suited to the framing at the time. Limiting measures to a regional scale was not enough: it had to be in special areas with special circumstances, and these had to be proven. This is well in line with the framing and policies of many actors, as well as their scientific arguments and supportive claims.

A majority of the scientific arguments and supportive claims present after BCH 22 were about delineation of special areas and not about the global cap. Actors for the oil industry and shipping industry interests became increasingly involved in showing only local contributions. As before, OCIMF played an important role in this regard, as did its further submitted studies by CONCAWE and IPIECA. As stated above on the first research question, OCIMF's submissions clearly showed the framing of the issue as not being a problem, or local at most, but it could agree to a special area solution. Was this a strategy to put a special area regulation in place and then make the area as small as possible? Later submissions showed just this kind of strategy. Almost every study by OCIMF in the continued process was about showing that ship emissions only contributed to impacts within ports and port areas. These studies gained significant support, e.g. a big alliance of States connected to Singapore.

This chapter has found no scientific information behind the criteria except on the issue of delineation. Instead, scientific criteria were first established and then negotiated in political terms on the basis of different policies of different actors. How the scientific criteria were negotiated could not be answered. Investigating amendments or new words in individual paragraphs of a draft is not the intention of this thesis. A group of experts was involved in a revised draft, though the reported list of participants indicated that these were merely delegations and representatives from observer organizations. Hence, these scientific criteria were the result of drafting and negotiations by policy-makers.

7.1.2.4 Changed Framing of the MEPC and a Persistent Critical Policy Environment

The discussions on delineation of special areas became the main issue in the scientific arguments and information found after BCH 22. The regional/local framing dominated both at the BCH and the MEPC. The framing of the MEPC had thus changed from a global issue to a regional one. After BCH 24, the MEPC found itself in locked negotiations with a regional special area approach and a majority favouring the highest possible global sulphur content limit (5%), a limit without any effect on emissions due to the already existing ISO standard. The content of the investigated submissions suggests that the higher the proposed sulphur content policy – i.e. the lesser the regulatory level – the more scientific arguments. This situation changed at MEPC 36 due a UK submission showing that a 50% reduction could not be reached with 1.5% in SECAs or globally. This was highlighted by several actors towards the end of the process, and more studies were submitted that showed the transboundary and complex nature of ship emissions.

The findings provided by the UK did not change the draft global cap of 5% (in square brackets) however. Scientific studies showing a need for stricter measures simply had no effect on policy at this stage of the process, and this despite the IMO having agreed to include the precautionary principle in its work. In this context, we are reminded that the correspondence group on regional control options had already realized that the target could not be reached and that it had the view that the target had to be revised. No revision was made however. Instead, the reference levels and years lost their policy significance during the years after the correspondence group. The target merely became a constant argument of those favouring stricter requirements and thus a less important factor for the majority favouring as low regulations as possible. The lack of policy impact of studies showing a need for stricter measures is explained by the critical policy environment. The process and the scientific debates had reached a deadlock. There were long discussions on scientific methods and concepts and strong cases of deconstruction and reconstruction. This time it was not all about emissions versus deposition but also about retained sulphur in the atmosphere. In the discussions on delineation at MEPC 38, it was reported that that the scientific evidence on transportation of SO_x emissions from ships had led to different interpretations among the policy-makers. This implies that there were uncertainties or that different studies gave different results with different conclusions or interpretations of the same phenomenon. It could easily be argued that it concerned the debate on emissions, retained sulphur and deposition, and it could be speculated that the different interpretations and opinions on the necessary size of special areas were derived from the submissions of Norway and OCIMF at the previous session.

As argued earlier, the important questions are how different figures were interpreted by the policy-makers and which approach had most policy relevance. Given the changed framing of the MEPC, it came down to the figure that confirmed the framing and majority positions. MEPC 37 is a good example of the critical policy environment, with OCIMF submitting criticism of studies that did not confirm its policy and further criticism being submitted both in support of and as counterviews on the OCIMF-CONCAWE-ICCET conclusions. At this time, it seemed that the process had arrived at an extensive technical debate, as the over-critical model suggests.

7.1.2.5 Closure

Following the SSK concepts of policy environments, deconstruction and reconstruction from Jasanoff (1987, 1997), extensive scientific debates in a critical policy environment should not mean failure to reach agreement but instead closure in critical policy environments is derived from deconstruction. Chapter 5 has shown increased scientific content for each session as the process progressed. The scientific arguments and claims increased, as did the submissions and the scientific discussions, yet policy-making remained stuck for many years with the majority 5% global cap and a special area approach. In this analysis, we have seen an uncritical policy environment with few scientific claims and many uncertainties turn into a critical policy environment, with criticism, deconstruction and reconstruction of scientific claims, existing uncertainties being exacerbated and debates without progress on scientific concepts and methods. How did closure occur is this situation?

Participation and the Role of 'Science'

Figures 7.1 and 7.2 show that the total participation of members and observers increased at both the MEPC and the BCH. These were primarily an increased number of member States and NGOs as shown in both figures. Figure 7.3, however, shows big variations in working

groups and drafting groups. No conclusion could be drawn on a participation trend of the groups due to the different kinds of groups at different stages of the policy-making process. According to Jasanoff (1996), it seems easiest to achieve international agreements on complex technical issues when participation is narrowed in the early parts of the process. Taking the Montreal protocol on ozone depleting substances as an example, the negotiations were initially restricted but the participation was gradually extended to include many countries. As a result, States that joined the negotiations on later parts of the process did not have the necessary preparation: they did not share the expertise, the framings of the environmental problems and an understanding of the causes of ozone depletion that the early participants had shared. The result was an emission-targeted policy and thus a shared Western belief by epistemic communities backed by the authority of science. For the studied case of this thesis, however, science had the conditions to be successful in the early parts of the process, but this remained as a condition (as for the earlier discussion on conditions). The framing and the scientific arguments were accepted, but this was due to the uncritical policy environment and the fact that few scientific claims were presented at this stage.

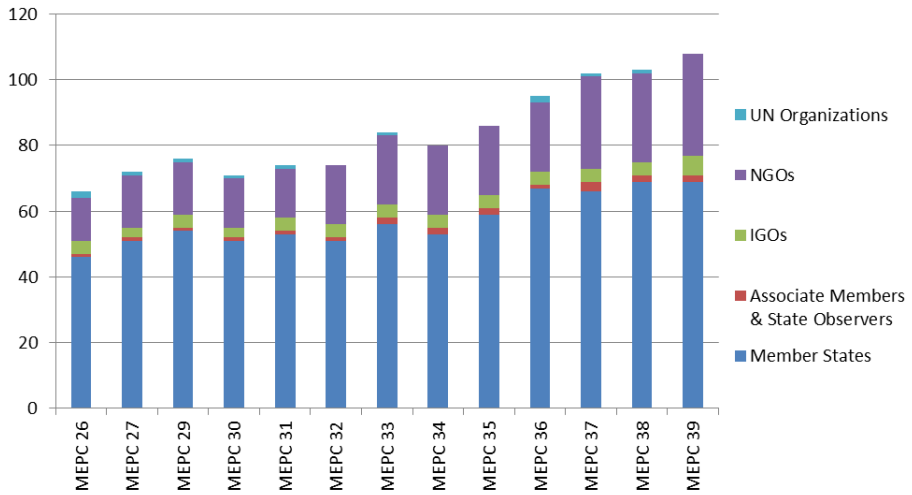


Figure 7.1. Participating Group of Actors, MEPC 1988-1997

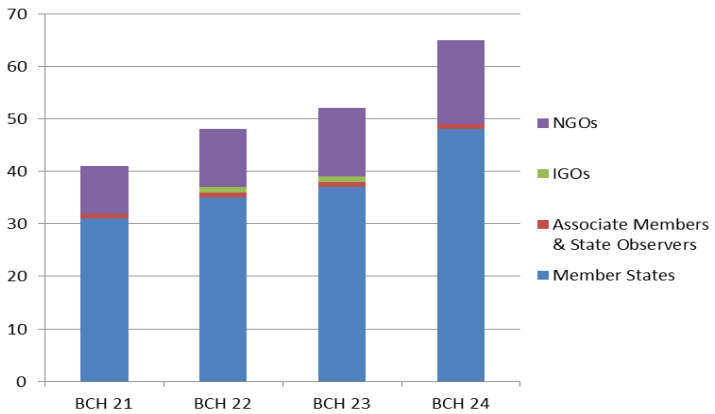


Figure 7.2. Participating Group of Actors, BCH 1991-1994

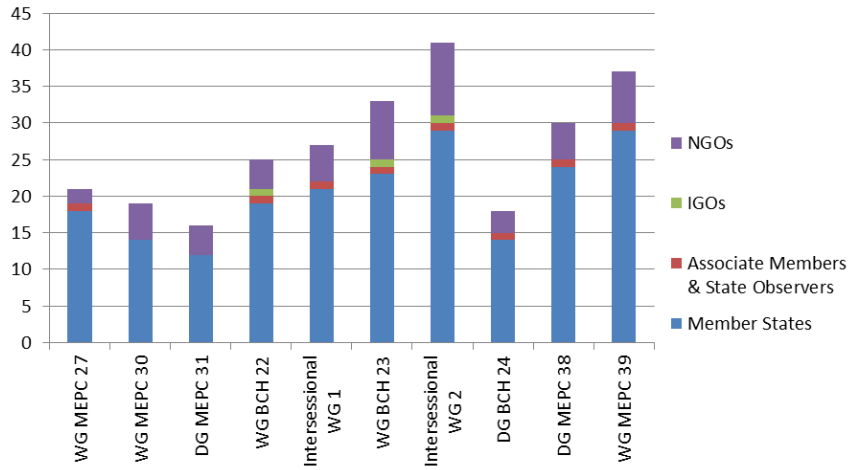


Figure 7.3. Participating Group of Actors, Working and Drafting Groups 1989-1997

As stated in Section 7.1.2.2, Jasanoff (1996) argued that different interest groups will fight over the label 'science' (or 'scientific' studies), since it represents the power to speak or be heard on an issue. A conclusion of the submitted studies of this process is that they were conducted by governmental agencies and industry organizations or in the interests of member States or member organizations for the purpose of providing input to the policy-making process. These studies thus represented socially constructed factual claims by actors with certain policy beliefs. Their policy beliefs guided their framing of the issue. The early studies were framed in a global context. As the number of participants increased, new participants with other policy beliefs arrived on the scene, resulting in criticism of previous scientific claims. These new beliefs formed alliances between member States and epistemic communities with shared policy beliefs, in particular oil and shipping industry organizations, flag States and oil-producing/exporting States. Two groups with different framings evolved: one that framed the issue as global and another as regional/local. This resulted in deadlocked negotiations, but the regional/local group was in a majority.

An Over-Critical Policy Environment: Negotiating the Framing and Compromising

Chapter 5 showed different framing by different actors, sometimes with support from scientific claims but often mere policies with later scientific arguments as justifications. No consensus on the framing was found from the investigated documents, and what looked like a clear global framing by the IMO in an Assembly resolution did not hold once the BCH started its work. A change of framing by the actors is clear at BCH 22, though what has been shown in this thesis is that the framing was not just an early stage of a policy process but rather it characterized the whole process. At almost every point in time of this process, there were different communicated messages from different actors on how the issue should be framed but no clear framing from the policy-makers as a group. Instead, what was found in this thesis when analysing the role of science was a ten-year process of negotiating the framing with attempts to agree on measures at the same time.

As shown in Section 2.2, NGOs function as knowledge pools and advisors to the policy-makers and are thus viewed as epistemic communities. In line with what has been described for land-based transboundary air pollution (Lidskog and Sundqvist, 2011), this studied process has shown a group of policy-makers and epistemic communities – e.g. LRTAP/EMEP and environmental NGOs – that emphasized the transboundary nature of the problem and submitted scientific claims to advance these arguments so that political action could be taken through the IMO. It has also shown another group of policy-makers and epistemic

communities – oil and shipping industry NGOs and the IEA – acting to prevent the issue from being perceived as global or even regional. These steps primarily focused on showing a minimal contribution of ship emissions to total emissions and depositions, thereby taking away the responsibility of one industry, among many, that contributed to pollution. They used scientific arguments and supporting claims as well as uncertainties and confusion over different scientific methods and concepts to confirm their framing and communicate it to the rest of the policy-makers. In line with the over-critical model and not SSK, however, these two groups of actors never really agreed, and the negotiations continued until the very end. As mentioned many times with regard to global capping, a majority favoured 5% and the other group of actors favoured a lower limit. At MEPC 38, however, the views were evenly divided between a 5% cap and a lower figure (unspecified). Hence, the 5% majority had been broken. Did scientific arguments and claims change the deadlocked negotiations?

Viewed from this conceptual lens, the answer is no. At MEPC 38, the previous main actors of the process were locked in their previous positions and arguments. New proposals on the global cap emerged, but these were mere compromises without scientific arguments. At the preceding session, the deadlocked scientific debates had resulted in compromises being manifested in submissions. For the BSS, designating the Baltic Sea Area as a special area had become the main priority due to the lack of support for a global solution, and their scientific arguments thus focused on the Baltic Sea Area. The UK (MEPC 37/13/10) made a clear compromise given its scientific arguments. Although it had shown that the targets would not be reached with a SECA for the North Sea, it proposed the use of a 12 nm limit for special areas, with larger areas needing to be proven by scientific evidence. The argument for this proposal was that awaiting further research would delay the finalization of Annex VI. This is just the kind of compromise due to extensive technical debates described by the over-critical model, and this analysis has indeed shown extensive technical debates. The agreement on the combined SECA and global cap approach can thus not be viewed as anything other than a mere compromise and determination of the actors to stop contesting it due to the time limit of the process. Hence, the outcome of this case confirms the over-critical model and not SSK. Closure could not appear in this critical policy environment by the use of 'science'.

Lidskog and Sundqvist (2011, pp. 11-12) reasoned that "by negotiating and constructing boundaries among the global, regional, national, and local levels, an identity is shaped between a specific environmental problem and a specific spatial level". They further clarified that "an image of a geographical location at risk is constructed and becomes the object of action" (ibid.). That the policy-makers negotiated the framing and at the same time tried to agree on measures explains the outcome of this process. An identity between the problem of SO_x emissions from ships and a specific spatial level was never established. Hence an image of the geographical location at risk had not been shaped and, thereby, no clear object of action. This can explain the adopted combination of a global cap and SECAs; Regulation 14 shows a negotiation of the framing.

Further Prerequisites for Science to Influence Policy

In addition to the above explanations on the research questions, a significant difference between the processes towards agreement on land-based emissions and ship emissions was the prerequisites for science to influence policy. As described in the background, the cooperation on long-range transboundary air pollution can be explained by science enabling cooperation in an East-West conflict. LRTAP and EMEP evolved in a mutual interdependency of the two contexts of science and the geopolitical climate. Science was a tool for cooperation demanded for by the policy-makers and EMEP was the response. The

policy-makers gave science both priority and authority, and an epistemic community became strongly connected to the policy-making arena as well as the regime. The extended role of science in policy-making was accepted by scientists who were given technocratic powers. Put in SSK terms, this is an example of knowledge and policy being co-produced (Lidskog and Sundqvist, 2002, 2011). The IMO simply did not have such prerequisites during the studied process. When the issue arrived at the IMO it concerned all the world's oceans and the international nature of shipping. The cold war was also nearing an end. There were thus no strong political pressures for using science as a means for cooperation. The institutional culture of the IMO is as important. With the smallest secretariat in the UN system and a budget relying on developing countries due to flags of convenience, there was no scope for conducting science, monitoring emissions, etc. (see more in Campe, 2009). The earlier discussed Assembly resolutions also played a very important role in determining the direction of the role of science in this process.

According to Jasanoff (1997), epistemic communities are needed to produce science that is meaningful to policy, which has been shown in this case by scientific claims and influence from LRTAP/EMEP and NGOs (primarily industry NGOs). No decision-making power was allocated to these communities by the IMO however. This is an important explanation for the role of science not being able to influence the policy outcome and yet another important factor explaining why the same issue could evolve into one of the most science-based and successful environmental regimes for land-based emissions and not for ship emissions.

7.2 Explaining by the Role of Economic Interests

The following sections analyse and discuss the results of Chapter 6 with explanations from the second conceptual lens; collective action and Wilson's theory of politics (see Section 3.3).

7.2.1 Why Change the Focus to Regional Measures at the BCH?

Since no economic aspects were reported until MEPC 29, let us start at a theoretical level to provide a conceptual starting point.

7.2.1.1 A Conceptual Starting Point and Early Acceptance

If viewed as a problem affecting our common atmosphere in general, SO_x emissions can be seen as a problem of public goods. However, the known problems of SO_x emissions at the time were not about the atmosphere or the oceans. The problem was acidification on land as well as air quality problems in general. This could be viewed as CPR problems on regional to local scales affecting the following 'goods': air quality, forests, lakes, precipitation, etc. Common to all of these is that it is not possible to exclude an individual from the benefits of these goods, but if a ship emits acidifying SO_x emissions, the goods are used as a 'sulphur sink': first the air, then precipitation, and then it falls on forests and lakes. A ship's sulphur emissions thus affect others' benefit from clean air, healthy forests and lakes, productive fish stocks, etc. by contributing its individual part to destroying these goods (given the rivalry of the issue structure).

The categorization of SO_x emissions from international shipping as a CPR problem is not suitable for explaining collective action at the IMO however. The issue structure is both rival and non-excludable, but the actors that caused the problems of acid rain and regional air quality at the time were not the same as those that suffered from it. The sources for this policy issue were individual ships that sailed around the world. Even if we assumed that the problem at the time was perceived as global with acid rain being manifested globally from a moving source around the world, it would not be a CPR problem. The significance of the directional character of acid rain – as emphasized by DeSombre (2007) – is thus underlined here, and a directional problem is viewed as a suitable characterization for this particular policy issue. However, since the source in this case was international shipping, the directional character is more complex and dynamic and covers greater distances. This policy issue was not a State-to-State directional issue with net polluters and net recipients. The source could 'send out' emissions to recipient States – and it could be relatively near the manifested problem – but it was a moving source and could be the responsibility of an owner or flag State far away from where the emissions took place. It could further be the responsibility of the producers and suppliers of HSFO. The sources and actors that caused the problem thus have two main dimensions as shown in Table 7.1: (1) the ships and the shipping industry, and (2) the fuels and the producers/suppliers. Connected to these actors are member States with decision-making powers at the IMO – *flag States, States with maritime interests, oil-producing/exporting States* and *bunker-supplying States* – and a number of interests represented in observer NGOs. For simplicity, connected interests to these such as charterers and cargo owners are excluded.

Table 7.1. Dimensions of sources, causing actors and IMO representatives

Source	Polluters	Representative States	Representative NGOs
1. Ships operating internationally	Ship operators, shipowners, etc.	- Flag States (including FOC States) - States with maritime interests	Shipping industry NGOs
2. High-sulphur fuels	Refineries and suppliers of high-sulphur fuels	Oil-producing/exporting States Bunker-supplying States	Oil industry NGOs

Strict interpretation of traditional collective action holds that self-interests are paramount and not the collective interests. A rational State will always put its self-interests first and free-ride in international environmental cooperation. I, however, assume that the free-rider problem does not apply to this case as it is a directional problem. The actors that caused the problem were not affected by it and did not have anything to benefit from; hence they could not free-ride. Instead of using the term *free-riding*, the term *opposition* is more appropriate in this particular case. Nonetheless, opposition could be expected from these two groups of actors even at the early stage and, given the international and directional character of the issue, such opposition would be strong according to DeSombre (2007).

Why then were the proposals by the NSS and the BSS on global action accepted collectively at an early stage when viewing it from this second lens? The early recognition of SO_x emissions from ships as a global problem for the IMO to deal with was mostly connected to air pollution as such. The concept of issue linkage[105] thus comes in as the sole theoretical explanation. The air pollutants addressed early on at the IMO included CFCs, which had been agreed to be phased out at a global level under the Montreal Protocol adopted in 1987 (UNEP, 2014): the year before air pollution made its way onto the IMO agenda. Measures on CFCs could thus have been important for many States, which could have given acceptance to start the negotiations on a multi-issue treaty that also addressed SO_x emissions. Such an explanation is without empirical support however, in other words, a speculation. In this regard, it should be kept simple and include other speculations. It could just as well be that the economic implications were simply not well known or thought of at this stage of the process or that it took some time to mobilize against the policy.

7.2.1.2 Early Economic Interests: Oil Industry Implications and Concentrated Costs

The investigated documents showed no indication of economic interests affecting policy choices until MEPC 31 in 1991. Nevertheless, the submitted information accumulated and economic interests slowly but steadily increased their role in the discussions. When the economic discussions appeared at the IMO, it immediately became strongly centred on oil-industry implications connected to the availability of LSFO and the costs of desulphurization. The sulphur content of HFO was dependent on the sulphur content of the crude oil used in the refineries, which varied across the world's regions. The availability of LSFO that would comply with the proposed 1.5% global limit was low and these fuels were only supplied in 12 countries. A global reduction of the sulphur content would thus require desulphurization of HFO in most refineries around the world. This meant high investment costs for desulphurization technology and high operational costs due to an energy-demanding process.

[105] With issue linkage, a State could agree on an issue since it links the issue with another issue or issues of its interest to be solved at international level. See Section 3.3.

