REGULATING VESSEL-SOURCE AIR POLLUTION

STANDARD-SETTING IN THE REGULATION OF SO_x EMISSIONS

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ABSTRACT

Emissions of sulphur oxides (SO_x) cause considerable global environmental and human health impacts including acidification, climate change, and increased premature deaths in human populations due to serious heart and lung diseases. Although recently revised regulations in MARPOL 73/78 Annex VI are expected to decrease SO_x emissions from ships, it is clear that these regulations will need further development. Even forthcoming requirements for SO_x emissions from marine sources will still be considerably less strict in 2020 than the requirements for SO_x emissions from terrestrial emission sources in force today. Without further regulatory developments, emissions of harmful SO_x emissions from ships will persist, and will also indirectly hinder the efficient operation of available exhaust aftertreatment devices for other air emissions from ships.

This thesis examines the regulation of SO_x emissions from ships with a focus on the dominant type of regulation: 'command and control' (CAC) regulation. The purpose is to identify and examine historical and current differences between standard-setting in the regulation of SO_x emissions from terrestrial sources, and the regulation of SO_x emissions from marine sources. Standard-setting differences are considered across three regulatory scales (international, regional, national), with a theoretical and methodological foundation mainly in international environmental law and regulatory studies, and with the further aims of identifying the underlying rationales for the key differences in standard-setting, the regulatory effects of these differences, and the possibilities of improvement of SO_x emissions regulation in the marine setting. Five categories of environmental standard-setting are examined: (a) product standards; (b) process standards; (c) emission standards; (d) environmental quality standards; and (e) other standards.

In conclusion, this thesis argues that standard-setting in the regulation of terrestrial and marine SO_x emission sources differs on all regulatory scales, both historically and presently. A key difference in standard-setting is that the control of SO_x emissions from terrestrial sources has relied on combinations of standard-setting approaches, whereas marine emission sources have primarily been controlled with product standards. Arguably, the emission to be controlled has been a crucial decisive factor for the choice of standard-setting type. Other decisive factors were *inter alia* technical, economic, and institutional. The regulatory effects of the key differences are that experiences were gained in the terrestrial regulatory setting from using various forms of regulatory standards compared to the marine setting. The possibilities of improvement of SO_x emissions regulation in the marine setting depend on perspectives and priorities. If the ambition is to refine the precision of standard-setting in SO_x emissions regulation, there are improvement possibilities.

Three broader implications of this study's results are highlighted: regulatory studies can provide deeper understandings of the design of regulation; the analysis of standard-setting against a surrounding explanatory context can demonstrate the influence on standard choice of factors such as emission type, technology, and science; and regulatory studies can be used to analyse large quantities of multiscale regulatory material, which can yield better overviews of a regulatory landscape.

Keywords: ships, air pollution, SO_x emissions, regulation, regulatory design, command and control, standard-setting, international environmental law, regulatory studies

ACKNOWLEDGEMENTS

It all started in a state of confusion, anxiety, and curiosity. I had recently received my LL.M. degree at the School of Business, Economics and Law in Gothenburg, and I was trying to figure out what to do next. Acting upon a vague and unconfirmed feeling that I would probably never really enjoy working as a 'traditional lawyer', I instead decided to try my luck in academia. After all, I thought, I had actually quite enjoyed reading even the most notoriously demanding books during my law studies, and I had always liked the feeling of digging into sources to look for 'forgotten gems of knowledge'. It had also dawned on me that I enjoyed writing and working with text.

It is after a lot of reading, digging, and writing, that I now write these lines. Although many years have passed, I can still recall the beginning of this project as if it was yesterday. I had received a grant, and had been given a desk at the department of law to work on a proposal for my doctoral thesis. I shared a room with two doctoral students in their final phase of writing. It seemed to me that they were both in some kind of exhausted condition. Despite brave attempts to convince me *not to* embark on the mad quest of trying to finish a doctoral thesis, I persisted, and as I see it nowadays; somehow miraculously made it to the end.