Economic implications were first introduced by Kuwait and Venezuela. These States were producing and exporting petroleum products with high sulphur contents (Eni, 2013), thus representing the second group of polluting actors in the above table. Viewed from this conceptual lens, these actors would put their self-interests first and not the collective interests. In this view, their self-interests were to protect their oil industry and markets for high-sulphur products. Their concerns were thus impacts on their exports if the sulphur content was regulated, and these States were those that would have to use and pay for costly desulphurization processes as their only way to stay in the market of marine fuels, as their crudes had high sulphur contents. So far, we can thus see that a concentrated group of actors would have to pay for benefits that were perceived at a global level[106] or for other States than this group given the directional character of the problem. In either case, the benefits were for a larger group of States than this one. We thus have a perceived policy issue in Wilson's third category: distributed benefits and concentrated costs – the typical environmental policy issue with polluters as a concentrated group of actors that would bear the cost burden and widespread or diffuse benefits. According to Wilson (1973, 1980), a concentrated group of actors that bears the costs of a policy has a strong incentive to mobilize against it if it has widely distributed benefits. Strong opposition could thus be expected from this group of actors. The first submission on economic impacts that entered the process was in fact by Kuwait, which was keen on keeping the sulphur content limits of 4-5% at the time, and by Venezuela, which opposed a 1% limit at the same session.

7.2.1.3 A Small Role of Shipping Interests

The highlighted costs for shipping were connected to the focus on oil industry implications and consisted only of figures of increased bunker fuel prices based on the costs of desulphurization. These figures should be viewed as arguments of self-interested oil-producing/exporting States concerned with their own industrial impacts but addressed to shipping interests to raise concern and, ultimately, gain support against a strict global sulphur limit. Notably, shipping industry organizations and FOC States were absent in the early discussions. On the other hand, Norway, the UK, France, and Sweden and the BSS addressed the implications for the oil industry and increased costs for shipping. These are *States with maritime interests* whose positions and economic arguments could be viewed as part of shipping interests, e.g. big ship-owning States such as the UK and Norway (Tan, 2006), but as they represented the NSS and the BSS they should instead be viewed as beneficiaries of regulations. They were the initiators of the issue at the IMO and the driving actors towards global regulations at the time. Their policies were also somewhat unclear, e.g. highlighted implications mixed with positive views on the feasibility of stricter measures. The fact that the NSS and the BSS themselves proposed including regional measures when they proposed the (later agreed) 50% reduction target at a global level should be viewed in this context. No explanation could be given on their introduction of regional measures due to the lack of presented arguments. On shipping interests, it should further be noted that the adopted Assembly resolution included taking into account the economic impacts of the shipping industry. [107] Although no prior discussion on this matter was found, its inclusion was an

[106] This is an assumption derived from the early acceptance of the IMO action for a global problem. Although this acceptance mainly concerned air pollution in general, arguments that it was a regional problem had not appeared at this stage (see more on the role of science).

[107] When approaching MEPC 31, it should also be noted that – the also big ship-owning State (Tan, 2006) – Germany proposed that the Assembly resolution on air pollution from ships should include an exclusion of national, regional or local regulations due to the international character of shipping.

important reference for the upcoming discussions and it increased the role of economic interests of the shipping industry.

7.2.1.4 An Opened Door for a Greater Role of Economic Interests

The removal of the target from the Assembly resolution at MEPC 31 is a significant factor towards a regional approach. Although specified as a 'technical' study, the US proposal indicates a request for an evaluation of measures before decisions, including evaluating economic implications. That is in fact one of three things the BCH was then instructed to do: deal with economic/technical implications of possible measures. Several notifications had been made at MEPC 31 on a number of initiated and ongoing studies on bunker markets and implications, with results being available in the near future. These notifications could also have played an important part in the decision to remove the target in accordance with the argument to await further study by the BCH. With no decisions on the target being taken before the outcome of the technical consideration by the BCH, there was time for evaluating the costs and benefits before decisions and more time given for discussing economic implications in general. The drafting period at the BCH became characterized by more and more highlighted economic implications and huge cost figures for the oil industry and, in turn, for shipping. I thus argue that the removal of the target opened a door for an increased role of economic interests. In particular, it allowed for a possibility for the oil industry and oil-producing States to make their self-interests heard by the policy-makers and to show as high economic implications as possible so that others would also oppose strict global regulation. It should thus be viewed as a first breaking-point towards a regional approach.

A US response to a Swedish statement at BCH 24 supports the removal of the target dates as a first breaking-point towards a regional approach. The delegation of Sweden emphasized that the BCH had taken a turn away from the MEPC objectives. The US delegation responded that the role of a sub-committee was to technically evaluate those areas that the main committee requested it to consider. Thus, the target level should not be seen as sole MEPC tasking without further technical review. Since the target levels and dates were not included in the Assembly resolution, the US delegation expressed that it was comfortable with a combined global and regional approach that did not strictly hold on to the MEPC target.[108] The removal of the target and this motivation for a regional approach were the only significant roles the US played through this lens. The US is otherwise a significant State of maritime interests and a dominant player in the policy-making dynamics for shipping (Tan, 2006). From 1985 to1995, it was still among the top ten flag States (in tonnage) and in 1999 it was the third biggest ship-owning State (by tonnage). In addition, most of the tonnage in registered open registries such as Liberia and the Bahamas are US-owned ships. Given that most of the largest oil-producing companies are located in the US, and it is a very significant petroleum importer, producer – including large quantities of sour crude oil – and consumer, with about 25% of the wold's oil consumption , its small activities in this process are notable. Nevertheless, the role of the US interests should not be considered small given its contribution to a first breaking-point towards a regional approach.

[108] The views of the US were supported by "other delegations" (BCH 23/14, para. 7.64) (meaning others than those that supported Sweden).

7.2.1.5 New Actors Went 'All In' for Economic Implications

When the issue arrived at the BCH, all possible arguments of availability problems, estimated costs and wide-reaching implications were basically thrown at the policy-makers, and new actors entered the scene. It is clear here that this analysis cannot just focus on DeSombre's division between those that caused and those that suffered from the problem. I thus follow Wilson that those that would bear the costs of regulation are those that would oppose regulation, and we thus need to focus on these actors. This does not mean an abandonment of collective action and DeSombre's insights on international negotiations but rather that connecting collective action and Wilson's theory of politics is a suitable approach to explaining the role of economic interests in this particular case.

The economic implications were taken to their heights by Japan. Its submissions at BCH 21-22 are remarkable in many ways: significantly higher desulphurization costs and, in turn, significantly higher bunker fuel prices, higher freight costs, words such as an 'excessive burden' (on the refining industry) and 'extremely high' costs, and an argument with supporting information that a 1.5% sulphur content could not be reached globally. Most remarkable, however, is that Japan extended the question of implications to a different and much higher level of importance to the policy-makers. Japan both feared and argued that low sulphur content limits would disturb the global supply and demand balance of oil in general. The use of low-sulphur crude oils as a basis for producing bunker fuels could result in a drop in crude oil supply. This would have huge impacts not only on crude oil-producing States but also on the global crude oil market, with effects also on the energy policies of countries dependent on oil for a stable energy supply.

According to Tan (2006), Japan has a significant role in shipping and significant influence at the IMO, not only because it is one of the largest ship-owning States and has a large shipbuilding industry but also because it is heavily dependent on imports by sea transport due to its lack of natural resources. The fact that Japan highlighted economic impacts for the shipping industry and high estimated bunker price increases should thus be seen in this context, as should the importance of Japan's submissions to this policy-making process. But why did Japan focus so much on oil industry implications and even bigger impacts on energy dependence? The lack of natural resources does of course have an energy dimension. Japan is dependent on importing oil primarily from the Middle East (ibid.). It could thus be considered to belong to both groups: *States with maritime interests* and *States with interests in maritime trade* (see Chapter 2). Hence, its submission should be viewed as an effort by a self-interested State to oppose regulation that would have economic implications on a national scale due to its high dependence on sea transport and high-sulphur crudes and also connected to the implications on its significant shipping industry.

Through this lens, Japan is the actor that showed the strongest arguments towards a regional approach before it was decided to take that policy direction. The fact that it was highlighted at BCH 21 that further consideration was needed on global versus regional application supports the direct influence of Japanese economic interests. Japan and OCIMF – with its CONCAWE summaries and support from IEA – became the primary influential actors of economic interests towards a regional approach at BCH 22. Their submissions are partial explanations of the turn at BCH 22 to develop a framework on regional control of SO_x emissions. The CONCAWE study showed even higher costs than for previous actors. Since these costs were found at European and regional European levels, it could be assumed that the global costs would be even higher perceived by the policy-makers. In addition to Japan and OCIMF, the Netherlands showed costs in a similar range. The Netherlands is a State with interests in

maritime trade, with Rotterdam as the largest port in Europe and the world's fourth largest container port in 1993 (Stopford, 1997). Moreover, Tan (2006) included the Netherlands as an influential maritime State actor. Notably, the group of volunteers for developing the regional approach was chaired by the Netherlands, which shows its policy significance in this process. Its submitted report on measures on the sulphur content of overall fuels in the EC further showed consensus between the oil industry and the study results, which is significant since it confirms oil industry implications from a study commissioned by 15 European countries.

The shipping interests aligned with the interests of the oil industry at this stage of the process. INTERTANKO – representing the interests of a large number of the tanker owners that are independent from the large oil companies (Tan, 2006) – is perhaps the most obvious connection between the economic interests of the oil industry and the shipping industry. At MEPC 32, it was stated that the costs would fall on both the oil industry and oil tanker owners and reaffirmed previous arguments on oil interests. Although the international character of shipping was highlighted by ICS – representing national shipowner associations worldwide, with about 50% of the merchant fleet tonnage (Tan, 2006) – as a reason for international regulations, it supported a regional approach. This shows the interdependence of the oil industry and shipping industry, and the impacts of the high cost figures presented by the oil interests. Some implications related to shipping interests were used, however, as arguments against a regional approach by Norway at BCH 22 with regard to the heavy burden on ship operations as well as national administrations and impacts on the free movement of international shipping. This had some support, but the working group agreed that the regional approach would encompass uniform standards that would prevent such implications.

The regional approach was motivated by the group of volunteers with the argument of availability problems for global use of LSFO and that environmental protection in particularly affected areas could be provided without unnecessary burdens for ship operators. This shows that the role of economic interests is important in explaining the turn towards a regional approach, and this analysis has showed that the above actors' self-interests connected to the oil industry and petroleum markets were the most significant factors. Annex 3 of this thesis shows the presented monetary costs and benefits from 1990 to 1997. Up to 1992, it shows an increasing number of cost estimates with ever higher figures for a strict global regulation of the sulphur content in marine fuels. The decision to develop a regional framework was taken in a policy climate in which the perceived costs of regulation were increasing each session, as were the actors highlighting them as arguments against global regulation. The benefits expressed in monetary values were few and only focused on the shipping industry with decreased fuel costs. No social costs or benefits were presented in monetary values during this period. Hence, the introduction of a regional approach was not based on an evaluation on the costs of regulations against the social benefits (or social costs without regulation).

7.2.1.6 Perceived Concentrated Benefits and Distributed Costs?

Japan attempted to show implications of strict global regulations to other States, and it used wider implications to do so. This is something we first saw by the oil-producing States, a strategy to use arguments and information that affect other actors' self-interests based on their own. Japan's recommendation to treat the issue separately as a global problem and a problem for special areas should not only be seen in the context of its self-interests but also in the context of influencing others to oppose a global regulation and to prefer a regional solution. The policy issue had now extended beyond implications for the refineries and the shipping industry. Negative effects on the global oil supply and demand structure and implication for

countries' energy policies are affecting the self-interests of most member States. At BCH 22, OCIMF then continued the extensions of the implications and stated that the energy consumption of desulphurization could accelerate the depletion of global petroleum reserves. If the policy-makers believed that these implications were correctly estimated then the perceived costs were not concentrated but widely distributed. Since the way the actors perceived the problem had changed, the relevant characterization for analysis also has to be changed. At BCH 22, the problem was mostly viewed as regional and even local (see the role of science), hence as were the benefits of regulation. We thus turn the policy categorization around and find ourselves looking at a policy issue of concentrated benefits and distributed costs – Wilson's second category.

According to Wilson (1973, 1980), no opposition could be expected in such a situation and the benefitting group of actors would be able to mobilize effective support. Wilson's theory on such a policy situation is thus very different from what this process has described at the international policy-making level. Wilson's theory can thus not explain opposition to global regulation with regional benefits if many actors bear the cost burdens. To categorize global regulation as a policy with perceived widely distributed costs, however, is based on the assumption that the policy-makers kept the same views of the implications as Japan and OCIMF. This is something that cannot be determined within the scope of this thesis. It is fair, however, to assume that different actors had different views on the extent of the implications and presented cost figures, and that the same could also be said about the benefits. This is one of the key assertions in this analysis with regard to explanations derived from Wilson's theory. We can turn it around in many different ways depending on the stage of the process and on who opposes the proposed policy. A categorization of this policy issue depends on different perceptions by different actors of who pays and who benefits, and these perceptions change with regard to the perceived geographical scale of the problem. This is not to say that we should discard Wilson's second policy category for the continued process. Rather, the continuing analysis assumes that all categories should be kept as possible explanations for the investigated case, and that it could change due to different proposed policies during the process. In addition, the perceived ratio of costs and benefits could change with new information (Vedung and Klefbom, 2002). The positions of States could thus change during the policy process due to their perceptions of costs and benefits.

7.2.1.7 The Regional Approach – Changing Wilson's Policy Categorization

Let us assume that the benefits were perceived by the policy-makers as concentrated at this stage of the process due to the regional character of the problem. Even if not all believed that global regulation would involve costs for all, the regional approach would at least change the costs to be more concentrated than regulation at a global level. The regional concept was thus a policy solution to a problem of widely distributed high costs that turned it into a policy issue of less costs for a concentrated group of actors. LSFO would still have to be provided for shipping but in smaller quantities and thus at lower costs for the States exporting high-sulphur crudes and HSFO. The smaller quantities of compliant fuels meant lower energy-demanding desulphurization processes and lower use of low-sulphur crudes. Hence, the implications would not be seen on the same wide-reaching scale for many member States as feared by Japan and OCIMF. This solution – or compromise – would mean less opposition from those that would bear the costs, while at the same time the smaller group of actors that were affected by acidification would accept the solution since it would provide benefits for them. The regional approach was a policy of concentrated benefits and concentrated costs: Wilson's fourth category. However, Wilson's theory holds that this is not a solution but rather the

policy of "continuing organized conflict" (Wilson, 1973, p. 335), which is discussed for the second research question.

7.2.1.8 A Regional Solution for a Directional Problem

DeSombre (2007) underlined that the self-interests of States determine international policy-making processes more for a directional problem than for other problems, e.g. CPR's. The directional character of the policy problem had made agreement on a global sulphur content limit difficult to reach. States affected by acidification sought global regulations on ship emissions while States causing pollution resisted it, at least at a global level. This is consistent with Sprinz and Vaahtoranta's (1994) expectations that States that are victims of pollution would seek international cooperation while contributors to pollution would resist. DeSombre (2007) argued that their hypothesis can easily be used to explain the European (LRTAP) and North American responses to acid rain. The result – or solution – in the case of LRTAP was differentiated emission cuts among the parties.[109] According to DeSombre (2007, p. 227), a directional problem is a policy-making case in which it actually could "makes sense to impose different levels of obligations on states" compared with other environmental issues. This particular case of SO_x emissions from ships has confirmed DeSombre's description that international cooperation is very difficult with a directional problem, but we should not forget that the issue was more complex due to the diffuse and moving sources of international character: ships. Having different sulphur limits for different parts of the world is also something that contradicts the very basic principle of the IMO and regulating international ship operations, ensuring a level playing field. A possible solution for this case could be a regional approach, but it would have to apply to all ships independent of the flag they sail under. A regional approach would have to have global characteristics – a special area approach – which leads us to the second research question.

7.2.2 Why Adopt a Combination of Stricter SECAs and a Global Cap?

No clear economic reason for the introduction of global capping was found in the investigated documents. The group of volunteers at BCH 22 merely mentioned that it could be helpful in resolving global LSFO availability problems with regional control. This was not explained further and thus remains an unclear motivation. Let us thus begin the analysis of the second research question by discussing a suitable categorization of the introduced global capping policy. This categorization also includes the special area concept, and the combined approach as a start of the analysis.

7.2.2.1 Categorizing and Re-categorizing

The Policy of Global Capping

Above, I stated that a regional approach could be viewed as a policy solution for a directional problem, but the concept of global capping is more difficult to place as such a solution. The intention of the global cap was not actually to reduce emissions and it therefore put a burden on those that caused the problem without providing any benefits 'worth mentioning' (see more on the role of 'science') to those that suffered from it. Collective action suggests that such a policy would generate strong opposition from the groups that caused the problem, and

[109] However, they were not as differentiated as could be expected, according to DeSombre, and the first agreement was equal emission cuts for all.

indeed it did. After BCH 22, new actors arrived on the scene and economic interests evolved to play their strongest role in the process. Global capping generated even further conflict.

When viewed with Wilson's theory, the question on what was a solution and what was a policy for further conflict is turned in the opposite direction at first sight. A regional approach was a policy of concentrated benefits and concentrated costs, which is viewed far from a solution and rather as a policy of "continuing organized conflict" (Wilson, 1973, p. 335). The concept of global capping could thus be viewed as a solution to such conflict: to let more actors pay and benefit, which would widen the distribution of both the costs and benefits. At second sight, however, the costs of a global cap would be widespread and there would be no benefits (or at best very small) since noticeable benefits of such a global cap would neither be seen globally nor regionally. The problem with this categorization is that no such category was provided by Wilson. Following his approach and collective action in general, it has to be assumed that if no one benefits but many need to pay, there would be the strongest opposition from all those that do not see benefits and, in turn, I argue, the most difficult situation for a policy to be adopted in.

We should not be so quick to categorize the costs as widely distributed however. Although it can be assumed that a stringent global sulphur content limit was perceived to have widely distributed costs due to the far-reaching implications on the oil markets in general, the same could not be said for a global cap of the proposed limits within the range 3-5%. These proposed limits were above the global average sulphur content at the time and not below it as before the regional approach emerged. The question of who would have to pay for a global cap is thus not only dependent on the actors that produced, exported and supplied fuels above or near the proposed limit but also on those that used it. It would firstly affect all the States producing and supplying fuels above a certain limit, and the higher the limit the fewer the actors that need to pay for desulphurization. A 5% limit would have no costs due to an existing ISO standard, while a 4.5% limit would have costs for a few States producing and exporting HSFO over 4.5%, as well as for States supplying HSFO over 4.5%, such as Singapore and Mexico. A 4% limit would affect a few more actors, 3.5% more still and 3% rather many actors as it is so close to the global average sulphur content. In line with Wilson's theory, it is thus easy to assume that the lower the limit proposed for a global cap, the more opposition would be generated from a larger number of actors, while higher limits below 5% would have a more concentrated group of actors and thus stronger opposition from those actors that would bear the cost burden alone. The question of the moral justification of a global capping policy thus grows stronger the higher the limit (but below 5%), both for the lack of benefits and for the costs to be borne by a concentrated group of actors. All of the proposed figures involve concentrated costs compared with a strict global limit below the global average sulphur content, while, at the same time, there would be no noticeable benefits above this average. At third sight, the policy of a global cap is thus a policy of concentrated costs and no benefits (or at best very small) where the concentration of the costs would vary depending on the capping level. Due to the lack of benefits, however, this policy is still not part of Wilson's categories.

The Special Area Concept – More Concentration

Along with the reappearance of a stronger economic debate on global capping, regional economic implications became as important and the concept of special areas became a tool to restrict the geographical application of regulations even further. The criteria and procedures for designating special areas/SECAs – which cost-effectiveness and implications for the shipping industry – were drawn up to restrict the geographical extension of an area and to

hinder proliferation of such areas around the world. This changes several important characteristics of the proposed policy.

Firstly, DeSombre's insights show that it is possible to change the issue structure through international cooperation, and it has high relevance with regard to special areas. Like EEZs, special areas provided an opportunity for certain coastal States to control ships' SO_x emissions within a designated area. In line with DeSombre (2006, 2007, 2012) on transforming the issue structure from non-excludable to excludable, this would provide excludability, and special areas could be regarded as a possible solution to collective action problems. Exclusion from benefits was not a relevant approach for this particular case, however. As previously emphasized, the actors that caused the problem were not affected by it and did not have anything to benefit from; hence they could not free-ride.

Secondly, the regional concept was a policy solution to a problem of widely distributed high costs that turned it into a policy issue of less costs for a concentrated group of actors. If it were to be restricted to certain special areas with criteria for designation and delineation, the costs would be even more concentrated, as would the benefits. The categorization of the special area approach is thus Wilson's fourth category but with a more narrowly concentrated distribution of the benefits and costs compared with the earlier regional approach without further defined restrictions. With further concentration, we should thus expect even more conflict. According to Wilson (1973, 1980), the benefitting group and the group that bears the costs have strong incentives to mobilize for and against the proposed policy respectively. A natural step here would thus be to start analysing how the economic interests evolved during the later parts of the process with this prediction of a continued conflict in mind, but let us not be so quick to treat the regional approach and global capping separately.

The Combination

We now have two policies before us to explain. The first is a regional special area policy of clearly defined concentrated costs and benefits in Wilson's fourth category, while the second is a global capping policy of concentrated costs and no or very small benefits of undefined distribution. The main assertion after these categorization efforts is that these policies cannot be viewed on their own. Instead we need to view them as described by the policy-makers themselves: a global cap would be part of the regional approach. When viewed as a policy package, a global cap added costs and actors that would have to pay for the same benefits as with the regional approach on its own. It added a cost burden on those that caused the problem, while the benefits to those that suffered from it were the same as without it. Based on DeSombre's insights of collective action for directional problems, I thus assume that more opposition would be expected from this combined policy than from a sole special area policy. The combination was a policy of concentrated costs and concentrated benefits, but the total sum of costs became higher and the new part of the costs would have to be borne by another group of specific actors that did not have to pay for a mere regional approach. We thus have a situation in which the costs are concentrated but unequally distributed. Based on Wilson's theory, I thus assume that it would not only result in worse conflict but also tin strong arguments of moral aspects and questions of legitimacy. Questions such as why some would have to pay for no global benefits or some for the benefits of others are frequently found arguments, as discussed in the sections below. It could of course be argued that some actors perceived benefits from a global cap, but the information found in the investigated documents suggests that such benefits were merely perceived as future risk prevention of a possible increase of the sulphur content.

In this context, I once again highlight one of the key assertions in this analysis: a categorization of this policy issue depends on different perceptions by different actors of who pays and who benefits, and these perceptions change with regard to the perceived geographical scale of the problem. In line with this assertion, Figure 7.4 illustrates how the policy issue of SO_x emissions from ships could be categorized in accordance with Wilsons' theory and based on how the actors could have perceived the problem, the costs and the benefits. Category 4B represent the distribution of the adopted combined policy based on the above reasoning on concentrated benefits and concentrated but unequally distributed costs. Category 2C shows a different way in which the adopted combination could be categorized depending on how the actors could have perceived the costs and the burden sharing. The latter category has its basis in the moral views presented by the shipping and oil interests; they highlighted the cost burdens for all – including consumers – as well as for a concentrated group, and both were considered unfair. It was either a regional issue with global burden sharing or a regional polluter pays issue. Of course the actors could have perceived the distribution in other ways, but the categories in the figure are based on the economic arguments of the actors. With this in mind, let us take a closer look at how the economic interests evolved further in the process from 1992 to 1997.

	Distributed Costs	**Concentrated Costs**
Distributed Benefits	**1. A Truly Global Issue** • Problem: global • Policy: global regulation • Benefits: global • Costs and implications: shared globally *	**3. A Global Polluter Pays Issue** • Problem: global • Policy: global regulation • Benefits: global • Costs and implications: - oil interests ** - shipping interests ***
Concentrated Benefits	**2. A Regional Issue with Global Burden Sharing** (A) • Problem: regional • Policy: global regulation • Benefits: regional • Costs and implications: shared globally * (B) • Problem: regional • Policy: special area approach • Benefits: regional • Costs and implications: shared globally * (C) • Problem: regional • Policy: special area & global cap • Benefits: regional • Costs and implications: shared globally *	**4. A Regional Polluter Pays Issue** (A) • Problem: regional • Policy: special area approach • Benefits: regional • Costs and implications: - oil interests ** - unequal burden for shipping interests *** (B) • Problem: regional • Policy: special area & global cap • Benefits: regional • Costs and implications: - unequal burden for oil interests ** - unequal burden for shipping interests ***

* oil industry, shipping, member States & ultimately consumers
** oil industry, oil-producing/exporting States & bunker supplying States
*** shipping industry, Flag States & States with maritime interests

Figure 7.4. Policy Characteristics of SO_x Emissions from Ships Based on Perceived Distribution of Costs and Benefits

7.2.2.2 Strong Opposition from Intertwined Interests

After investigating the documents of the whole process, it is easy to conclude that the economic focus of the policy-makers has mostly been on the oil industry's costs and implications. An important aspect of this one-sided focus is that the shipping interests took the same positions as the oil industry and used the same economic arguments. The oil interests continued to emphasize high costs for shipping in the form of increased bunker fuel prices based on the costs of desulphurization. The figures came from the oil industry but were highlighted by a larger group of actors consisting of oil-producing/exporting States, oil industry organizations, HSFO-supplying States with an increasingly large group of Singapore allies, States with maritime interests, States with interests in maritime trade, major flag States and shipping industry NGOs. These actors' policies were all intertwined during most of the continued process with the same policy positions and economic arguments.

Opposition to global capping started immediately when it was introduced, and it was not by Venezuela, Kuwait, Japan or OCIMF as before. Instead, the first opposition came from the major FOC State Bahamas, which emphasized high costs and implications. The opposition then continued with the IPIECA study being submitted by OCIMF. This study was central to the further development on the global cap with the high costs of a 3.5% global cap being referred to in submissions up to the very last year – which was also the case for OCIMF's submissions in general. OCIMF's arguments that the environmental benefits of a 3.5-4% global cap would not justify the high costs and that the required funds could be used for more urgent environmental issues were frequently highlighted by high-sulphur oil-producing/exporting States such as Saudi Arabia, Venezuela, Egypt, Bahrain and Mexico (Eni, 2013), but most notable is the growing group of Singapore allies as well as the major FOC States. Singapore and some of its allies supplied fuels with over 4% sulphur contents, and other States in its alignment produced and exported such fuels (ibid.). This was a large group of actors that later increased to 19 States, and they all opposed any global cap under 5%. Since the 5% limit was an existing ISO standard, by setting a global cap of 5%, no additional measures would be imposed on the oil industry and no costs would be borne by these States. Most relevant in their arguments is the moral aspects and their perceived distribution of costs and benefits. They felt that some States that exported and produced oils with high sulphur contents would be significantly affected economically and that it would not be an equal cost burden shared by the IMO members. This concentrated group of actors that would bear the cost burdens also highlighted that the costs would ultimately be borne by citizens in the member States or consumers worldwide, which thus is far from a policy issue of concentrated costs. The use of both arguments shows that they tried to affect the interests of other States. On the introduction of the concept of special areas, the oil industry was quick to respond with economic arguments to further restrict regulation by making such areas as small as possible, preferably only applying to ports and port areas. OCIMF's submission of the second CONCAWE study was used to support such restrictions. Although it was considered more cost-effective to reduce emissions from land-based sources, it was at least more cost-effective to reduce in-port emissions than those further out at sea

Now, let us look at the shipping interests. The major FOC States Bahamas, Liberia and Panama were against a low limit of the global cap and establishing large special areas, which according to the Bahamas should be limited to 12 nm from the shore. They highlighted cost figures and implications from the CONCAWE and IPIECA studies and used the same economic and moral arguments as the oil interests: "unacceptable and unfair consequence of extraordinarily high costs being imposed on many oil producing and oil refining countries in other parts of the world" (MEPC 37/13/3, p. 1). Furthermore, these cost were viewed to "be

borne disproportionately" (ibid., p. 2), and it was considered that the IMO should not take action that would penalize some of the member States. This is repeated here to highlight the magnitude of the way the shipping and oil interests were intertwined. The major FOC states even thought it was unfair that the oil industry, some oil producing/exporting States along with some supplying States would have to pay. They did not highlight such an unfair situation for themselves and thus completely represented the oil interests. It is also repeated to refer to the above reasoning around Figure 7.4, and on the moral aspects.

The FOC States highlighted an unfair distribution of costs borne unequally by a concentrated group of actors, and their wording implied a preference for an equal sharing of the burden by the IMO member States. With regard to the intertwined interests, we should not forget the early Norwegian opposition to regional measures due to the implications for shipping – as shown in the first research question – but then it was rather quiet on that matter. Finland stressed that international measures would prevent disturbed competiveness of Finnish ships. In addition, threats of unilateral measures were frequently used to draw the attention of the shipping interests to stricter global measures, as discussed below. The intertwined positions and economic arguments provided a large and strong group of policy-makers with economic interests opposing strict regulation at global level and minimum regulation at regional level. At the second intersessional meeting in 1994, a majority favoured a global cap of 4-5%. This majority group included oil-producing States, major flag States and oil and shipping industry organizations.[110]

7.2.2.3 Pro-Environmental Efforts but Concessions and Compromises

The BSS and the NSS had difficulties to influence with this large opposition group of intertwined interests. High criticism of cost figures and the oil industry focus was given by Sweden and Norway, followed by two environmental NGOs: FOEI and WWF. Part of the strategy of the NSS, the BSS and the environmental NGOs was to show social costs of SO_x emissions and positive economic aspects of a reduction, e.g. WWF's view that availability problems would be solved on their own. Despite its criticism of cost focus and economic self-interests, cost-effectiveness became an important argument by this pro-environmental group. By its side were representatives for the EC/EU and LRTAP. Both had the opportunity to express their views on regulating ship emissions through the IMO, and both stressed that it was more cost-effective to reduce emissions from ships close to a sensitive area than to reduce land-based sources. With the EC/EU acidification strategy, the use of LSFO for ships was found to be a cost-effective method to reduce European acidification. The most important strategy against the large opposition, however, was to use threats of unilateral action if the IMO did not take action globally and at an acceptable level. Sweden was particularly active in statements indicating such threats, as were Norway, the UK and Germany. In this regard, the EC/EU became a key player in the process. The Commission of the EC/EU had indicated early on that measures would be taken at the EC/EU level if progress was not met at the IMO and it soon proposed a directive with a 3% sulphur content in all EU waters and 1.5% in special areas to be adopted by the IMO. Hence, the EC directive was a clear unilateral threat that the policy-makers at the IMO had to take into account due to the international character of shipping. It added pressure for a stricter global cap and increased the pressure to designate the Baltic Sea Area as a SECA.

[110] See more on the different views in Svensson, 2011.

This pro-environmental group did not have much effect on policy, however, due to the large opposition. The lack of support was a main reason for the real abandonment of a strict global approach at BCH 23. This was after the arguments of the correspondence group, which saw a lack of support as a result of the high costs and risk of seriously disrupting the residual fuel market; hence a clearly expressed economic reason. The lack of support for a global approach also forced the BSS and the NSS to adapt to this large opposition: to abandon a policy position of global strict measures and apply for special area designation in their areas. This is confirmed by the submission presenting the background document by the BSS, along with statements with preferences for a low global cap, but proposals were made that took the economic implications into account or were stated to be compromise proposals. The focus of costs-effectiveness by these actors thus became concentrated to measures in their own areas, which strengthened the special area approach. Since cooperation is necessary for environmental protection, proposed measures often need concessions in order to persuade them to join (DeSombre, 2007). With the directional character of the problem, I assume that the significance of concessions was strong. The polluters and connected interests had little incentives to cooperate since they did not suffer from acidification problems, while, at the same time, the BSS and the NSS – that were affected most by emissions from ships – were dependent on the actions of the polluters. According to DeSombre (2007), States that aim to resist regulation based on their self-interests thus gain great power in international negotiations, which is confirmed in this case. States affected by acidification had to accept concessions and compromised solutions far beyond their own preferences.

A strong factor forcing these concessions is the fact that the shipping interests aligned with the oil interests. As mentioned in Chapter 2, flag States and States with maritime interests have a high level of influence at the IMO. The entry into force criteria of MARPOL Annex VI was 15 States representing not less than 50% of the gross tonnage of the world's merchant fleet (MP/CONF. 3/34, Article 6). The flag States with the largest fleets – i.e. FOC States – thus decided when and if Annex VI would enter into force. This suggests implications on the negotiation dynamics of the process.. The FOC States had the possibility of hindering entry into force and render proposed regulations useless, independent of the sulphur limit adopted. This means that the policy-makers had to listen to them and find a compromise solution or, to put it another way, the least common denominator. This adds to the powers of the large group of opposition in the directional issue. Once the major flag States had opposed a stringent global solution, and preferred special areas and a global cap under 5%, there was no other way than to accept the combination of special areas and a high sulphur cap. The only thing the pro-environmental actors could do was to try to find a compromise solution. In this regard, we should not forget that the 5% majority on the global cap was broken at MEPC 38. This is argued to be the result of the above efforts of the pro-environmental group – in particular the threats of unilateral action – but it could not be concluded with confidence in this analysis.

7.2.2.4 Efforts of Separated Shipping Interests

The shipping interests gradually became divided and partially separated from the oil interests in the later part of the process. It was primarily NGOs that broke away from the locked positions shared with the FOC States and States with maritime interests. At the conference, however, Greece joined the shipping industry NGOs. It started at MEPC 37 when ICS briefly mentioned problems with disturbance of international competiveness by a regional approach, but it still saw special areas as a solution if agreed and applied internationally. However, IAPH – representing the interests of ports worldwide – completely defended the basic principles of international shipping and opposed special areas with a preference for a global

uniform solution. IAPH's primary reason was a possible distortion of the competitiveness between ports within and outside special areas, but it feared distortion of competiveness in shipping as well.

The NGOs representing the shipping industry then made a turn in 1997 by proposing the sole use of a global cap for economic and practical reasons of switching fuels in SECAs and due to the international competiveness of shipping. BIMCO – the world's largest private shipping association, represents shipowners, shipping agents, etc. in over 120 countries (Tan, 2006) – underlined the threat of unilateral measures in the absence of IMO standards that were acceptable worldwide, which would result in severe operational problems for shipping. BIMCO's solution was a 3% global cap without SECAs. Then, at the conference, ICS made its huge turn of policy. It had concerns over the far-reaching impacts on the shipping industry. SECAs would result in a significant burden on ships entering them on occasions. The required use of two fuels for these ships was costly and problematic not only due to the more expensive fuel but also due to several technical and practical aspects. It also feared proliferation of SECAs around the world, which could have consequences for the whole of international shipping. ICS also turned the policy issue of SECAs the other way around with regard to previous moral arguments on who would pay and who ought to pay. As highlighted in connection to Figure 7.4, the issue was either perceived as a global burden shared by all or by a concentrated group of actors: the polluters. It seems that ICS had the view that the problem was a public good with all actors being responsible for conserving the atmosphere. It thus saw it as unfair that the cost burden would be borne by international shipowners. However, it also highlighted that SECAs would merely provide protection around SECAs and not globally. Hence, its view was still that it was a regional problem. Its solution of a global uniform standard without SECAs should thus be viewed both as an argument against disturbance of international competition of the shipping industry and as a moral argument against the polluter pays principle. In addition to ICS, BIMCO repeated its views at the conference. Most remarkable at the conference, however, was that Greece also made a proposal of a stepwise reduction of the global cap. Hence, even the world's largest ship-owning State (by tonnage in 1999) and the fourth largest flag State (by tonnage) in 2000 (Tan, 2006) had joined the shipping organizations' opposition to the SECA approach and preference for a global approach.

7.2.2.5 Reaching Agreement

Although not much was reported at the conference, it is not difficult to conclude that the above efforts by the shipping interests had little effect on the established policy of a combined SECA and global cap approach, and thus little effect on the positions of the majority of the States with decision-making powers at the conference. At least it could be concluded with confidence that the preceding efforts by IAPH and BIMCO did not affect the deadlocked positions at the MEPC. Instead, the Singapore allies got significant support for their repeated proposal of a 5% global cap and 1.5% in SECAs, and these were the figures reflected in the final draft to the conference. This indicates that the flag States and the policy-makers in general had listened more to the voices of the oil industry than the voices of international shipowners. Nevertheless, taken together, the shipping and oil industries have had both close and diverse positions. One explanation for the acceptance of the regional approach by the shipping interests and their partial turn lies at the heart of governing international shipping: uniform standards to ensure a level playing field. The regional approach would have global characteristics with uniform standards for all flags in SECAs, but it was later realized that it would disturb the international competiveness of shipping. On this particular policy issue, the

principle of a level playing field fell aside due to fears of high costs and then reappeared when it was too late, when the positions of States where locked for adoption at the conference. The adoption was a compromise solution reflecting a balance of interests: a balance not worth disturbing. To disrupt the balance could take the policy-makers back to where they started and would mean that a conference would not go through with adoption in 1997. It should not be forgotten, however, that the global cap was adopted at 4.5% and not the former 5% and that a waiver was introduced that postponed the effect of the SECA regulations by one year for ships entering a SECA from outside. It could thus be concluded that the efforts of the pro-environmental group at least had some success in reaching through with their unilateral threats, and that the same could be said about the efforts of the shipping industry with its highlighting of problems with SECAs for ships entering them on occasions. Surprisingly, the waiver was the result of an actor that previously silent actor viewed through this lens: the Russian Federation. Notably, Russia was the tenth largest ship-owning State (by tonnage) in 1999 (Tan, 2006).

Before ending this analysis, let us take another look at Annex 3 of this thesis, which summarizes the presented monetary costs and benefits of the process. It could easily be observed from the annex and Chapter 6 that the policy-makers put their focus on the costs and impacts of regulations rather than the social costs, in the absence of regulations. Compared with the earlier part of the process, however, some social cost figures were provided by the BSS, the NSS and environmental organizations, and these figures were very high. On the other hand, no social cost was specifically estimated for impacts derived from ship emissions, but instead all possible sources were marked by parenthesis in the annex. Even the simplest form of cost estimates using the estimated proportion of ship emissions in a specific area was not made. As an example, cost figures of liming in Sweden did not take into account the percentage contribution of shipping to deposition in Sweden. All the estimated cost figures for the proposed policy options were thus limited to industry costs – in particular the oil industry – and did not cover the costs to society. The presented social costs were also merely parts of many different impact factors for the costs to society, e.g. forest production in Europe, liming, etc. Many impacts were highlighted, as well as the difficulty estimating them. On the benefits of regulation, the presented or reported benefits also focused on industry rather social benefits, but in this case for the shipping industry (with the exception of the highlighted savings of the second sulphur protocol). It could thus be concluded that the decision to adopt a regional SECA approach with a supplementing global cap was based on biased cost-benefit assessments that almost only addressed the costs of the oil and shipping industries. The shipping industry costs were based on the costs for the oil industry and the figures supplied by the oil industry. Specific economic analyses for shipping were absent for this policy issue in this process from 1988 to 1997. Questions on other costs for shipping derived from technological implications and operational burdens did not arrive until the later parts of the process and were never presented in monetary cost figures.

The frequently referred to Assembly resolutions are most important explanations for this cost focus. Resolution A.500(XII) (para. 3) with the connected Resolution A.777(18) recommended taking into account "the costs to the maritime industry and the burden on the legislative and administrative resources of Member States", and Assembly Resolution A.719(17) (p. 326) on air pollution from ships highlighted taking into account "technical and economic impact on the whole of the industry". The resolutions determined what role economic interests would play in this process. These principles enabled one-sided focus on the economic impacts of measures rather than economic impacts without measures. The focus on the costs was put on the oil industry, however.

I end this analysis by highlighting issue linkage as an aspect that could not be analysed in this thesis and that should be explored in future research. The negotiated and adopted Annex VI was a multi-issue treaty that provided a possibility for the policy-makers – with different priorities for different pollutants – to trade off their positions and ultimately to agree on sulphur regulations far from their preferences in return for actions on prioritized pollutants. In addition, Annex VI is just as it reads a sixth annex to the MARPOL Convention, which should be viewed as a multi-issue treaty and thus opens up possibilities of other trade-offs.

7.3 Two Explanations: Connections and Differences

Two conceptual lenses have been used in this thesis to guide the empirical investigation and to analyse the results of Chapters 5 and 6. We have thus seen the process from two lenses that provided different explanations to the research questions. From here and on, 'the first lens' and 'the second lens' are used as reference for both the empirical results and the analysis on the role of science and economic interests respectively. The lenses show a number of connections as well as some differences in explanations of individual policy choices of the process. This section discusses those connections and differences.

7.3.1 The Removal of the Target

The first lens showed that an acceptance of the framing by the NSS and the BSS resulted in agreement on the 50% reduction target for the year 2000. The analysis on the role of 'science' was not conclusive on why the target was then removed from the Assembly resolution. Several initiated or ongoing studies were highlighted at MEPC 31 when the target was removed. These studies included both scientific and economic aspects and could have played its part in the decision to remove the target. When viewed from the second lens, the influence of the US as a significant State of shipping and oil interests played an important role in the removal. The US proposed that decisions on targets would await a technical study, and the BCH was immediately instructed to deal with technical and economic implications. The first lens further showed that the reduction target was agreed on without scientific evaluation against different targets, and there were indications that the necessary scientific data for a decision on a target was missing. This situation of scientific uncertainty added to the economic reason to remove the target. The removal of the target from the Assembly resolution at MEPC 31 is a key factor towards a regional approach. Viewed from the second lens, it opened a door for an increased role of economic interests, in particular for self-interests of oil industry and oil-producing States. It was viewed as a first breaking-point towards a regional approach. Viewed from the first lens, the BCH did not consider the reference levels and dates as instructed but instead initiated the regional concept. The correspondence group on regional control options realized that the target could not be achieved with the regional concept and suggested that it had to be reviewed. No revision was made and the target had lost its importance other than as an argument of stricter requirements.

7.3.2 Observer NGOs: Epistemic Communities and Interests

NGOs with observer/consultative status had a significant appearance in the process and Figures 7.1 and 7.2 show increased participation in the sessions. The investigated documents showed particularly high activity by *industry NGOs* (INGOs), primarily oil-industry organizations, and gradually increasing activity by shipping industry organizations. These also attracted great attention by the policy-makers. The two *environmental NGOs* (ENGOs) with active participation in this issue – FOEI and WWF – attracted less attention in this process. As described in Section 2.2, observer NGOs serve with expertise relevant to the IMO and function as knowledge pools and advisors to the policy-makers on primarily technical issues with scientific and economic aspects. Viewed from the first lens, they are epistemic communities. NGOs played an important role as epistemic communities in producing scientific claims that are meaningful to policy, primarily INGOs. Oil and shipping INGOs were important actors in the group that framed the issue as regional/local. They used scientific arguments and claims to show a minimal contribution of ship emissions and emphasized uncertainties and confusion over different scientific methods and concepts. Viewed from the second lens, however, they are interest organizations, directly and indirectly influencing the

policy-makers with their submissions and arguments in discussions. Notwithstanding the environmental interests of ENGOs and various economic interests connected to shipping such as port interests, the active NGOs in the process mainly represented the actors that caused the problem and that would be affected economically by regulation: the oil and shipping industries. As with the process in general, the arguments and positions of oil interests and shipping interests were intertwined. Shipping industry NGOs made a huge turn, however, at the end of the process by stressing the economic implications of the SECA approach. The ENGOs were also involved in the economic arguments and joined the efforts of the BSS and the NSS against the intertwined interests.

Taken together, INGOs had played a substantial role in the process and OCIMF was a key player from both lenses. OCIMF was able to shape policy by the use of both scientific and economic arguments and supportive information by creating scientific claims showing minimal contribution and presenting economic figures showing extremely high costs. The views of the shipping INGOs were crucial in enabling this influence due to their support. The later break in this support did not result in an abandonment of the SECA approach but was one of two factors that enabled the compromises at the end of the process, i.e. the 4.5% global cap and the waiver. The second was efforts by the BSS, NSS and ENGOs to show a high emission contribution with transboundary transport, high social costs and cost-effectiveness, and to use unilateral threats. Both shipping INGOs and ENGOs were thus important for the outcome of the process. This thesis has shown that NGOs have acted both as epistemic communities and interest organizations. The view of observer NGOs as knowledge providers in international organizations should be seen in the context of epistemic communities sharing policy views and presenting scientific claims based on their views. For the studied process, NGOs provided knowledge in a clearly biased manner from INGOs with underlying economic interests of the oil industry. Although, ENGOs joined the group of actors that framed the issue as global, they did not contribute with scientific claims.

7.3.3 Justification, Legitimacy and Strength with Combined Arguments

The first lens showed no direct influence of scientific arguments or claims behind the expressed need for further considerations of the geographical scope of regulations at BCH 21. However, the submission by the IEA is viewed as particularly important in this context. Uncertainty and a lack of scientific knowledge were used by the IEA as arguments not to take decisions at the time. Most important for explaining the focus on the geographical scope is that the IEA had particular emphasis on whether local measures could provide most of the desired reductions. When viewed from the second lens, it was shown that the reason for concern was the economic implications connected to refining investments being raised by some of the IEA member States. By this submission, the IEA started a significant trend in the process: to use scientific arguments and claims to justify views with underlying economic arguments. Different industrial interests of both member States and NGOs started to use scientific arguments and claims to highlight their own results or uncertainties as reasons not to take decisions with high economic consequences.

This trend was taken to its heights at BCH 22. The cost-effectiveness of regional measures was a motive that was further justified with scientific arguments of impacts being worse in specific areas. Since special areas enabled emission reductions where they were needed most, this approach was a cost-effective solution to reduce SO_x emissions from ships. An important factor in this context is the concept of critical loads being introduced at BCH 22. Critical loads measure natural barriers and maximum pollution loads of ecosystems. It is thus a

concept in natural science; yet, behind it were economic motivations on cost-effectiveness within LRTAP. According to Lidskog and Sundqvist (2002, p. 93), the concept of critical loads is "an instrument of integration between science and policy" and "is basically a choice of policy and should be scrutinized as such". With the use of this policy tool, cost-effective strategies could be developed, with science providing the necessary information. The UK used this concept as an argument for a regional special area approach. The use of critical loads would result in the most cost-effective way of reducing SO_x emissions, and this argument was placed in a context of desulphurization being a costly process. The second lens showed that the focus on the high costs of global emissions was paramount to the introduction of the regional approach. The issue was turned from perceived widely distributed high costs into less costs for a concentrated group of actors. The UK used critical loads to add a stronger argument – a cost-effective solution – to the problem of high cost figures for achieving global emission reductions. Critical loads thus provided scientific justification for a policy of economic reasons.

At BCH 22, the necessity of action was questioned. This was explained from the first lens by changed framing by actors at the BCH, coupled with scientific claims showing a minimal contribution from ships and a critical policy environment targeting the previous studies and starting a debate on scientific concepts. Viewed from the second lens, the economic arguments and supportive information presented during this session certainly added strength and legitimacy to the scientific arguments questioning the need for action. Given the huge and widely distributed costs shown, with feared impacts on global crude oil reserves and countries' energy supplies, why should measures be taken if the need was not scientifically proven? This question puts particular emphasis on the reasoning of collective action with rational utility-maximizing actors that act out of self-interest and not the collective interest. It also emphasizes the role of scientific uncertainty in policy-making connected to the concept of critical policy environments and the over-critical model. With uncertainty, the policy-makers decided how to interpret the available information based on their views of policy, which allowed an increased role of economic interests. Based on the economic interests of the actors that caused the problem and would bear the cost burden of regulation, a critical policy environment emerged in which these actors criticized scientific arguments and claims and showed both extreme economic implications and a low contribution from ship emissions.

The correspondence group on regional control options – the 'case' document for a combined approach – weighed scientific arguments and economic arguments of global versus regional measures, as well as a combined approach with a global cap. The main argument for a regional approach was the lack of support for a global approach. This was also a main reason for the real abandonment of a strict global approach at BCH 23. Viewed from the second lens, the correspondence group saw the lack of support as a result of the high costs and risk of seriously disrupting the residual fuel market. Compared with the first lens, we thus have one clearly expressed economic reason for this lack of support. The first lens instead showed that scientific arguments were used to justify the regional and combined approach. The weighing of arguments by the correspondence group resulted in a conclusion that the combined approach with a global cap of about 3% would provide *some* environmental protection at *acceptable costs*. This shows a relationship between scientific and economic arguments of the process where the policy goal was to reach a balance between environmental and economic interests, but the economic interests were weighed higher. A policy was drawn up based on the high costs of strong economic interests of oil and shipping industries. Environmental protection was down-prioritized due to these interests and scientific arguments were used to justify this policy.

The introduction of scientific criteria for special area designation justified and enabled a restriction of the geographical extension of an area and hindered proliferation of such areas around the world. As stated by the correspondence group, the establishment of areas with stricter regulations around a few countries affects the interests of other countries. The economic interests of shipping and oil interests were behind the establishment of scientific criteria. Although the complication of ship operations by many special areas was part of the concern, the arguments centred around the costs of large and many special areas, along with the cost-effectiveness of small and a few areas where the need for measures could be proven scientifically and by cost-effectiveness. The first lens showed that 'local framing' was a central explanation of this restriction. The arguments presented were all about showing a minimal contribution on a regional scale, with emphasis on the local contribution mostly from ships in or close to ports. The second lens showed that the same actors presented economic arguments and figures of cost-effectiveness based on these scientific claims. Studies on cost-effectiveness used data to show a low contribution from ships, which showed it to be more cost-effective to reduce land-based sources or those in ports compared with large special areas. Taken together, the economic arguments used on the issue of special area delineation were not only strengthened with legitimacy by using scientific arguments, but scientific arguments enabled the use of economic arguments of cost-effectiveness. This is interplay of scientific and economic arguments driven by underlying economic interests and interplay between science and economics merged into a format of a basis for decision-making.

As the process continued, combined scientific and economic arguments continued with the emphasis on justification. Discussion on global capping included the argument that the environmental benefits of a global cap were too small to justify the huge costs of a global cap. These arguments were made by the large group of intertwined interests. On special areas, the cost-effectiveness approach was also used by the NSS and the BSS. It was shown to be more cost-effective to reduce ship emissions in Europe than land-based sources, which was a strong argument against local cost-effectiveness and local framing. Moreover, cost-effectiveness and the implications for the shipping industry would be taken into account for designation along with the scientific criteria. This provided strength through combined scientific and economic legitimacy of restricting regulation and preventing proliferation of special areas in the world.

7.3.4 Knowledge, Self-interests and the Power of Persuasion

The above discussion on observer NGOs highlighted two concepts surrounding the two lenses: knowledge and interests. Scientific claims can be argued to have provided knowledge for the policy-makers as a basis for decisions, but this thesis has shown that 'science' was primarily used to compete among the self-interests of different actors. Economic arguments and figures on costs and benefits as well as on supply and demand could also be viewed as knowledge necessary for decisions. However, there is a big difference between viewing scientific claims as knowledge and economic figures as knowledge. Science claims to represent nature – the object – with constraints of the physical world. For this case, it was shown that business as usual for shipping using high sulphur contents as fuel caused acidification and that the pollutants were transported long distances. Regulating the sulphur content, however, puts a constraint on the economic development of oil and shipping industries and, in turn, on world trade and economic developments of countries dependent on sea transport for their imports and exports. Economics thus represents the economic interests of different actors – the subjects. Science and economics are two different world views representing knowledge about the object and the interests of the subjects respectively. What happens in policy-making when these world views come together?

This thesis shows that economic interests have played the most important role in the process. The basis of the knowledge gained by the policy-makers had higher influence from the different self-interests of different actors. As emphasized by SSK in the first lens, it is not knowledge that unites policy-makers through epistemic communities but shared beliefs of policy that allow knowledge to be used when it is seen as relevant to the policy. For the studied case, the interests of the policy-makers have decided this relevance, and the economic interests were prioritized over environmental interests. The second lens showed that the focus on oil industry costs was one of the main factors for many elements of both the process and the outcome. The lens had its conceptual premise that self-interests were paramount. It did show, however, that economic arguments and supportive information were used to show how the proposed policy would affect other actors' self-interests. Dimitrov (2012) termed this strategy "the Trojan horse approach" (Dimitrov, 2012, p. 80). This approach is about the power of persuasion in international environmental negotiations. One key proposition of his work was that considerable efforts are made by governments to persuade others. Dimitrov found that the type of arguments that were most effective in changing the minds and policies of others were to focus on their interests:

> *Countries seek to take others in a particular policy direction by delivering information that reflects their rivals' interests. This is a "Trojan horse" approach to argumentation because it seeks change from within the camps of other nations. Actors seek to affect their opponent's policy preferences by molding their own arguments to their opponents' concerns* (Dimitrov, 2012, p. 80).

This phenomenon relates to a persuasion technique of altering the perceived costs and benefits of action (ibid.), which is something we have clearly seen in this thesis. The scientific arguments and supportive information were used in this manner to persuade others. A lesson from this thesis is that we cannot merely view the action of member States and observer NGOs in negotiations as a result of their self-interests, nor can we view it as a mere result of science as decision support either. Rather, economic self-interests were underlying factors for the way arguments were shaped by actors. Some arguments emphasized self-interests and others shaped their arguments in a way to persuade others. This thesis has shown that arguments with a 'Trojan horse approach' indeed have affected the policies of other actors. These changes in were behind the policy choices and decisions by the MEPC and the BCH that resulted in a combined regional approach with SECAs and a global cap. Viewed from both lenses of this thesis, self-interests have found to be paramount in understanding both the economic and scientific arguments and how these arguments shaped policy-making towards the adopted regional approach by the power of persuasion. As emphasized by Jasanoff (1996), values and power are always present in negotiations, whether expressed politically or scientifically.

This thesis thus questions the conventional view of science as decision support for policy-making by providing 'knowledge'. The first conceptual lens was based on SSK, which holds that science does not speak truth to power but that science can influence policy under certain social conditions. The next section elaborates on such conditions. Putting this discussion aside for now, a conclusion is that the framing of the issue, the scientific arguments and claims, and the positions of actors were all shaped by interests: one group of actors with environmental interests and a larger group of actors with economic interests. This thesis thus confirms the views of radical relativists such as Collingridge and Reeve (1986) that policy outcomes are

determined by the actors' competing interests and values with science being used to gain strength in arguments in this competition of different interests.

7.3.5 Economic Interests as Social Conditions and the Significance of Resolutions

Viewed from the first lens, one of the mechanisms on how science could influence policy includes whether science is supported by economic interests, and that these interests allow for science to enable consensus. This thesis has shown that such support was highly selective and that science did not enable consensus among the policy-makers. Economic interests supported those scientific claims that backed the economic interests. For this case, it involved industrial interests, in particular oil interests. DeSombre's view of a directional problem in which the actors that caused the problem were not the same as those that suffered from it is central in understanding this selection. States affected by acidification sought global regulation on ship emissions while States causing it opposed global regulation. This connects to Collingridge and Reeve's (1986) description that the actors that are affected by regulation will both criticize the scientific claims and try to show unexpected costs or impacts of a proposed policy. Criticism of science, emphasis on high costs and scientific justification of economic arguments were mainly manifested by opponents of strict global regulation. Scientific claims did not enable consensus among the policy-makers but rather divided them into two groups with different framing due to this selective support by economic interests. The largest group consisted of intertwined oil and shipping interests with both member States and epistemic communities with shared policy beliefs based on industrial and economic interests. This large group had the greatest impact on policy viewed through both lenses.

Common to both lenses are the frequent references to three Assembly resolutions. The first was the Assembly resolution on air pollution from ships (Resolution A.719(17)), which included a request to take into account economic and technical impacts on industry. The other two (Resolution A.500 (XII) and A.777(18)) emphasized a clear and well-documented demonstration of a compelling need in proposals for new conventions (or amendments), as well as the importance of informed decisions. They also recommended taking into account costs for the shipping industry and administrative (and legislative) burdens of member States. Viewed from the first lens, the Assembly resolutions had a substantial role in determining the direction for the role of science in this process. IMO's institutional culture and formal procedures were regarded as necessary social conditions for science to successfully affect policy-making. The way science was treated in these resolutions determined what roles science was to play. The principle of a 'compelling need' is a factor that directed the role of science in this process. References to these resolutions were made by actors questioning scientific claims that showed a need for a global cap, expressing the need for scientific criteria for special areas and using scientific uncertainty as arguments to postpone decisions on strict – primarily global – regulations. The principle of a compelling need was used by actors that caused the problem and that would be economically affected by regulation. Based on their economic interests, they used scientific arguments and claims and highlighted uncertainty to show that a compelling need was not proven.

The second lens showed that the inclusion of economic impacts in Resolution A.719(17) was a first step in an increased role of the economic interests of the shipping industry, which had a rather small role in the early parts of the process. Nonetheless, the most important role of the Assembly resolutions in the second lens was to enable the one-sided focus on the costs and economic implications instead of evaluating the costs of regulation against the social costs without regulation. Although the resolutions put emphasis on the shipping industry, the focus

on the costs was put on the oil industry. These costs, in turn, had impacts on the shipping industry due to increased bunker fuel prices. The Assembly resolutions were frequently referred to by the intertwined oil and shipping interests as economic arguments against strict global regulations and large special areas. As with the first lens, the resolutions had a substantial role in determining the direction for the role of economic interests. Since costs and economic implications were emphasized in IMO's institutional culture and formal procedures, it directed the role of economic interests towards a cost focus of industrial interests.

From two lenses, this thesis has shown that these principles, of a compelling need and taking into account costs and economic implications, have been taken to their heights in this particular case of developing regulations on SO_x emissions from ships. They have slowed down the process in two ways: (1) the focus on costs and economic implications, and (2) the creation of a critical policy environment in which scientific arguments, claims and uncertainty were used by different interests to compete. The formal institutional procedures of the IMO were thus of outmost importance to the way this process has come about and how the interplay of 'science' and different interests has been played out. This is a lesson for other policy issues with regard to reaching a balance between industry interests and environmental interests by institutionally controlling the directions that the roles of science and economic interests can take.

7.3.6 Unexplained Policies of the NSS and the BSS

Finally, one unexplained policy direction is highlighted. No explanation could be given by either the first or the second lens of the introduction of regional measures by the NSS and the BSS in their initial proposal on the 50% global reduction target. It can be argued that both the NSS and the BSS were the initiators of the MEPC's global reduction target. Conversely, they also contributed in the firsts steps towards a regional approach by the presenting the first proposals of regional measures with stricter regulation in specific areas. However, neither science nor economics was presented to support these recommended strategies on SO_x emissions. Explaining such a policy would require studies of the North Sea Conferences and HELCOM or domestic policies of the NSS and the BSS.

7.4 Methodological and Theoretical Discussion

This section discusses the choices of the methodological approach and the use of the two conceptual lenses in relation to the results and general implications of research approaches.

7.4.1 Pre-understanding and the Challenge of Changing Conceptual Lenses

The thesis should be viewed within the contexts of the researcher. The analyst's personal background decides on an initial conceptual lens for the research, whether consciously or not. Let us very briefly turn to the hermeneutic view of *pre-understanding*, initially introduced by Hans-Georg Gadamer with the word 'prejudice' (German: vorurteil). By prejudice he meant pre-judgement in our understanding. Pre-understanding is a fundamental condition for understanding. Interpretation of a social phenomenon or texts requires certain ideas of what to look for to guide our attention in certain directions. Here, concepts and language are significant factors. Certain concepts highlight certain aspects of a phenomenon, and other aspects are hidden (Gilje and Grimen, 2007; Jahnke, 2012; Malpas, 2014). This make us see the world through the concepts we know – our "invisible glasses" (Hanson, 1969, pp. 149-170, quoted in Gilje and Grimen, 2007, p. 180). Other factors of pre-understanding include our world views, beliefs and personal experiences. All of these pre-understandings are brought to our interpretations of phenomena – researchers are no exceptions. We are aware of some but not all of our pre-understandings (Gilje and Grimen, 2007). So, let us discuss those parts of my pre-understanding of which I am aware – my personal conceptual lens – in relation to the chosen approaches of this thesis.

My background is within the broad field of environmental science. My involvement in crossing disciplines started during my BSc and MSc studies through combined social science and natural science approaches to environmental science. My primary fields were human ecology and biology. Human ecology is an interdisciplinary and transdisciplinary field focusing on relationships between human societies and natural environments. It transcends social science, humanities and natural science. I was then employed by the *Swedish Maritime Administration* (SMA) as a PhD candidate at Chalmers University of Technology towards a licentiate degree in 2011. During the time at the SMA, I worked at the unit for international cooperation and learned about governmental work in international policy-making for shipping, the IMO and the shipping industry. My research project has been a cross-disciplinary cooperation between the School of Business, Economics and Law at the University of Gothenburg and Chalmers University of Technology. This cooperation continued after the licentiate thesis. When the work on this thesis began, I had supplemented my environmental science education with knowledge about shipping, the IMO and environmental policy-making. The SMA, the University of Gothenburg and Chalmers University of Technology further provided me the opportunity to participate in two IMO sessions (BLG 15 in 2011 and MEPC 66 in 2014) and the United Nations Climate Change Conference in Warsaw 2013[111]. I thus had the opportunity to observe the policy-making process behind IMO documents and to compare it with a process of the biggest format in international environmental politics.

My supervisor steered me towards the concept of 'conceptual lenses'. I began to look at how my research area has been studied previously among traditional disciplines with an extended

[111] Observer delegation (RINGO) for the University of Gothenburg at the United Nations Climate Change Conference (COP 19/CMP9), the National Stadium, Warsaw, 18-22 November 2013 (19th session of the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC) and the 9th session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol).

period of finding the conceptual basis of the two lenses of this thesis. The choices made on methodological and analytical approaches should be viewed in this context, as should this research as a whole. It shows development across disciplines from a researcher in environmental science without disciplinary research traditions and thus with an open mind of methodological and analytical approaches.

However, changing the conceptual lens is to change the way you think, to abandon what you take for granted and to abandon your view of 'science' and research in general. In many ways, this thesis has not only been a challenge but also a struggle to learn to think in different ways. The first conceptual lens was a challenge to embrace. I actually had the belief that science speaks truth to power and that more science was needed in environmental policy-making to make more informed decisions. I had a belief that science could be a consensus builder among different interests by providing knowledge to the policy-makers. Constructivism and radical relativism in science and technology studies changed this belief. SSK was found to be the least normative approach to studying the role of science in policy-making. In such an approach, as a researcher myself, I cannot be blamed for analysing the role of science based on university views that more of our science is needed in the policy-making process. Radical relativism was used more as a supplementary approach, though it, rather than SSK, was found to explain the outcome of the process. The first lens provided me with a new pair of glasses by looking at the empirical material. With the second lens, I initially had difficulties in personally accepting the traditional way of thinking within rational choice, though the chosen conceptual basis was found to be the most suitable way to analyse the role of economic interests in accordance with the research questions, aim and objectives of this thesis. The second lens moves further away from my personal background and radically changed my way of thinking. I was equipped with another pair of glasses.

7.4.2 Choice of Approach and Methods

Multiple sources of data on the same phenomenon – so-called data triangulation – are often used to strengthen the validity of the research (e.g. Yin, 2009). There are different forms of the concept of validity, but in general it can be said to involve the extent to which the research actually answers the questions it asks and how the findings correspond to the social world it addresses (Peräkylä, 2011; Bergström and Boréus, 2012). It is common to treat documents as secondary data with observations and interviews as primary data. Secondary data are then used to validate primary data or to provide a context. This thesis has documents as its single source, which could be seen as problematic if viewed from the traditional concept of validity when evaluating the quality of explanatory research. Triangulation with primary data in the form of interviews could have strengthened the validity of the findings from the secondary data. On the other hand, instead of viewing a single source as problematic for the validity of this thesis, I follow Atkinson and Coffey (2011) who stressed that documents should be regarded as data in their own right. Documents "often enshrine a distinctively documentary version of social reality" (Atkinson and Coffey 2011, p. 80).

The historical approach of studying events in the past means that secondary data in the form of documents from a meeting are preferred over primary data in the form of interviews with persons in the meeting several years later. Sources that originated as close as possible to the studied event in both time and place are preferred by historians. The longer the time between an event and the source describing it, the higher the probability is of retrospective reconstruction of the event. Protocols and reports of a meeting are more reliable than an interview with a participant of the meeting 20 years later. Sources during and close to the

event are more credible due to people having a strong tendency to forget and rationalize in retrospect. A former decision-maker will also tend to exaggerate his/her own importance to the decision and to idealize the past. The richness of details is another advantage of using archived sources closer in time to an event than conducting interviews (Thies, 2002; Atkinson and Coffey, 2011; Esaiasson et al., 2012).

It acknowledged that the studied session reports represent retrospective reconstruction of the sessions as well. The contents of the IMO reports are even negotiated, as described in Chapters 2 and 4. In this context, it should be noted that this was observed during my participation at MEPC 66. It is thus acknowledged that some interpretation made in this thesis could have been affected by my observations at two IMO meetings. It is however important to underline that this thesis focuses on what can be learnt from the documents of IMO negotiations. It does not claim that the findings of this thesis represent reality, but rather it follows hermeneutics in that our view of 'reality' depends on our interpretations. What is important is the way we interpret things and what we as researchers bring to our data. The conceptual lenses and my pre-understanding brought meaning to the empirical data connected to the phenomenon that was to be explained so that understanding could be reached. The observations made at the two IMO meetings should be viewed as part of my pre-understanding.

Qualitative historical analysis was used as a choice of research approach. Does this mean that this thesis is *qualitative* research with qualitative methods? Relationships between science and policy-making or economic interests and policy-making are not something we can measure, but we can interpret the documents and provide different explanations. In this sense, it is qualitative research. Qualitative research is about words and not numbers. However, this division in quantitative or qualitative research has been criticized (Bryman, 2012; Åsberg, 2001). According to Åsberg (2001), we should forget the predominant division between qualitative and quantitative research and raise awareness of the a priori assumptions of a research approach. Åsberg (2001) suggested that the researcher needs to reflect on possible and real choices and not just be locked in a particular division of approaches. For this thesis, the aim and research questions along with the conceptual lenses were the primary guide in the choice of methods, rather than choosing predefined methods that would have limited the objectives of the research.

7.4.3 The Use of Different Conceptual Lenses

The theoretical framework of this thesis covers many different aspects and theoretical assumptions. Moreover, the contents of Sections 3.2 and 3.3 show fractions of more extensive literature in the different fields covered. Not all the theoretical aspects and assumptions of each conceptual lens were taken into account in the respective analysis. It would have required more sources than documents, and an extensive spatial scope including domestic politics as well as actions of individuals in both political settings and where the scientific claims were produced. In short, it would have been rather difficult to accomplish. SSK would require social conditions to be analysed at micro level where 'science' was produced. This was neither possible nor intended. The under- and over-critical models have many connections, and they were included where SSK lacked explanations, where micro-level study was needed and to confirm explanations of critical policy environments. The over-critical model was found to be a suitable model for explaining the outcome, but SSK has provided most of the explanations on the role of science in explaining the research questions.

The second lens has its basic foundation in rational choice theory. The basic unit of analysis is the individual, but the actions of individuals were not studied in this thesis. However, the reported actions and arguments of individual 'actors' were studied with regard to their self-interests. A member State or organization was considered an actor with self-interests. This is in line with the use of collective action in explaining international environmental negotiations in which States are considered rational actors and their actions are explained in the same manner as those of individuals. Since rational choice has been criticized with regard to theory versus 'reality' and empirical observations (e.g.; Simon, 1959; Arlen, 1998; Ostrom, 2000; Pålsson Syll, 2013), it is important to emphasize that rational choice is viewed in this thesis as an assumption of a conceptual lens, and as a starting point to explain policy-making from the role of economic interests. According to Lyon (2009, p. 2), the assumption that individuals maximize their utility "is an approach, rather than a falsifiable hypothesis". It is this view of rational choice theory that this thesis undertakes. In this regard, it should be noted that it has not been intended to test a particular theory. A theory-consuming approach was chosen. The framework was used to fit the research questions and the empirical basis of this thesis and not the other way around. As mentioned in Chapter 3, the theoretic content is used to represent a way of thinking, and gathering and analysing the empirical grounds. In this context, the empirical chapters and the analytical sections of this thesis both show a number of differences with regard to assumptions, emphasis, scope and empirical details. These differences are discussed below.

As a general rule, contextual extensions such as for developments in the UN, the EU and LRTAP during 1988-1997 were delimited to what was reported in the investigated IMO documents. However, some additional information on LRTAP was given in the first lens with regard to the concepts of framing, policy environments and scientific authority. Due to the focus of these concepts, the temporal scope was extended for the first lens to include preceding developments on reducing land-based emissions. These extensions were provided as background information derived from secondary sources and thus to contextualize the framing of the problem and issue. Extensions of the scope of the thesis were also made in the second lens. Although domestic politics and economic and scientific aspects in individual member States were not within the scope of the research, the analysis of the role of economic interests included some brief additional information on the main actors' interests. This was necessary due to the conceptual basis with the focus on the self-interests of States (and NGOs) and because the aim and objectives of this thesis focused on the role of economic *interests* and not just the economic basis of decisions. Another difference is that the empirical investigation of the role of 'science' goes into more detail in the reports on methods and background information to show the 'science' behind the policy. It was not intended that the empirical investigation into the role of economic interests would go deeper into the methodology or the basis of economic calculations, e.g. calculations of the total costs for refineries. This was due to the fact that economic calculations are not within my area of expertise. This methodological difference in the level of empirical detail between the two explanations is a consequence of the challenge of changing conceptual lenses in relation to the pre-understanding of the analyst, which is emphasized in Section 7.4.1 above.

Most importantly, the conceptual lenses of this thesis differ substantially in their assumptions of the way social phenomena are explained and in the emphasis on what was important to highlight or exclude. The selection of empirical data to investigate separately for two lenses is in itself important to these differences. As emphasized earlier, science and economics are two different world views. Science represents nature – the object. This means that the first lens included the natural science of the process (the object). However, as Lidskog and Sundqvist

(2011, p. 12) explained: “It is not the object per se, but those who speak for it or claim to represent it who are the driving causal agents in the political process”. The explanations in the first lens thus included many different social aspects of how it was claimed that the object was represented, how political actors addressed the claims and how political environments created different conditions for these claims to affect policy-making. Economics represents the economic interests of different actors – the subjects. Viewed from the second lens, more emphasis was placed on the actors. The focus was on the economic self-interests of the actors. The problem in itself was expressed in terms of costs and benefits and, in particular, the possible solutions to the problem. The foundation of the second lens is the economic reasoning of rational choice, which focuses on explaining individual behaviour on a simple deductive basis. The two lenses were thus expected to show many differences in explanations. Indeed, they did, but after the two lenses had been tried out, I found myself with a combined lens on the studied phenomenon. Connections between the two different explanations were manifested, as shown in Section 7.3. As final words in this discussion, the conclusions of this thesis are the result of viewing a phenomenon from different conceptual lenses and of my pre-understanding.

7.5 Research Contributions

This thesis makes a rich empirical contribution based on a large quantity of documents for a somewhat lengthy policy-making process at the IMO. This reveals – on the basis of what was reported in the documents – the scientific and economic grounds behind the policies of different actors and the policy choices and decisions made by two bodies of the IMO. This empirical basis can be used for further research on environmental policy-making of the IMO. Gaining access to and compiling useful information from older IMO documents is not an easy task and involves going through extensive archived prints if the time and authority are given to delve through archived material in governmental agencies.[112] This thesis highlights the contents of IMO documents from a time before digitalization and thus sheds light on information that is hard to get hold of by researchers, governments, industry and civil society. In particular, this thesis contributes a description of the scientific and economic arguments, supportive information and discussions of the whole process towards the first version of sulphur regulations for shipping. No such research has been found on international environmental negotiations for shipping. Investigations of scientific and economic arguments and supportive information based on documents from international environmental negotiations are hard to find with similar details to those in this thesis. Research presented in book chapters and papers seems to focus on presenting the analytical parts and not to cover the empirical basis the way Chapters 5 and 6 of this thesis have. Future research on other environmental policy issues should continue with such a detailed approach.

This thesis enriches our understanding of environmental policy-making for shipping through the IMO, what roles science and economic interests could play and how the negotiations could result in internationally agreed regional measures. The main theoretical contribution is the use of different conceptual lenses to study the same phenomenon. In particular, this contribution applies to the very diverse and rather loosely defined fields of international environmental politics and global environmental governance. Within these fields today, the literature is covered by different disciplines and fields and is dominated by many disciplinary boundaries and traditions on how to analyse the same phenomenon in their own respective ways. The need for studies that break the traditional disciplinary borders is eminent. In particular, the dominance of regime theory and focus on institutions in the field of international relations suggests that the seminal contributions of Allison (1971) have been forgotten when studying international environmental negotiations. It is often said about environmental problems that they transcend national borders, which requires international action. When studying international actions, however, researchers seem to forget that understanding environmental issues requires recognition that environmental problems also transcend disciplinary borders. This thesis contributes to the fields of international environmental politics and global environmental governance by viewing an international environmental policy-making process through different conceptual lenses. It provides these fields with the lesson that one cannot understand the international action for environmental issues if one does not understand the scientific and economic aspects and arguments of the issue. Science and economics are different world views, and environmental problems force policy-makers to face both. We thus need to use different conceptual lenses in order to understand the policies of different actors and their collective decisions.

With regard to more specific research contributions, detailed studies on the role of science in international environmental policy-making at the IMO have not been found. For STS focusing

[112] Such documents not only include neutral documents from the IMO secretariat but also notes from the negotiations and governmental positions on specific questions.

on the role of science in policy-making, this thesis contributes empirical grounds for a case that goes against the traditional view that science speaks truth to power. The IMO has attracted little attention in this field on a subject that is overloaded with studies on land-based regimes. To focus on the IMO provides new perspectives on the role of science in policy-making and the studied case show a big difference in social conditions for science to be successful in policy than the studied cases of for example the LRTAP regime. For this case, SSK could not provide an explanation for the outcome, instead the over-critical model showed an explanatory strength. Lidskog and Sundqvist (2011) highlighted that SSK was not fully theoretically and empirically mature in studies of international environmental policy-making. Through a combination of SSK and radical relativism, this thesis contributes to the development of SSK in line with the need for and possibilities of cross-fertilization emphasized by different scholars in Lidskog and Sundqvist (2011).

A common theme in environmental issues is the conflict of interests between, on the one hand, economics with the focus on the costs of regulation and, on the other, environmental and health protection. This thesis provides an insight into the dynamics of the two conflicts in the studied process. Interests, in particular those of the oil industry, have played essential roles in this process. There are numerous studies on the role of self-interests in environmental policy-making, but this thesis has shown that traditional collective action could not explain this particular case. Instead, the insights of DeSombre (2007) into directional issues have provided a foundation for explanation. This thesis has further shown that it is fruitful to supplement DeSombre's approach with Wilson's theory of politics. This combined approach has not previously been applied to an extensive empirical basis in studies of international environmental policy-making.

8 Conclusions, Recommendations and Further Research

Viewed from conceptual lenses on the roles of science and economic interests, this thesis has analysed scientific and economic arguments (including supportive information and reported discussions) in documents of IMO negotiations during 1988-1997. To provide an understanding of why a regional approach was chosen to control SO_x emissions from international shipping, the conclusions of this thesis were drawn from viewing the policy-making process through the two lenses with an emphasis on their connections and differences. The conclusions are presented in three parts: findings for each lens and overall conclusions of the thesis. Recommendations for policy-makers and stakeholders are then given. This final chapter ends with propositions for further research.

8.1 Findings on the Role of 'Science'

The analysis on the role of 'science' found that a central factor in explaining the two research questions is the way the issue of SO_x emissions from ships was framed by different actors as a global, regional or local problem requiring global, regional or local measures. Equally central is the character of the policy environment as uncritical (science accepting) or critical.

Why Change the Focus to Regional Measures at the BCH?

- The submitted studies of the process represented socially constructed factual claims by actors with certain policy beliefs, which guided their framing. One group of actors (the NSS and the BSS) framed the issue as global, emphasized the transboundary nature of the problem and presented scientific claims to show a need for global action. Its framing, scientific arguments and claims were accepted in the early years due to an uncritical policy environment along with a recognized scientific authority.

- Another group of actors with other policy beliefs then arrived on the scene. This group framed the issue as regional/local and focused on showing a minimal contribution of ship emissions. They used scientific arguments and supporting claims as well as uncertainties and confusion over different scientific methods and concepts. This resulted in criticism of previous scientific claims, which were reconstructed to confirm their views. A critical policy environment had emerged at BCH 22 in 1992, and the framing by the actors had changed to a regional issue, no issue or local at most.

- Due to its removal from the Assembly resolution, the 50% global reduction target lost its importance despite being part of the action plan. The BCH did not consider the reference levels and dates as instructed but instead initiated the regional concept.

Why Adopt a Combination of Stricter SECAs and a Global Cap?

- With a framing of the problem as regional/local, there was no need for a global emission reduction. A regional approach with sulphur limits in special areas was framed as the leading principle. No global reduction of emissions was intended with a global cap, but to prevent a possible future increase in the sulphur content of fuels.

- A clear role of 'science' was as a restriction of regulating SO_x emissions by the use of scientific criteria to establish special areas.

- The policy-makers faced a lack of sufficient scientific information for their policy choices and decisions. New studies primarily deconstructed and reconstructed existing factual claims instead of gathering new data. Scientific uncertainty and a lack of information were also used as arguments to postpone decisions on strict regulations.

- The critical policy environment resulted in long discussions at the MEPC on scientific methods and concepts. The process had arrived at deadlocked negotiations with extensive technical debates. The agreement on the combined approach was nothing other than a compromise.

- The two groups of actors with different framing never agreed on a clear framing of the issue. Instead the policy-making process was a process of negotiating the framing, with attempts to agree on measures at the same time. An identity between the problem of SO_x emissions from ships and a specific spatial level was never established.

8.2 Findings on the Role of Economic Interests

The second lens showed that this policy issue has the characteristics of a directional problem in which the actors that caused the problem (the polluters) were not the same as those that suffered from it. The States affected by acidification sought global regulation on ship emissions while the States causing it opposed global regulation. The significant role of self-interests in a directional problem along with the perceived distribution of costs and benefits made the policy-makers focus on oil industry costs and implications, which, in turn, is the ultimate factor explaining both research questions. The focus was put on the costs and impacts of regulations rather than the societal costs without regulations. The decisions were based on biased cost-benefit assessments that focused on the costs of the oil and shipping industries.

Why Change the Focus to Regional Measures at the BCH?

- The opposition to reducing the sulphur content was strongly connected to the economic interests of the oil industry and petroleum markets. Producers and exporters of high-sulphur petroleum products would have to pay for costly desulphurization processes. This was a concentrated group of actors that would have to pay for widely distributed benefits, which provided strong incentives for opposition.

- The removal of the target from the Assembly resolution was a first breaking-point towards a regional approach. It enabled an increased role of economic interests with a strong focus on the costs of oil industries when the BCH begins its considerations. The highlighted costs for shipping were strictly connected to oil industry implications with increased bunker fuel prices.

- The lack of support for a global approach was central to the choice of a regional approach. This was a result of the high costs of the oil industry and arguments that widely extended the scope of implications. Japan and OCIMF showed huge impacts on the global crude oil market, the energy supplies of many countries and the depletion of petroleum reserves. At the same time, the benefits were perceived as regional or even local. A regional approach would mean a concentration of the costs through lower costs for fewer actors, and the benefits would also be concentrated.

Why Adopt a Combination of Stricter SECAs and a Global Cap?

- A global cap provided no benefits worth mentioning but significant costs for some actors. Any figures below a 5% cap would impose costs for the States that produced, exported or supplied fuels over 4% sulphur contents. The combined approach added unequally distributed costs to a policy of concentrated benefits. This provided incentives for strong opposition by a large group of intertwined oil and shipping interests, with emphasis on high costs and moral arguments of unequal cost burdens.

- The response by the NSS, the BSS and environmental NGOs was to show social costs and cost-effectiveness of a ship emission reduction in Europe, and to threaten unilateral action. Since the intertwined interests had few incentives to cooperate, as they did not suffer from acidification, the BSS and the NSS had to accept compromises far beyond their own preferences.

- In 1997, some actors with shipping interests broke away from the intertwined interests and criticized the SECA approach for the reasons of competiveness of shipping. However, the shipping interests' earlier alignment with the oil interests had resulted in locked positions.

- The principle of a level playing field was put aside by the shipping interests due to the fear of high costs, but then emerged when it was too late. The efforts of the NSS, the BSS environmental NGOs and shipping industry NGOs, however, explain the compromises at the end of the process.

8.3 Conclusions of the Thesis

- The two conceptual lenses used in this thesis differ substantially in assumptions and emphasis. They were expected to show many differences in explanations, but significant interactions were found.

- One important shared factor towards a regional approach was the removal of the target from the Assembly resolution. Another was the significant role of INGOs. In particular, one oil industry organization (OCIMF) was able to shape policy through the use of both scientific and economic arguments and supportive information.

- The framing of the issue, the scientific arguments and claims, and the positions of the actors were all shaped by interests. The interests of the policy-makers decided the policy relevance of science, which for this case was used by environmental and economic interests to compete rather than enabling consensus.

- The MEPC faced great scientific uncertainty on ship emissions and their contribution to acidification on land. This enabled an increased role of economic interests, which in turn supported those scientific claims that backed the economic interests. Based on the economic interests of the actors that caused the problem and that would bear the costs of regulation, a critical policy environment emerged in which these actors showed a low contribution of ship emissions as well as extreme economic implications.

- Scientific arguments and claims were used to justify views with underlying economic arguments, which were strengthened with legitimacy. Uncertainties were highlighted as reasons not to take decisions with high economic consequences. Scientific claims further enabled the use of cost-effectiveness as an argument.

- The policy-makers' focus on oil industry costs and implications stands as the primary factor in explaining both research questions. A regional approach was drawn up based on strong economic interests of oil and shipping industries and environmental protection was down-prioritized. This thesis has found that economic self-interests are paramount in understanding both economic and scientific arguments and how these could shape policy-making through the power of persuasion.

- Three Assembly resolutions determined the direction of the roles of science and economic interests. The principles of a compelling need and taking into account the costs and economic implications were the primary causes of the cost focus and the emergence of a critical policy environment. This is a lesson for future policy issues in terms of achieving a balance between industry interests and environmental interests by institutionally controlling the roles of science and economic interests.

- This thesis shows that the use of two conceptual lenses provides different explanations and that these particular lenses complement each other with additional explanations. The combination of these conceptual lenses can increase our understanding of environmental policy-making processes and their outcomes.

- In order to understand why policy-makers sometimes follow the path of environmental protection based on scientific claims and, at other times, follow the path of economic self-interests researchers studying international environmental policy-making need to take into account both by different conceptual lenses. We need to force ourselves to change our conceptual lenses to gain understanding.

8.4 Recommendations to Policy-makers and Stakeholders

The findings of this thesis should be viewed as an indicator for the IMO of how resolutions on its work procedures could affect the dynamics of economic and environmental interests. If a balance between these interests is sought by the IMO member States, then there is a need to evaluate possible implications of specific formulations in IMO resolutions. The member States should ask whether or not is more appropriate to add a requirement of cost-benefit assessments in its resolutions instead of a sole focus on costs and implications for industry and administrative burdens. If a balance is sought, the environmental interests need to be included in resolutions that the guides the work of the MEPC. The work should be guided by an emphasized focus on environmental impacts and on social costs instead of the phrase 'a compelling need'. A starting point to strengthen the role of science when drawing up regulations for shipping is to look more closely at the different institutional conditions for science to influence policy in LRTAP and the IMO. It is recommended to consider a possible institutionalization of science in the same way as with the LRTAP regime.

It is my sincere hope that the findings of this thesis will be used as lessons for governments, the shipping industry and environmental organizations in their efforts to affect the IMO process towards more proactive policy-making that takes into account the interplay of science and economic interests. A better understanding of the relationship between science and

economic interests in IMO policy-making could help the shipping industry to avoid waking up one day in a plethora of costly and different geographically located environmental regulations. With this knowledge, the recommendation is to take an active role in the development towards sustainable shipping together with governments and environmental organizations. Focus on the costs of regulation has not led the shipping industry towards a level playing field in this particular case, which shows a need for a different approach.

8.5 Further Research

This thesis has contributed a detailed empirical description of the scientific and economic arguments, supportive information and discussions for this particular process. Such detailed descriptions are lacking in studies of international environmental negotiations. Future research on other environmental policy issues should continue with this detailed approach. This thesis has further shown that the use of different conceptual lenses to study the same phenomenon is a fruitful way of understanding international environmental negotiations. In particular, this thesis maintains that the scientific and economic aspects of the issue need to be understood. Further studies on international environmental negotiations need to be open for cross-fertilization without a search for a unified framework but rather applying different approaches to the same studied phenomenon. As researchers, our minds should not be constrained by one disciplinary explanation in our understanding of social phenomena. It is suggested that further studies are conducted that apply the theoretical framework of this thesis. This thesis has been delimited to the first process of Annex VI up to 1997. Further research is needed on the revision process 2006-2008 including interim developments from 1997. It is proposed that the present research be continued where it ended in order to gain an understanding through the use of different explanations.

In order to better understand international environmental decisions, the findings on the NGO influence in this thesis suggest a need to look closer into NGOs as participants and members of international organizations. Peet (1994) studied the NGO influence during one session of the MEPC that included all the agenda items, though the author represented an environmental NGO at the IMO, and the paper had neither theoretical contributions nor any references. Betsill and Corell (2008) presented a revised analytical framework published earlier[113] for analysing NGO influence in negotiation processes and outcomes. It is suggested that further research utilize this framework.

This thesis excluded the reduction alternative of on-board *exhaust gas cleaning* (EGC) such as the use of scrubbers.[114] EGC has been promoted as a cost-effective option for SECA compliance by the European Commission (2011). Approaching 2015, there are several uncertain environmental and practical factors of using scrubbers as compliance. It could lead to high levels of a number of harmful substances into the marine environment (AEAt et al., 2009). Hassellöv et al. (2013) highlighted that large-scale use of seawater scrubbers in the current SECAs with seawater as the neutralizing base before discharge would merely act "as an efficient mechanism for transferring the acid to the surface water" (Hassellöv et al., 2013, p. 2735). The studied process and the revision process are crucial to study further in order to gain understanding how this uncertainty of environmental protection of SECAs emerged.

[113] Betsilll and Corell (2001) and Corell and Betsilll (2001), cited in Betsilll and Corell (2008)

[114] Regulation 4 of revised Annex VI allows the use of methods with at least equivalent emission reductions as Regulation 14. The environmental issues of using EGC are regulated in (non-mandatory) IMO guidelines (Resolution MEPC.184(59)).

Abbreviations and Acronyms

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 (Conservation of Clean Air and Water in Europe)
DNV	Det Norske Veritas
ECA	Emission Control Area
EEC / EC	European Economic Community European Community (officially from 1993)
EGC	Exhaust Gas Cleaning
EMEP	European Monitoring and Evaluation Programme
ENGO	Environmental Non-Governmental Organization
EU	European Union (former EC and EEC)
FOC	Flag of Convenience
FOEI	Friends of the Earth International
GT	Gross Tonnage
HELCOM	Helsinki Commission
HFO	Heavy Fuel Oil
HSFO	High-Sulphur Fuel Oil
IACS	International Association of Classification Societies
IAPH	International Association of Ports and Harbors
ICCET	Imperial College Centre for Environmental Technology
ICS	International Chamber of Shipping
IEA	International Energy Agency
IFO	Intermediate Fuel Oil
IGO	Inter-Governmental Organization
IIASA	International Institute for Applied Systems Analysis
IMCO	Inter-Governmental Maritime Consultative Organization, see IMO
IMO	International Maritime Organization
INGO	Industry Non-Governmental Organization
INTERTANKO	International Association of Independent Tanker Owners
IPIECA	International Petroleum Industry Environmental Conservation Association
IR	International Relations
ISO	International Organization for Standardisation
kt	kilotonne, 10^3 t
Marintek	Norwegian Marine Technology Research Institute A/S
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto
MDO	Marine Diesel Oil
MEPC	Marine Environment Protection Committee
MGO	Marine Gas Oil
MoU	Memorandum of Understanding
MSC	Maritime Safety Committee
mt	Million tonnes, 10^6 t
nm	Nautical miles

NO_x	Nitrogen oxides
NGO	Non-Governmental Organization
LRTAP	1979 Convention on Long-range Transboundary Air Pollution (also: CLRTAP)
LSF	Low-Sulphur Fuels
LSFO	Low-Sulphur Fuel Oil
OCIMF	Oil Companies International Marine Forum
OECD	Organisation for Economic Co-operation and Development
PM	Particulate Matter
PSSA	Particularly Sensitive Sea Area
SECA	SO_x Emission Control Area
SEK	Swedish krona (the Swedish currency)
SMA	Swedish Maritime Administration
SO_2	Sulphur dioxide
SO_x	Sulphur oxides (SO_2 and/or SO_3)[115]
SOLAS	International Convention for the Safety of Life at Sea, 1974
SSK	Sociology of Scientific Knowledge
STA	Swedish Transport Agency
STS	Science and Technology Studies
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNCLOS 1982	United Nations Convention on the Law of the Sea, 1982
WWF	World-Wide Fund for Nature

[115] Here: related to combustion. It could also include SO, S_2O, S_nO and SO_4.

References

LITERATURE AND WEBSITES

Adams, M., Fernandez, R., Barkman, A. (2009) *Development of Greenhouse Gas and Air Pollution Emissions.* In: Pleijel, H. (ed.) (2009) *Air pollution and climate change: two sides of the same coin?*. Stockholm: Swedish Environmental Protection Agency.

AEAt, TNO, IVL & EMRC (2009) *Cost Benefit Analysis to Support the Impact Assessment accompanying the revision of Directive 1999/32/EC on the Sulphur Content of certain Liquid Fuels*. Final report to the European Commission. Didcot: AEA Technology.

Agrawal, H., Malloy, Q.G.J., Welch, W.A., Wayne Miller, J., Cocker III, D.R. (2008) *In-use gaseous and particulate matter emissions from a modern ocean going container vessel*. Atmospheric Environment, 42 (21): 5504–5510.

Ahmed, S., and Potter, D. (2006) *NGOs in International Politics.* Sterling, VA: Kumarian Press.

Alexandersson, A., Flodström, E., Stålberg, P., Öberg, R. (1993) *Exhaust Gas Emissions from Sea Transportation*. Report no: 1993:1. Stockholm: The Swedish Transport Research Board.

Allison, G. T. (1971*) Essence of decision: explaining the Cuban missile crisis.* Boston, Mass.: Little, Brown.

AMEC (2013) *UK Chamber of Shipping: Impact on Jobs and the Economy of Meeting the Requirements of MARPOL Annex VI*. Final Report, March 2013. Glasgow: AMEC Environment & Infrastructure UK Limited.

Arlen, J. (1998) *Comment: The future of behavioral economic analysis of law*. Vanderbilt Law Review, 51(6): 1765–1788.

Atkinson, P. & Coffey, A. (2011) *Analysing Documentary Realities*. In: Silverman, D. (ed.) (2011) Qualitative research: issues of theory, method and practice. 3rd ed. London: SAGE.

Bengtsson, S., Andersson, K. & Fridell, E. (2011) *A comparative life cycle assessment of marine fuels; liquefied natural gas and three other fossil fuels*. Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment, 225: 97–110.

Bergström, G., & Boréus, K. (ed.) (2012) *Textens mening och makt: metodbok i samhällsvetenskaplig text- och diskursanalys*. 3rd ed. [extended]. Lund: Studentlitteratur.

Betsill, M.M. & Corell, E. (ed.) (2008) *NGO diplomacy: the influence of nongovernmental organizations in international environmental negotiations*. Cambridge, Mass.: MIT Press.

Birnie, P., Boyle, A., Redgwell, C. (2009) *International Law & the Environment*. 3rd ed. Oxford: Oxford University Press.

Boisson, P. (1999) *Safety at Sea: Policies, Regulations & International Law*. Paris: Edition Bureau Veritas.

Borrell, P., Builtjes, P., Grennfelt, P. (ed.) (1997) *Photo-oxidants, acidification and tools: policy applications of EUROTRAC results : the report of the EUROTRAC application project*. Berlin: Springer.

Brandt, J., Silver, J. D., Christensen, J. H., Andersen, M. S., Bønløkke, J. H., Sigsgaard, T., Geels, C, Gross, A., Hansen, A. B., Hansen, K. M., Hedegaard, G. B., Kaas, E. and Frohn L. M. (2011) *Assessment of Health-Cost Externalities of Air Pollution at the National Level using the EVA Model System*. CEEH Scientific Report No. 3, Centre for Energy, Environment and Health Report series. Roskilde: Aarhus University.

Bryman, A. (2012) *Social research methods*. 4th ed. Oxford: Oxford University Press.

Buhaug, Ø., Corbett, J.J., Endresen, Ø., Eyring, V., Faber, J., Hanayama, S., Lee, D.S., Lee, D., Lindstad, H., Markowska, A.Z., Mjelde, A., Nelissen, D., Nilsen, J., Pålsson, C., Winebrake, J.J., Wu, W., Yoshida, K. (2009) *Second IMO GHG Study 2009*. London: International Maritime Organization.

Butler, E. (2012) *Public Choice: A Primer*. London: The Institute of Economic Affairs.

Campe, S. (2009) *The Secretariat of the International Maritime Organization: A Tanker for Tankers*. In: Biermann, F. (ed.) & Siebenhüner, B. Managers of Global Change: The Influence of International Environmental Bureaucracies. Cambridge, MA, USA: MIT Press.

Collingridge, D., and Reeve, C. (1986) *Science speaks to power: the role of experts in policy making*. London: Pinter.

CONCAWE (1993) *The European environmental and refining implications of reducing the sulphur content of marine bunker fuels*. Report no. 1/93. Brussels: CONCAWE.

CONCAWE (1994) *The contribution of sulphur dioxide emissions from ships to coastal deposition and air quality in the channel and southern north sea area*. Report no. 2/94. Brussels: CONCAWE.

CONCAWE (1998) *Heavy fuel oils*. Product dossier no. 98/109. Brussels: CONCAWE.

Corbett, J. J. and Fischbeck, P. (1997) *Emissions from Ships*. Science, 278(5339): 823–824.

Corbett, J. J., Winebrake, J. J., Green, E. H., Kasibhatla, P., Eyring, V., Lauer, A. (2007) *Mortality from Ship Emissions: A Global Assessment*. Environ. Sci. Technol., 41(24): 8512–8518.

Czarniawska, B. (1997) *Narrating the organization: dramas of institutional identity*. Chicago: Univ. of Chicago Press.

Czarniawska, B. (2014) *Social science research: from field to desk*. London: SAGE Publications Ltd.

Dalsøren, S. B., Eide, M. S., Endresen, Ø., Mjelde, A., Gravir, G., Isaksen, I. S. A. (2009) *Update on emissions and environmental impacts from the international fleet of ships: the contribution from major ship types and ports*. Atmos. Chem. Phys. 9: 2171–2194.

Dauvergne, P. (ed.) (2012) *Handbook of Global Environmental Politics*. 2nd ed. Cheltenham: Edward Elgar.

De La Rue, C. and Anderson, C.B. (2009) *Shipping and the Environment: Law and Practice*. 2nd ed. London: Informa.

Denscombe, M. (2009) *Forskningshandboken: för småskaliga forskningsprojekt inom samhällsvetenskaperna*. 2nd ed. Lund: Studentlitteratur.

DeSombre, E. R. (2006) *Flagging standards: globalization and environmental, safety, and labor regulations at sea*. Cambridge, Mass.: MIT Press.

DeSombre, E. R. (2007) *The global environment and world politics*. 2nd ed. London: Continuum International Pub. Group.

DeSombre, E. R. (2012) *Changing Issue Structure to Avoid Free Riders: Protecting the Ocean Environment*. In: Dauvergne, P. (ed.) Handbook of Global Environmental Politics. 2nd ed. Cheltenham: Edward Elgar.

Dimitrov, R. (2012) *The politics of persuasion: UN climate change negotiations*. In: Dauvergne, P. (ed.) Handbook of Global Environmental Politics. 2nd ed. Cheltenham: Edward Elgar.

Dirks, J, (2001) *Decision Making in the International Maritime Organization: The Case of the STCW 95 Convention*. Workshop Paper on Decision Making Within International Organisations, 29th ECPR Joint Sessions of Workshops, 6 - 11 April 2001. Grenoble: European Consortium for Political Research.

Dirks, J. (2004) *Decision making in the International Maritime Organization: The case of the STCW 95 Convention*. In: Reinalda, B. & Verbeek, B. (ed.) (2004) Decision making within international organizations. London: Routledge.

Dubois, A., and Gadde, L.E. (2002) *Systematic combining: an abductive approach to case research*. Journal of Business Research 55: 553–560.

Elvingson, P. and Ågren, C. (2004) *Air and the environment*. Gothenburg: Swedish NGO Secretariat on Acid Rain.

EMEP (2014) *Meteorological Synthesizing Centre - West (MSC-W).* European Monitoring and Evaluation Programme. Oslo: Norwegian Meteorological Institute. Accessed 27.10.2014. <http://emep.int/mscw/index_mscw.html>

EMSA (2010) *The 0.1% sulphur in fuel requirement as from 1 January 2015 in SECAs: An assessment of available impact studies and alternative means of compliance*. Technical Report, 13 December, 2010. Brussels: European Maritime Safety Agency.

Enevoldsen, M. (2001) *Rationality, Institutions and Environmental Governance.* In: Beckmann, S. C., and Kloppenborg Madsen, E. (eds.) Environmental Regulation and Rationality: Multidisciplinary perspectives. Aarhus: Aarhus University Press.

Eni (2013) *Production Quality*. Directed from main page to statistics by country. Published 07.10.2013. Rome: Eni S.p.A. Accessed 3.8.2014. <http://www.eni.com/world-oil-gas-review-2013/production/production.shtml>

Esaiasson, P., Gilljam, M., Oscarsson, H., Wängnerud, L. (2012) *Metodpraktikan: konsten att studera samhälle, individ och marknad*. 4th ed. [rev.]. Stockholm: Norstedts juridik.

Entec (2011) *Study to Review Assessments Undertaken of the Revised MARPOL Annex VI Regulations.* Final Report, July 2010. London: Entec UK Limited.

European Commission (2011) *Impact Assessment*. SEC(2011) 918 final, Commission Staff Working Paper, 15.7.2011, accompanying COM(2011) 439 final. Brussels: European Commission.

European Environment Agency (2012) *European Union emission inventory report 1990–2010 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP).* EEA Technical report, No 8/2012. Copenhagen: European Environment Agency.

Finlayson-Pitts, B. J. and Pitts, J.N. (2000) *Chemistry of the upper and lower atmosphere: theory, experiments, and applications*. San Diego, Calif.: Academic Press.

Fowler, D., Smith, R., Muller, J., Cape, J.N., Sutton, M., Erisman, J.W., Fagerli, H. (2007) *Long Term Trends in Sulphur and Nitrogen Deposition in Europe and the Cause of Non-linearities*. Water Air Soil Pollut: Focus, 7:41–47.

Gaskell, N. (2003) *Decision Making and the Legal Committee of the International Maritime Organization*. The International Journal of Marine and Coastal Law, 18(2): 155–214.

Gilje, N. & Grimen, H. (2007) *Samhällsvetenskapernas förutsättningar*. 3rd ed. Gothenburg: Daidalos.

Grennfelt, P. and Nilsson, J. (ed.) (1988) *Critical loads for sulphur and nitrogen: report from a workshop held at Skokloster, Sweden, 19-24 March, 1988*. Copenhagen: Nordic Council of Ministers. Lund: Studentlitteratur.

Haas, P.M, (1999) *Social Constructivism and the Evolution of Multilateral Environmental Governance*. In: Prakash. A., and Hart, J.A. (eds.) (2001) Globalization and Governance. London and New York: Routledge.

Haas, P.M. (1992) *Introduction: epistemic communities and international policy coordination*. International Organization 46(1): 1–35.

Haas, P.M. (1997) *Scientific Communities and Multiple Paths to Environmental Management*. In Brooks, L.A., and VanDeveer S.D. (eds) Saving the Seas: Values, Scientists, and International Governance, pp. 193–228. College Park, Md: Maryland Sea Grant College.

Haas, P.M. (ed.) (2003) *Environment in the new global economy. Vol. 1, Analytic approaches to the IPE of the environment*. Cheltenham: Edward Elgar.

Hardin, G. (1968) *The tragedy of the commons*. Science, 162: 1243–1248.

Harrison J. (2011) *Making the Law of the Sea: A Study in the Development of International Law*. Cambridge: Cambridge University Press.

Harvey, M. (2012) *The Origins of the International Maritime Organization*. London: International Maritime Organization. Accessed 4.5.2014. <http://www.imo.org/KnowledgeCentre/ReferencesAndArchives/Pages/TheOriginsOfIMO.aspx#FN1>

Hassellöv, I.M., Turner, D.R., Lauer, A., Corbett, J.J. (2013) *Shipping contributes to ocean acidification*. Geophysical Research Letters 40: 2731–2736.

Hovik, S. (1997) *How to make local government think global?* Paper presented at European Consortium for Political Research (ECPR) Joint Sessions of Workshops, Bern, 27 February to 4 March 1997.

IMO (1998a) *IMO 1948-1998: a process of change*. Focus on IMO, September 1998. London: International Maritime Organization. Accessed 3.5.2014. <http://www.imo.org/KnowledgeCentre/ReferencesAndArchives/FocusOnIMO%28Archives%29/Documents/Focus%20on%20IMO%20-%20IMO%201948-1998,%20a%20process%20of%20change%20%28September%201998%29.pdf>

IMO (1998b) *Protocol of 1997 to amend MARPOL 73/78 : Annex VI of MARPOL 73/78 - Regulations for the Prevention of Air Pollution from Ships - and Final Act of the 1997 MARPOL Conference including the resolutions of the conference and the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines*. London: International Maritime Organization.

IMO (2012) *About IMO*. Main page; Conventions; FAQs; Membership. London: International Maritime Organization. Accessed 05.11.2012. <http://www.imo.org/About/Pages/Default.aspx>

IMO (2014a) *Introduction to IMO*. London: International Maritime Organization. Accessed 4.5.2014. <http://www.imo.org/About/Pages/Default.aspx>

IMO (2014b) *International Convention for the Prevention of Pollution from Ships (MARPOL).* London: International Maritime Organization. Accessed: 10.10.2014. <http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-%28MARPOL%29.aspx>

IMO (2014c) *Air Pollution, Energy Efficiency and Greenhouse Gas Emissions*. London: International Maritime Organization. Accessed: 10.10.2014. <http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Default.aspx>

IMO (2014d) *Special Areas under MARPOL*. London: International Maritime Organization. Accessed 9.4.2014. <http://www.imo.org/OurWork/Environment/PollutionPrevention/SpecialAreasUnderMARPOL/Pages/Default.aspx>

IMO (2014e) *Key Dates 1949-2011*. London: International Maritime Organization. Accessed 4.5.2014. <http://www.imo.org/KnowledgeCentre/ReferencesAndArchives/Documents/Key%20dates%201948-2011%20%28with%20major%20accidents%29.pdf>

IMO (2014f) *Structure of IMO.* London: International Maritime Organization. Accessed 5.5.2014. <http://www.imo.org/About/Pages/Structure.aspx>

IMO (2014g) *Member States, IGOs and NGOs*. London: International Maritime Organization. Accessed 7.5.2014. <http://www.imo.org/About/Membership/Pages/Default.aspx>

IMO (2014h) *Rules and Guidelines for Consultative Status of Non-Governmental International Organizations with the International Maritime Organization*. London: International Maritime Organization. Accessed 8.5.2014. <http://www.imo.org/About/Membership/Documents/RULES%20AND%20GUIDELINES%20FOR%20CONSULTATIVE%20STATUS.pdf>

IMO (2014i) *Introduction: Adopting a convention, Entry into force, Accession, Amendment, Enforcement, Tacit acceptance procedure*. London: International Maritime Organization. Accessed 10.16.2014. <http://www.imo.org/About/Conventions/Pages/Home.aspx>

Ishii, A. (2011) *Scientists Learn Regime Not Only Science but Also Diplomacy: Learning Processes in the European Transboundary Air Pollution Regime*. In: Lidskog, R, Sundqvist, G. (eds) Governing the Air: the Dynamics of Science, Policy, and Citizen Interaction. Cambridge, MA: MIT Press.

Jahnke, M. (2012) *Revisiting Design as a Hermeneutic Practice: An Investigation of Paul Ricoeur's Critical Hermeneutics*. DesignIssues (MIT Press Journals), 28(2): 30–40.

Jasanoff, S. (1987) *Contested Boundaries in Policy-Relevant Science*. Social Studies of Science 17: 195–230.

Jasanoff, S. (1990) *The Fifth Branch: Science Advisers as Policymakers*. Cambridge, MA: Harvard University Press.

Jasanoff, S. (1996) *Science and Norms in Global Environmental Regimes*. In: Hampson, F.O., and Reppy, J. (eds), Earthly Goods: Environmental Change and Social Justice, pp. 173–197. Ithaca, NY: Cornell University Press.

Jasanoff, S. (1997) *Compelling Knowledge in Public Decisions*. In: Brooks, L.A., and VanDeveer, S.D. (eds) (1997) Saving the Seas: Values, Scientists, and International Governance, pp. 229–252. College Park, Md.: Maryland Sea Grant College.

Jasanoff, S., and Wynne, B. (1998) *Science and Decisionmaking*. In Rayner, S., and Malone, E.L. (eds) Human Choice and Climate Change vol. 1: The Societal Framework, pp. 1–87. Columbus: Battelle Press.

Jones, H. (2009) *Policy-making as discourse: a review of recent knowledge-to-policy literature*. ODI-IKM Working Paper No. 5. Bonn: IKM Emergent Research Programme, European Association of Development Research and Training Institutes.

Krasner, S. D. (ed.) (1983) *International regimes*. Ithaca, N.Y.: Cornell University Press.

Langley, P. (2001) *Transparency in the Making of Global Environmental Governance*. Global Society, 15(1): 73–92.

Larson, D. W (2001) *Sources and Methods in Cold War History: The Need for a New Theory-Based Archival Approach*. In: Elman, C. & Elman, M. F. (eds.) Bridges and boundaries: historians, political scientists, and the study of international relations, pp. 327–350. Cambridge, Mass.: MIT Press.

Levy, J. S. (1997) *Too Important to Leave to the Other: History and Political Science in the Study of International Relations*. International Security, 22(1): 22-33.

Levy, J. S. (2001) Explaining Events and Developing Theories: History, Political Science, and the Analysis of International Relations. In: Elman, C. & Elman, M. F. (eds.) Bridges and boundaries: historians, political scientists, and the study of international relations, pp. 39–83. Cambridge, Mass.: MIT Press.

Lidskog, R., and Sundqvist, G. (2002) *The role of science in environmental regimes: the case of LRTAP*. Eur. J. Int. Relat. 8 (1): 77–101.

Lidskog, R, Sundqvist, G. (eds) (2011) *Governing the Air: the Dynamics of Science, Policy, and Citizen Interaction*. Cambridge, MA: MIT Press.

Lidskog, R., and Pleijel, H. (2011) *Co-producing Policy-Relevant Science and Science-Based Policy: The Case of Regulating Ground-Level Ozone*. In: Lidskog, R, Sundqvist, G. (eds) Governing the Air: the Dynamics of Science, Policy, and Citizen Interaction. Cambridge, MA: MIT Press.

Lighty, J.S., Veranth, J.M., Sarofim, A.F. (2000) *Combustion aerosols: Factors governing their size and composition and implications to human health*. Journal of the Air and Waste Management Association, 50 (9): 1565–1618.

Lyon, T.P. (2009) *Environmental Governance: An Economic Perspective*. In: Delmas, Magali A. & Young, Oran R. (eds.) Governance for the environment: new perspectives. Cambridge: Cambridge University Press.

Lövblad, G., Tarrasón, L., Tørseth, K., and Dutchak, S. (Eds.) (2004) *EMEP Assessment: Part I: European Perspective.* Oslo: Norwegian Meteorological Institute.

Malpas, J. (2014) *Hans-Georg Gadamer*. The Stanford Encyclopedia of Philosophy (Fall 2014 Edition), Edward N. Zalta (ed.). Accessed 7.10.2014 <http://plato.stanford.edu/archives/fall2014/entries/gadamer/>.

Mason, C. F. (2002) *Biology of freshwater pollution*. 4th ed. Harlow: Prentice Hall.

Mestl, T., Løvoll, G., Stensrud, E., and Le Breton, A. (2013) *The Doubtful Environmental Benefit of Reduced Maximum Sulfur Limit in International Shipping Fuel*. Environ. Sci. Technol. 47: 6098–6101.

Newell, P. (2008) *The political economy of global environmental governance*. Review of International Studies, 34: 507–529.

Ninaber, E. (1997) *MARPOL Annex VI: A licence to pollute*. North Sea Monitor: 7–9.

Neumeier, F. (2014) *Abgas-Vorschriften für Kreuzfahrtschiffe*. Published 8.11.2012, accessed 29.10.2014. <http://www.cruisetricks.de/abgas-vorschriften-fuer-kreuzfahrtschiffe/>

Okamura, B. (1995) *Proposed IMO Regulations for the Prevention of Air Pollution from Ships*. Journal of Maritime Law and Commerce, 26(2): 183–195.

Olson, M. (1971[1965]) *The logic of collective action: public goods and the theory of groups*. Cambridge, Mass.: Harvard U.P.

Ostrom, E. (1990) *Governing the commons: the evolution of institutions for collective action*. Cambridge: Cambridge Univ. Press.

Ostrom, E., Gardner, R., & Walker, J. (1994) *Rules, Games and Common-Pool Resources.* Ann Arbor: University of Michigan Press.

Ostrom, E. (2000) *Collective Action and the Evolution of Social Norms*. The Journal of Economic Perspectives, 14(3): 137–158.

Peet, G. (1994) *The Role of (Environmental) Non-Governmental Organizations at the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO), and at the London Dumping Convention (LDC).* Ocean & Coastal Management 22: 3–18.

Pershagen, G., Kjellström, T., Bellander, T. (2009) *Air Pollution Interacts with Climate Change: Consequences for Human Health*. In: Pleijel, H. (ed.) (2009) Air pollution and climate change: two sides of the same coin?. Stockholm: Swedish Environmental Protection Agency.

Peräkylä. A. (2011) *Validity in Research on Naturally Occurring Social Interaction*. In: Silverman, D. (ed.) Qualitative research: issues of theory, method and practice. 3rd ed. London: SAGE.

Pleijel, H., and Grennfelt, P. (2007) *European air pollution: the historic legacy*. In: Pleijel, H. (ed.) Transboundary air pollution: scientific understanding and environmental policy in Europe. 1st ed.

Pleijel, H., Bråkenhielm, S., Ericson, L., Finlay, R., Hallingbäck, T., Lundkvist, H., Taylor, A. (2001) *Effekter på biologisk mångfald av markförsurning och motåtgärder.* Jönköping: Swedish Forest Agency.

Pope III, C.A. and Dockery, D.W. (2006) *Health effects of fine particulate air pollution: Lines that connect*. Journal of the Air and Waste Management Association, 56(6): 709–742.

Pålsson Syll, L. (2013) *Economic theory – A critical realist perspective*. In: Corvellec, H. (ed.) What is theory?: answers from the social and cultural sciences. 1st ed. Stockholm: Liber.

Ragin, C. C. (1992) *Introduction: Cases of "What is a case?".* In: Ragin, C. C. & Becker, H.S. (Eds.) What is a case?, pp. 1–18. Cambridge: Cambridge University Press.

Ricoeur, P. (2008[1991]) *From text to action: essays in hermeneutics, II*. Translated by Blamey, K. and Thompson, J. B. London: Continuum International Publishing.

Sikirica, N. (2008) *Air Pollution from Ships – Explaining Regime Evolution*. MSc Thesis. Wageningen: Wageningen University.

Simon, H. A. (1959) *Theories of Decision-making in Economics and Behavioural Science*. The American Economic Review, XLIX(3): 253–283.

Sliggers, J. and Kakebeeke, W. (Eds.) (2004) *Clearing the Air: 25 years of the Convention on Long-Range Transboundary Air Pollution*. ECE/EB.AIR/84. New York and Geneva: United Nations Economic Commission for Europe.

Smith, S.J., Conception, E., Andres, R. and Lurz, J. (2004) *Historical sulfur dioxide emissions 1850-2000: Methods and results*. Joint Global Research Institute, College Park. Report PNNL-14537.

Smith, S. J., van Aardenne, J., Klimont, Z., Andres, R., Volke, A., Delgado Arias, S. (2011) *Anthropogenic sulfur dioxide emissions: 1850-2005*. Atmos. Chem. Phys., 11: 1101–1116.

Sprinz, D. F., and Helm, C. (1999) *The Effect of Global Environmental Regimes: A Measurement Concept*. International Political Science Review, 20(4): 359–369.

Sprinz, D., and Vaahtoranta, T. (1994) *The Interest-Based Explanation of International Environmental Policy*. International Organization, 48(1): 77–105.

Sundqvist, G. (2011) *Fewer Boundaries and Less Certainty: The Role of Experts in European Air Policy*. In: Lidskog, R, Sundqvist, G. (eds) Governing the Air: the Dynamics of Science, Policy, and Citizen Interaction. Cambridge, MA: MIT Press.

Stopford, M. (1997) *Maritime economics*. 2nd ed. London: Routledge.

Svensson, E. (2011) *The Regulation of Global SO_x Emissions from Ships: IMO proceedings 1988-2008*. Report No 11:127. Gothenburg: Chalmers University of Technology.

Swedish Ministry for Foreign Affairs and Swedish Ministry of Agriculture (1971) *Air pollution across national boundaries: the impact on the environment of sulfur in air and precipitation : Sweden's case study for the United Nations Conference on the Human Environment*. Stockholm: Swedish Ministry of Foreign Affairs.

Swedish Transport Agency (2014) *IMO-dokumentation*. Start / Sjöfart / IMO-dokumentation / Kommittéer och underkommittéer. Restricted access. Accessed April 2014. <http://www.transportstyrelsen.se/IMO>

Tan, A. K.J. (2006) *Vessel-Source Marine Pollution: The Law and Politics of International Regulation*. Cambridge: Cambridge University Press.

Thomas, G. (2011) *A Typology for the Case Study in Social Science Following a Review of Definition, Discourse, and Structure*. Qualitative Inquiry, 17(6): 511–521.

Trafikanalys (2013) *Konsekvenserna av skärpta krav för svavelhalten i marint bränsle: slutredovisning*. Rapport 2013:10. Stockholm: Trafikanalys.

Tullock, G. (2008[2014]) *Public Choice*. In: Durlauf, Steven N. & Blume, Lawrence (eds.) (2008) New Palgrave dictionary of economics. 2nd ed. Basingstoke, Hampshire: Palgrave Macmillian. Accessed 18.3.2014 from The New Palgrave Dictionary of Economics Online. <http://www.dictionaryofeconomics.com/article?id=pde2008_P000240>

UNCTAD (2013) *Review of Maritime Transport 2013*. New York and Geneva: United Nations Conference on Trade and Development (UNCTAD).

Underdal, A., & Hanf, K. (ed.) (2000) *International environmental agreements and domestic politics: the case of acid rain*. Aldershot: Ashgate.

UNEP (2014) *The Montreal Protocol on Substances that Deplete the Ozone Layer*. United Nations Environment Programme (UNEP), Ozone Secretariat, accessed 1.8.2014. <http://ozone.unep.org/new_site/en/montreal_protocol.php>

United Nations (2013) *The United Nations System*. New York: United Nations Department of Public Information. Published on August 2013. Accessed 3.5.2014. <http://www.un.org/en/aboutun/structure/pdfs/UN%20system%20chart_lettercolor_2013.pdf >

United Nations (2014) *Glossary*. New York: United Nations Treaty Collection. Accessed 16.10.2014. http://treaties.un.org/Pages/Overview.aspx?path=overview/glossary/page1_en.xml

USEPA (2014) *1970 - 2014 Average annual emissions, all criteria pollutants in MS Excel*. National Emissions Inventory (NEI) Air Pollutant Emissions Trends Data, February 2014. United States Environmental Protection Agency. Acessed 2014-10-10. <http://www.epa.gov/ttn/chief/trends/>

Vedung, E. and Klefbom, E. (2002) *Ozonhålet: globalt, nationellt, lokalt*. 1st ed. Malmö: Liber AB.

Vestreng, V., Myhre, G., Fagerli, H., Reis, S., Tarrasón, L. (2007) *Twenty-five years of continuous sulphur dioxide emission reduction in Europe*. Atmos. Chem. Phys. Discuss., 7: 5099–5143.

Warfvinge, P. and Bertills, U. (2000) *Naturens återhämtning från försurning – aktuell kunskap och framtidsscenarier.* Report 5028. Stockholm: Swedish Environmental Protection Agency.

Wiener, J.B. (1999) *On the Political Economy of Global Environmental Regulation*. The Georgetown Law Journal, 87: 769–794.

Winnes, H. (2010) *Air Pollution from Ships: Emission Measurements and Impact Assessments*. Gothenburg: Chalmers University of Technology.

Wilson, J. Q. (1973) *Political organizations*. New York: Basic Books, Inc.

Wilson, J. Q. (ed.) (1980) *The politics of regulation*. New York: Basic Books, Inc.

Wilson, J. Q. (1986) *American government: institutions and policies*. 3rd ed. Lexington, Mass.: D.C. Heath.

Wilson, J. Q. (2011) *American government: brief version*. Andover: Cengage Learning.

Yearley, S. (2004) *Making Sense of Science: Understanding the Social Study of Science*. London: SAGE.

Yin, R. K. (2009). *Case study research: design and methods*. 4th ed. London: SAGE.

Ziman, J. (1996) *Postacademic Science: Constructing Knowledge with Networks and Norms*. Science Studies, 9(1): 67-80.

Åsberg, R. (2001) *Det finns inga kvalitativa metoder – och inga kvantitativa heller för den delen: Det kvalitativa argumentens missvisande retorik*. Pedagogisk forskning i Sverige, 6(4): 2070–292.

MEPC SESSION REPORTS

MEPC 26/25. *Report of the Marine Environment Protection Committee on Its Twenty-sixth Session*. Marine Environment Protection Committee, 28 September 1988. London: International Maritime Organization.

MEPC 27/16. Idem, 27th session, 2 may 1989.

MEPC 29/22. Idem, 29th session, 18 April 1990.

MEPC 30/24. Idem, 30th session, 8 January 1991.

MEPC 31/21. Idem, 31st session, 29 July 1991.

MEPC 32/20. Idem, 32nd sessions, 24 March 1992.

MEPC 33/20. Idem, 33rd session, 5 November 1992.

MEPC 34/23. Idem, 34th session, 6 August 1993.

MEPC 35/21. Idem, 35th session, 28 March 1994.

MEPC 36/22. Idem, 36th session, 22 November 1994.

MEPC 37/22. Idem, 37th session, 11 October 1995.

MEPC 37/22/Add.1. Idem.

MEPC 38/20. Idem, 38th session, 16 August 1996.

MEPC 39/13. Idem, 39th session, 25 April 1997.

MEPC SUBMISSIONS AND WORKING PAPERS

MEPC 26/22. *Inclusion of air pollution from ships in the work programme*. Submitted by Norway, 8 July 1988. Marine Environment Protection Committee, 26th session, agenda item 22.

MEPC 26/24. *Outcome of the Second International Conference on the Protection of the North Sea: Ministrial Declaration*. Note by the Secretariat, 6 April 1988. Idem., agenda item 24.

MEPC 26/INF.19. *Baltic Sea Environment Proceedings No. 26: Activities of the Commission 1987*. Submitted by Helsinki Commission, 4 August 1988. Idem., agenda item 24.

MEPC 26/INF.3O. *Inclusion of air pollution from ships in the work programme*. Submitted by Norway, 30 August 1988. Idem., agenda item 22.

MEPC 27/6/2. *Improved standards for heavy fuel oil*. Submitted by Norway, 24 January 1989. Marine Environment Protection Committee, 27th session, agenda item 6. London: International Maritime Organization.

MEPC 27/6/3. *Prevention of oil pollution from machinery spaces: oily-water separators and monitors, fuel oil quality*. Submitted by Denmark, Finland, the German Democratic Republic, the Federal Republic of Germany, Poland, Sweden and the USSR, 25 January 1989. Idem.

MEPC 27/6/7. *Quality of heavy fuel oils: liaison with ISO*. Note by the Secretariat, 10 February 1989. Idem.

MEPC 27/WP.3. *Prevention of oil pollution from machinery spaces: oily-water separators and monitors and fuel oil quality*. Draft report of the working group, 16 March 1989. Idem.

MEPC 29/18. *Prevention of air pollution from ships, including fuel oil quality*. Submitted by Norway, 19 December 1989. Marine Environment Protection Committee, 29th session, agenda item 18. London: International Maritime Organization.

MEPC 29/18/1. *Prevention of air pollution from ships, including fuel oil quality*. Submitted by Denmark, Finland, the German Democratic Republic, the Federal Republic of Germany, Poland, Sweden and the USSR, 9 January 1990. Idem.

MEPC 29/18/2. *Prevention of air pollution from ships, including fuel oil quality*. Submitted by Friends of the Earth International, 11 January 1990. Idem.

MEPC 29/18/4. *Actions concerning air pollution from ships*. Submitted by Norway, 12 January 1990. Idem.

MEPC 29/18/6. *Status report on the work with fuel oil quality*. Submitted by Norway, 23 January 1990. Idem.

MEPC 30/14/2. *Prevention of air pollution from ships, including fuel oil quality*. Submitted by Belgium, Denmark, France, the Federal Republic of Germany, the Netherlands, Norway, Sweden, the United Kingdom and the Commission of the EEC, 12 September 1990. Marine Environment Protection Committee, 30th session, agenda item 14. London: International Maritime Organization.

MEPC 30/14/4. *Prevention of air pollution from ships, including fuel oil quality*. Submitted by Norway, 19 September 1990. Idem.

MEPC 30/14/6. *Prevention of air pollution from ships, including fuel oil quality*. Submitted by Denmark, Finland, Germany, Poland, Sweden and the USSR, 10 October 1990. Idem.

MEPC 30/14/7. *Fuel and lubricated oil quality.* Submitted by the United Kingdom, 11 October 1990. Idem.

MEPC 30/14/8. *Test bed and operational assessment of the marine exhaust contribution to atmospheric pollution.* Submitted by the United Kingdom, 10 October 1990. Idem.

MEPC 30/INF.17. *Prevention of air pollution from ships, including fuel oil quality*. Note by the Secretariat, 10 October 1990. Idem.

MEPC 30/WP.3. *Tentative plan of action for the reduction of SO_2 and NO_x emissions from ships*. Submitted by the Netherlands, 12 November 1990.

MEPC 30/WP.11. *Prevention of air pollution from ships, including fuel oil quality*. Report of the working group, 14 November 1990. Idem.

MEPC 31/13/2. *Basis year and discharge levels for ozone-depleting substances and exhaust gases*. Submitted by Norway, 30 April 1991. Marine Environment Protection Committee, 31st session, agenda item 13. London: International Maritime Organization.

MEPC 31/13/3. *Marine fuel quality*. Submitted by Germany, 10 May 1991. Marine Environment Protection Committee, 31st session, agenda item 13.

MEPC 31/13/4. *Future marine fuel oil standard*. Submitted by Sweden, 10 May 1991. Idem.

MEPC 32/12/1. *Contribution of ship emissions to overall sulphur burdens*. Submitted by the Oil Companies International Marine Forum (OCIMF), 16 January 1992. Marine Environment Protection Committee, 32nd session, agenda item 12. London: International Maritime Organization.

MEPC 32/12/2. *Residual Fuels: Quality, Demand Supply and Price*. Submitted by the International Association of Independent Tanker Owners (INTERTANKO), 17 January 1992. Idem.

MEPC 33/INF.17. *Prevention of air pollution from ships, including fuel oil quality.* Submitted by the United States, 31 July 1992. Marine Environment Protection Committee, 33rd session, agenda item 12. London: International Maritime Organization.

MEPC 34/3/1. *Global sulphur caps*. Submitted by the Oil Companies International Marine Forum (OCIMF), 9 April 1993. Marine Environment Protection Committee, 34th session, agenda item 3. London: International Maritime Organization.

MEPC 34/INF.12. *Research report on environmental discharges from ships and harbours along the coast of Finland*. Submitted by Finland, 13 April 1993. Idem

MEPC 34/INF.20. *Exhaust Gas Emissions from Sea Transportation*. Submitted by Sweden, 12 May 1993. Idem., agenda item 3.

MEPC 34/INF.21. *Evaluation attempt of exhaust gas emissions from maritime traffic in western Mediterranean Sea*. Submitted by France, 7 May 1993. Idem.

MEPC 34/INF.36. *The European environmental and refining implications of reducing the sulphur content of marine bunker fuels*. Submitted by OCIMF, 14 May 1993. Idem.

MEPC 36/9/6. *The findings of a research project into sulphur dioxide emission reduction scenarios*. Submitted by the UK, 5 August 1994. Marine Environment Protection Committee, 36th session, agenda item 9.1. London: International Maritime Organization.

MEPC 36/INF.5. *Economic Commission for Europe: Draft Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Further Reduction of Sulphur Emissions*. Note by the Secretariat, 5 August 2994. Idem.

MEPC 36/INF.16. *Marine exhaust emissions research programme*. Submitted by the UK and the Netherlands, 9 September 1994. Idem.

MEPC 37/13/3. *Measures for SO_x*. Submitted by the Bahamas, Liberia and Panama, 12 May 1995. Marine Environment Protection Committee, 37th session, agenda item 13. London: International Maritime Organization.

MEPC 37/13/4. *New Annex to MARPOL 73/78 on air pollution*. Submitted by OCIMF, 19 May 1995. Idem.

MEPC 37/13/5. *The relationship between distance from a ship and the rate of deposition from its downwind plume*. Submitted by OCIMF, 31 May 1995. Idem.

MEPC 37/13/6. *Reduction of NO_x in existing engines and global capping of sulphur*. Submitted by Norway, 8 June 1995. Idem.

MEPC 37/13/6/Add.1. *The North Sea as a special area*. Submitted by Norway, 29 June 1995. Idem.

MEPC 37/13/7. *Recognition of the Baltic Sea Area as a "Special Area" under the new Annex to MARPOL 73/78 on prevention of air pollution from ships.* Submitted by the Baltic Sea States, 8 June 1995. Idem.

MEPC 37/13/9. *Sulphur Capping.* Submitted by the UK, 15 June 1995. Idem.

MEPC 37/13/10. *Criteria and procedures for designation of special areas*. Submitted by the UK, 16 June 1995. Idem.

MEPC 37/13/11. *Draft new annex on air pollution*. Submitted by the Netherlands, 16 June 1995. Idem.

MEPC 37/13/14. *New Annex to MARPOL 73/78 on air pollution*. Submitted by ICS, 16 June 1995. Idem.

MEPC 37/13/17. *Fuel oil Quality*. Submitted by IAPH, 3 July 1995. Idem.

MEPC 37/13/21. *Sulphur Oxides (SOx) emissions/deposition*. Submitted by Austria, Bahrain, India, Mexico, Singapore, Salomon Islands, Vanuatu and Venezuela, 21 July 1995. Idem.

MEPC 37/13/26. *New Annex to MARPOL 73/78 on air pollution*. Submitted by Germany, 21 July 1995. Idem.

MEPC 37/INF.19. *The contribution from ship generated sulphur emissions to acidification in the North Sea countries*. Submitted by Norway, 12 July 1995. Idem.

MEPC 38/9/2. *Comments on the Draft Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto by the Executive Body to the Conventions on Long-range Transboundary Air Pollution (LRTAP).* Submitted by Norway, 2 April 1996. Marine Environment Protection Committee, 38th session, agenda item 9. London: International Maritime Organization.

MEPC 38/9/5. *Sulphur content in fuel oil*. Submitted by the Russian Federation, 4 April 1996. Idem.

MEPC 38/9/6. *An effective regime for sulphur emissions from ships*. Submitted by FOEI, 4 April 1996. Idem.

MEPC 38/9/7. *New Annex to MARPOL 73/78 on air pollution*. Submitted by the UK, 4 April 1996. Idem.

MECP 38/9/11. *Draft Protocol of 1997 to amend MARPOL 73/78: Regulation 15(1) - Sulphur Oxides (SOx) Global Capping of Sulphur*. Submitted by Antigua, Barbados, Bahrain, Bahamas, Barbuda, Brazil, Ecuador, Ethiopia, Hungary, Liberia, Maldives, Mexico, Peru, Romania, Singapore, Tunisia, Turkey, Vanuatu and Venezuela, 30 April 1996. Idem.

MEPC 38/9/13. *Application of the Precautionary Approach to Sulphur Content of Fuel Oil*. Submitted by WWF, 3 May 1996. Idem.

MEPC 38/WP.4. *Regulation 15: Sulphur Oxides (SO_x).* Submitted by an informal Drafting Group, 3 July 1996. Idem.

MEPC 38/WP.5. *Prevention of air pollution from ships*. Proposal from the Netherlands delegation, 3 July 1996. Idem.

MEPC 38/WP.11. *Regulation 15: Sulphur Oxides (SO_x).* Submitted by a Group of Experts, 5 July 1996. Idem.

MEPC 38/WP.12. *Appendix II (to Draft New Annex VI): Criteria and Procedures for Designation of SOx Emission Control Areas*. Submitted by a Group of Experts, 8 July 1996.

MEPC 39/6. *Draft Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto*. Submitted by the Secretariat, 26 July 1996. Marine Environment Protection Committee, 39th session, agenda item 6. London: International Maritime Organization.

MEPC 39/6/7. *Draft guidelines for monitoring of sulphur content of residual fuels*. Submitted by the Netherlands and the UK, 12 December 1996. Idem.

MEPC 39/6/9. *Global sulphur cap and SOx Emission Control Areas*. Submitted by Australia, Singapore and Vanuatu, 13 December 1996. Idem.

MEPC 39/6/17. *Global sulphur cap and SOx Emission Control Areas*: Draft new Annex VI to MARPOL 73/78. Submitted by the State of Bahrain, 7 January 1997. Idem.

MEPC 39/6/19. *Sulphur content in fuel oil*. Submitted by the Russian Federation, 8 January 1997. Idem.

MEPC 39/6/20. *SOx Emission Control Area in the North Sea*. Submitted by Denmark, 8 January 1997. Idem.

MEPC 39/6/21. *Annex VI to MARPOL 73/78, Regulation 14: Sulphur Oxides (SOx)*. Submitted by BIMCO, 10 January 1997. Idem.

MEPC 39/6/24. *Recognition of the Baltic Sea area as a SOx Emission Control Area under the new draft Annex VI to MARPOL 73/78 on prevention of air pollution from ships*. Submitted by the Baltic Sea States, 10 January 1997. Idem.

MEPC 58/INF.24. *Address of the Secretary-General at the Opening of the Fifty-Eighth Session of the Marine Environment Protection Committee (6 to 10 October 2008)*. Marine Environment Protection Committee, 58th session, 6 October 2008. London: International Maritime Organization.

BCH SESSION REPORTS

BCH 21/15. *Report to the Maritime Safety Committee and the Marine Environment Protection Committee*. Sub-Committee on Bulk Chemicals, 21st session, 3 October 1991. London: International Maritime Organization.

BCH 22/14. Idem, 22nd session, 24 September 1992.

BCH 23/14. Idem, 23rd session, 18 October 1993.

BCH 24/15. Idem, 24th session, 25 October 1994.

BCH SUBMISSIONS AND WORKING PAPERS

BCH 21/11/2. *Overview of present knowledge*. Submitted by Norway, 22 July 1991. Sub-Committee on Bulk Chemicals, 21st session, agenda item 11. London: International Maritime Organization.

BCH 21/11/4. *IACS comments on prevention of air pollution from ships*. Submitted by IACS, 8 August 1991. Idem.

BCH 21/11/5. *Communication from OECD/IEA*. Note by the Secretariat, 8 August 1991. Idem.

BCH 21/11/6. *SO_2 emission*. Submitted by Japan, 9 August 1991. Idem.

BCH 21/INF.28. *SO_2 emission*. Submitted by Japan, 9 August 1991. Idem.

BCH 22/7. *Air pollution from ships: SO_x and NO_x emissions from ships' machinery*. Submitted by the United Kingdom, 8 June 1992. Sub-Committee on Bulk Chemicals, 22nd session, agenda item 7. London: International Maritime Organization.

BCH 22/7/3. *Report of the correspondence group on air pollution from ships*. Submitted by Norway, 12 June 1992. Idem.

BCH 22/7/4. *Comments on the new annex for the prevention of air pollution from ships*. Submitted by Japan, 23 June 1992. Idem.

BCH 22/7/6. *Prevention of air pollution from ships including fuel oil quality*. Submitted by the International Chamber of Shipping (ICS), 17 July 1992. Idem.

BCH 22/7/7. *Prevention of air pollution from ships including fuel oil quality*. Submitted by Liberia, 17 July 1992. Idem.

BCH 22/7/8. *SO_2 emission*. Submitted by Japan, 17 July 1992. Idem.

BCH 22/7/9. *Comments on the draft annex to MARPOL 73/78 on Prevention of Air Pollution from Ships*. Submitted by Oil Companies International Marine Forum (OCIMF), 17 July 1992. Idem.

BCH 22/7/11. *Comments on data sources (EMEP) used for OCIMF submissions on NOx and SOx burdens*. Submitted by Oil Companies International Marine Forum (OCIMF), 17 July 1992. Idem.

BCH 22/7/12. *An assessment of the environmental contribution and cost implications of reducing emissions of sulphur dioxide from ships in Europe*. Submitted by Oil Companies International Marine Forum (OCIMF), 17 July 1992. Idem.

BCH 22/INF.7. *Desulphurization of bunker oil*. Submitted by the Netherlands, 7 July 1992. Idem.

BCH 22/INF.10. *Present state of SO_2 emission from ships*. Submitted by Japan, 17 July 1992. Idem.

BCH 22/INF.11. *State of supply of bunker oil*. Submitted by Japan, 17 July 1992. Idem.

BCH 22/INF.12. *Potential desulphurization level of bunker oil*. Submitted by Japan, 17 July 1992. Idem.

BCH 22/INF.13. *Methods for determining special areas concerning SO_2 emissions from ships*. Submitted by Japan, 17 July 1992. Idem.

BCH 22/INF.14. *Present state of air pollution*. Submitted by Japan, 17 July 1992. Idem.

BCH 22/INF.33. *Study on sulphur and SO_2 limits: Desulphurization of bunker oil*. Submitted by the Netherlands, 17 July 1992. Idem.

BCH 22/WP.4. *Report of the Working Group*. Sub-Committee on Bulk Chemicals, 22nd session, agenda item 7, 9 September 1992.

BCH 22/WP.4/Corr.1. *Report of the Working Group: Corrigenda to BCH 22/WP.4*. Idem, 10 September 1992.

BCH 23/7/1. *Marine exhaust emissions research programme*. Submitted by the Netherlands and the UK, 22 June 1993. Sub-Committee on Bulk Chemicals, 23rd session, agenda item 7. London: International Maritime Organization.

BCH 23/7/4. *A regional approach of air pollution from ships*. Submitted by the Netherlands, 22 June 1993. Idem.

BCH 23/7/5. *Comments on the work of the two intersessional correspondence groups*. Submitted by OCIMF, 22 June 1993. Idem.

BCH 23/7/6. *Proposed legislation concerning air pollution caused by ships*. Submitted by Saudi Arabia, 22 July 1993. Idem.

BCH 23/7/7. *Report of the intersessional meeting of the working group on air pollution*. Idem. 21 July 1993.

BCH 23/7/8. *Air pollution from ships including fuel oil quality.* Submitted by the US, 21 July 1993. Idem.

BCH 23/INF.18. *Emission and corresponding deposition of NO_x and SO_2 from international shipping*. Submitted by Norway, 23 July 1993. Idem.

BCH 23/WP.3. *Report of the Working Group*. Idem. 15 September 1993.

BCH 24/7/1. *Second report of the working group at BCH 23*. Sub-Committee on Bulk Chemicals, 24th session, agenda item 7, 21 March 1994. London: International Maritime Organization.

BCH 24/7/4. *Comments by the Baltic Sea States on the second draft of the BCH's Correspondence Group on Regional Control of SO_x and NO_x*. Submitted by the Baltic Sea States, 21 January 1994. Idem.

BCH 24/7/6. *Report of the intersessional meeting of the working group on air pollution*. Idem. 21 March 1994.

BCH 24/7/7. *Summary of submissions on economic considerations with regard to the introduction of requirements for sulphur oxide emission*. Note by the Secretariat, 3 June 1994.

BCH 24/7/8. *A global sulphur cap of 4.0% maximum for marine bunker fuels (BUNKER) (compromise position)*. Submitted by Spain, 20 June 1994. Idem.

BCH 24/7/9. *Procedures and criteria for designation of special areas: Report of the correspondence group on regional control*. Submitted by the US, 24 June 1994. Idem.

BCH 24/7/13. *Measures for SOx: CONCAWE study of the contribution of SO2 emissions from ships to overall deposition and air quality in the Channel Zone Area: A summary of the key results*. Submitted by OCIMF, 24 June 1994. Idem.

BCH 24/7/14. *Sulphur oxide emissions*. Submitted by Singapore, 7 July 1994. Idem.

BCH 24/WP.2. *Draft text for inclusion in the Sub-Committee's draft report on SOx global capping*. Submitted by the Secretariat, 20 September 1994. Idem.

BCH 24/WP.7. *Criteria for designation of special areas*. Report of the Drafting Group, 21 September 1994. Idem.

SUBMISSIONS AP/WG 2

AP/WG 2/3. *Report of the correspondence group on the regional approach*. Submitted by the US, 31 January 1994. BCH Working Group on Air Pollution, 2nd session, agenda item 3. London: International Maritime Organization.

AP/WG 2/3/1. *CONCAWE study on the impact of emissions of SO2 from ships in the English Channel/Southern North Sea*. Submitted by OCIMF, 7 February 1994. Idem.

AP/WG 2/3/2. *Historical data on sulphur content of marine fuel oil.* Submitted by OCIMF, 7 February 1994. Idem.

RESOLUTIONS, CIRCULARS AND OTHER IMO DOCUMENTS

Resolution A.500(XII). *Objectives of the Organization in the 1980s*. Adopted on 20 November 1981. Assembly 12th session, agenda item 21. London: International Maritime Organization.

Resolution A.719(17). *Prevention of Air Pollution from Ships*. Adopted on 6 November 1991, Assembly 17th session, agenda item 10. Idem.

Resolution A.777(18). *Work Methods and Organization of Work in Committees and the Subsidiary Bodies.* Adopted on 4 November 1993, Assembly 18th session, agenda item 27. Idem.

Resolution MEPC.176(58). *Amendments to the Annex of the Protocol of 1997 to Amend the International Convention for the Prevention of Pollution from Ships, 1973, As Modified By the Protocol of 1978 Relating Thereto (Revised MARPOL Annex VI).* Adopted on 10 October 2008, MEPC 58. Idem.

Resolution MEPC.184(59). *2009 Guidelines for Exhaust Gas Cleaning Systems*. Adopted on 17 July 2009, Marine Environment Protection Committee, 59th Session. Idem.

MSC-MEPC.1/Circ.2. *Guidelines on the Organization and Method of Work of the Maritime Safety Committee and the Marine Environment Protection Committee and Their Subsidiary Bodies*. IMO Secretariat, 27 May 2008. Idem.

THIRD CONFERENCE ON MARINE POLLUTION (MP/CONF.3)

MP/CONF.3/RD/1 – 8. *Records of decisions of the Plenary*. 15-26 September 1997. London: 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.3/2. *Provisional Rules of Procedure*. Agenda item 2, 21 March 1997. Idem.

MP/CONF.3/10. *Annex VI to MARPOL 73/78, Regulation 14 – Sulphur Oxides (SOx)*. Submitted by BIMCO, 20 June 1997. Agenda item 6. Idem.

MP/CONF.3/16. *Proposal to declare the North Sea as a SO_x Emission Control Area*. Submitted by the North Sea States, 1 July 1997. Idem.

MP/CONF.3/17. *Comments on Regulations 18, 14 and 17 of the draft new Annex VI to MARPOL 73/78*. Submitted by the International Chamber of Shipping, 21 July 1997. Idem.

MP/CONF.3/24. *Proposal to declare areas to the West of the United Kingdom as a SO_x Emission Control Area*. Submitted by the UK, 12 September 1997. Idem.

MP/CONF.3/29. *Recognition of the need to reduce sulphur deposition in the North West Europe*. Submitted by the North Sea States, 22 September 1997. Idem.

MP/CONF.3/29/Corr.1. Idem. 23 September, 1997.

MP/CONF.3/32. *A Proposal to achieve a Global Reduction of SOx Pollution Levels*. Submitted by Greece, 24 September 1997. Agenda item 6. Idem.

MP/CONF. 3/34. *Text of the Protocol of 1997 to amend the International Convention for the prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, as adopted by the Conference*. Agenda item 6, 28 October 1997. Idem.

MP/CONF.3/WP.4. *Report of Working Group 2*. Agenda item 6 and 7, 15 [*sic!*] September 1997. Idem.

OTHER INTERNATIONAL CONFERENCES/AGREEMENTS

Convention on the International Maritime Organization. Adopted 6 March 1948 in Geneva.

Declaration of the United Nations Conference on the Human Environment, 1972. 21st Plenary meeting, 16 June 1972, United Nations Conference on the Human Environment, Stockholm.

Declaration on the Protection of the Marine Environment of the Baltic Sea Area, 1988. Baltic Marine Environment Protection Commission (Helsinki Commission), 9th meeting, Helsinki, 15 February 1988.

1979 Geneva Convention on Long-Range Transboundary Air Pollution. Adopted 13 November 1979 in Geneva. United Nations Economic Commission for Europe.

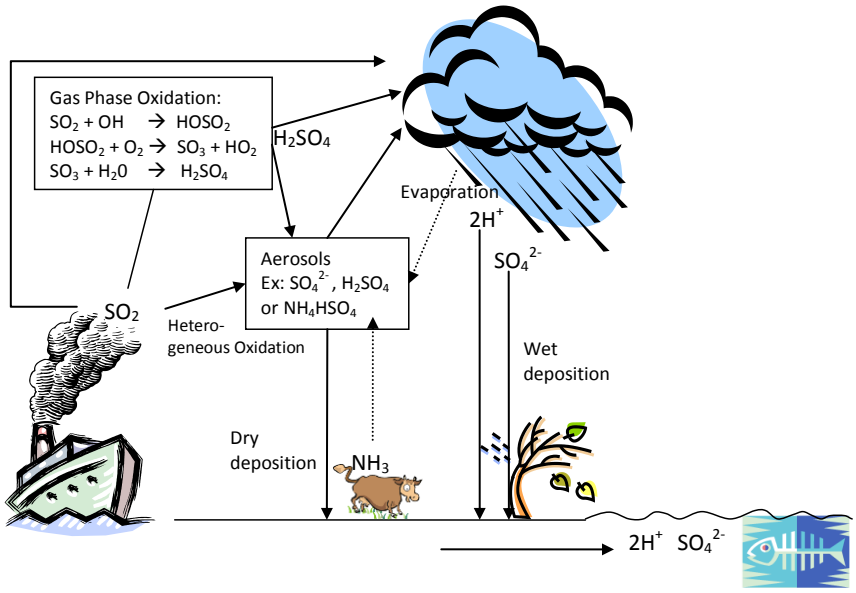
Rio Declaration on Environment and Development. Report of the United Nations Conference on Environment and Development, Rio De Janeiro, 3-14 June 1992, Annex I. United Nations General Assembly, 12 August 1992. Document: A/CONF.151/26 (Vol. I).

The London Declaration, 1987. Ministerial Declaration. Second International Conference on the Protection of the North Sea, London, 24-25 November 1987, agenda item 10.

Annex 1: Atmospheric Processes and Impacts of SO_x Emissions

SO_2 – Atmospheric Processes and Deposition

The atmospheric processes from SO_2 emissions to acidic deposition are illustrated below (Borell et al., 1997; Finlayson-Pitts and Pitts, 2000). In the atmosphere, SO_2 oxidizes in two different forms: gas phase oxidation and 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 into SO_3. SO_3 then reacts with water (H_2O) in the atmosphere and forms sulphuric acid (H_2SO_4). *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. The pH of water droplets has a strong influence on the reaction pathway and the oxidant that will be used. Ammonia (NH_3) emissions change the acidity of cloud droplets and 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). Acidic gases and 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* (Finlayson-Pitts and Pitts, 2000; Borell et al., 1997). 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).



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. Water is generally classified as acidic at a pH[116] level below 6.2. SO_2 is the primary air pollutant causing acidification in many areas. Other pollutants are nitrogen oxides (NO_x) and ammonia (NH_3). In water, sulphuric acid (H_2SO_4) from SO_2 emissions is dissolved into two hydrogen ions ($2H^+$) and one sulphate ion (SO_4^{2-}). It is the hydrogen ions that cause acidification, though sulphate is as significant in the acidification process (Smith et al., 2004; Mason, 2002; Borell et al., 1997; Finlayson-Pitts and Pitts, 2000; Elvingson and Ågren, 2004). Natural buffering

[116] pH is a measure of the acidity of a solution measured as the concentration of hydrogen ions. A neutral solution has pH 7. A lower pH value means a surplus of hydrogen ions, i.e. 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).

reactions neutralize acidic inputs in both soils and lakes. In soils, there are several different buffer systems with complex processes, of which chemical weathering of minerals is the most important in the long term. Soils with large quantities of easily weathered minerals can receive large quantities of acidic deposition without acidification, while 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 (HCO^{3-}), which originates from the surrounding soils (Warfvinge and Bertills, 2000; Mason, 2002; Elvingson and Ågren, 2004).[117]

Effects of Acidification

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 (ibid.). There is strong evidence of big impacts on biological diversity in aquatic environments (Pleijel et al., 2001). 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 from 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). The effects on biological diversity of acidic deposition are better known in freshwater ecosystems and are likely to be more severe than for terrestrial ecosystems. 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 (Pleijel et al., 2001; Elvingson and Ågren, 2004).

Particles and SO_x Emissions

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.). *Primary particles* are 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

[117] Note that natural acidification has taken place since the last ice age by a slowly declining weathering rate of soil minerals. Moreover, CO_2 from decomposed humic substances in brown water lakes reacts with water and forms acidifying carbonic acid (H_2CO_3) (Warfvinge and Bertills, 2000; Elvingson and Ågren, 2004).

temperature and humidity of the gas. 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 (Winnes, 2010; Finlayson-Pitts and Pitts, 2000; Lighty et al., 2000). 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.

Particles: 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 the health effects at low concentrations of ambient particulate matter. Similar results were reported in studies from Germany, Canada, Finland and the Czech Republic. According to Pope and Dockery (2006), these studies provided "a critical mass of evidence" of the 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 interests 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 is shown in a large number of studies, studies on long-term exposures are fewer (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. Standard terms for different particle sizes are shown below (Lighty et al., 2000).

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	nanometre-sized particles formed by gas-to-particle conversion

Particles originating from natural sources, such as mechanical erosion, are generally in the upper size range. Large particles that are inhaled 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 there is no protective mucus layer (Finlayson-Pitts and Pitts, 2000). Ultrafine particles dominate urban aerosols by number. These can be deposited in deeper parts of the lung, as well as penetrate further into the body. The finest particles (nuclei or nanoparticles) are secondary particles formed by gas-to-particle conversions (Lighty et al., 2000). Air quality standards for PM 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).

Annex 2: Purpose and Functions of the IMO from its Convention

The following excerpts the primary purpose and functions of the IMO from the 1948 Convention on the International Maritime Organization, as amended in 1977.

Primary purpose of the IMO as defined in Article 1(a)

"To provide machinery for co-operation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning the maritime safety, efficiency of navigation and prevention and control of marine pollution from ships; and to deal with administrative and legal matters related to the purposes set out in this Article."

Primary functions of the IMO as defined in Article 2

a) … "consider and make recommendations upon matters arising" within the scope of the IMO

b) "Provide for the drafting of conventions, agreements, or other suitable instruments, and recommend these to Governments and to intergovernmental organizations, and convene such conferences as may be necessary"

c) "Provide machinery for consultation among Members and the exchange of information among Governments"

Annex 3. Presented Monetary Costs and Benefits 1990-1997

Session (Year)	Actor(s)	Oil industry costs	Bunker price increase	Abatement costs	Social costs without regulation	Benefits
BCH 21 (1990)	Kuwait	From 4% to 3%, 2%, 1% 10.6, 15.6 and 19.5 USD / tonne respectively	11, 16 and 20 USD / tonne	-	-	-
MEPC 31 (1991)	France	Identical to figures by Kuwait		-	-	-
BCH 21 (1991)	Japan	1%: 60 USD / tonne[118] 2%: 30 USD / tonne[119]	50% bunker price increase	-	-	-
BCH 21 (1991)	The Netherlands	Identical to figures by Kuwait or by Japan		-	-	5 USD / tonne
BCH 22 (1992)	OCIMF / CONCAWE	1.5% (30% of European demand): 5.6-8.2 billion USD 1% in Europe: 2.1-3.5 billion USD	1.5% regional: 53-76 USD / tonne 1% in Europe: 67-95 USD / tonne	-	-	-
BCH 22 (1992)	The Netherlands	1-0.5%:20-83 USD / tonne		-	-	5 USD / tonne
MEPC 34 (1993)	OCIMF / IPIECA	Global cap 3.5% global investment costs: 1.4-2 billion USD annual cost increase: 470-650 million USD	14 USD / tonne	12,000 USD / reduced tonne of sulphur deposited on land	-	-

[118] Original: ton
[119] Idem.

Session (Year)	Actor(s)	Oil industry costs	Bunker price increase	Abatement costs	Social costs without regulation	Benefits
MEPC 34 (1993)	OCIMF / CONCAWE (1993) (*revised and new figures in italics*)	1.5% for 30% of European demand 5.6-8.2 billion USD 1% in Europe 2.1-3.5 billion USD *2% in Europe* *4.2-6.4 billion USD*	*1.5%:* *46-68 USD / tonne* *1%:* *58-85 USD / tonne* *2%:* *35-52 USD / tonne*	-	-	From 3.5% to 1.5%: 1-2 + 1-1.5 USD / tonne
BCH 23 (1993)	FOEI	-	-	-	(30.4 billion USD / year from forest damage in Europe)[120]	-
BCH 24 (1994)	Singapore	-	From 4.5% to 3.5%: increase by 35%	-	-	-
BCH 24 (1994)	OCIMF (in Secretariat paper)	Global cap 1.5%: 20 billion USD 3.5%: 1.4-2.0 billion USD 5.0%: 0 USD Regional (North-western Europe) 1.5%: 5.6-8.2 billion USD 2.0%: 4.2-6.4 billion USD	-	-	-	-

[120] From all sources

Session (Year)	Actor(s)	Oil industry costs	Bunker price increase	Abatement costs	Social costs without regulation	Benefits
MEPC 37 (1995)	Singapore allies - Singapore study above	-	From 4.5% to 4.0% 6 USD 4.5% to 3.5% 28 USD 5% to 4.5% 15 USD 5% to 4.0% 15-30 USD 5% to 3.5% 25-50 USD	-	-	-
MEPC 37 (1995)	BSS	-	Ferries with 0.5% S fuel 15 USD / tonne	Ferries with 0.5% S fuel 0-20 SEK / kg S	[121] (Annual cost of liming in Sweden: 25 million USD) (Estimated annual costs of measures in Sweden: billions of SEK) (Annual corrosion damage in Sweden: 700 million SEK)	-
MP/ CONF.3 (1997)	NSS	1.5% in the North Sea and the Baltic Sea Areas 75 million of annual costs	-	-	-	[122] (8 billion USD in savings of the second sulphur protocol of LRTAP - decreased damage to buildings)

[121] Idem.
[122] Land-based sources