A fact well-known to anyone who has attempted to complete a doctoral thesis is that the process involves a lot of solitary work. Yet, progress is at the same time very dependent on the presence of others. Of those 'others' who have been indispensable for the completion of this thesis, I would first like to thank my earlier main supervisor, former professor of maritime and transport law, and current supreme court justice of Sweden, Svante O. Johansson. In you I found not only an academic role model, but also a skilled mediator, a communicator of precious silent knowledge, and a good friend. Thank you Svante, for believing in this project from the beginning.

Late 2012, a new captain appeared on deck. Taking over as my main supervisor, professor Lars-Göran Malmberg started giving directions in a broad and familiar dialect. Thank you for helping me navigate this project into a safe harbour. To my co-supervisor, professor Lena Gipperth, I am equally grateful. Thank you for stimulating discussions, original comments and support during this project. In the final phases of writing, I had the pleasure of getting acquainted with and receiving additional co-supervision from professor Rosemary Rayfuse. Thank you for your clear-sighted and challenging guidance, which helped me further refine my ideas and improve the overall structure of this thesis. I would also especially like to acknowledge the readers at my final seminar, professor David Langlet and doctor Joachim Åhman for insightful comments and useful recommendations for how to proceed with an earlier version of this thesis.

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In another harbour in the North, I found a home away from home in 2011 when I started as a guest researcher at the Scandinavian Institute

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[1] Brunčević, Linné (2013).

of Maritime Law, Oslo, Norway. The atmosphere I experienced at the institute always left me inspired when I needed it the most. For the institute's hospitality and professionalism I would like to extend my sincere gratitude. Some individuals particularly helped create the hospitable and professional atmosphere at the institute. Here, I would especially like to extend my gratitude to the head of office, Kari Marie Pound Davies. Thank you for making everything practical surrounding my recurring research visits pass very smoothly indeed. I would also like to acknowledge former head librarian of the institute, Kirsten Al-Araki, for tediously assisting me in my search for relevant literature. Finally, I would like to express my deep gratitude to my colleague and friend professor Erik Røsæg. Without your steady encouragement and guidance from a distance as I passed through the thickest of mental fogs, I would probably have ended up shipwrecked.

As a doctoral student associated with the interdisciplinary research environment of the maritime knowledge centre Lighthouse, I got to interact with many sharp minds during the making of this book. In this setting, some individuals deserve a special mention. First, I would like to express my deep gratitude to professor emeritus Thomas Polesie, School of Business, Economics and Law. As a true visionary, you foresaw the potential of the Lighthouse research environment early on. I benefitted immensely from your vision as I crossed the river to Lindholmen, where I ended up in a group of hardworking and inspiring researchers in the maritime environment field. Thank you Thomas, for all encouragement and your one thousand and one illustrative metaphors.

While mentioning Lighthouse and Lindholmen, there are many people that made my interaction with other sciences both pleasurable and graspable. Here, I would especially like to mention professor Karin Andersson, associate professor Lena Granhag, adjunct professor Erik Fridell, doctor Kent Salo, doctor Selma Brynolf, doctor J. Fredrik Lindgren, doctor Maria Zetterdahl, doctor Hanna Landquist, doctor Martin Eriksson, Ph.D. student Magda Wilewska-Bien and Andreas Hanning. Thank you very much for letting me into your research environment and for sharing your knowledge. I would also particularly like to acknowledge doctor Erik Svensson for continuous sulphur and whatever discussions, doctor Francesco Baldi, (pineapple) pizza expert extraordinaire, and doctor Hannes von Knorring, my friend of the friends of the Chairman. Lastly, I would like to express my heartfelt thanks and deep admiration for doctor Mathias Magnusson. Your energy, humour and strong support has saved me countless number of times over the years. Thank you for everything.

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If there is one lesson that I would like to pass on to future generations of doctoral students, it is to hold on to those other things in life, apart from thesis writing(!), that create value and self-appreciation. In times of doubt, and when everything strangely seems to boil down to just finishing the doctoral thesis, it is useful to remember that there are so many other joys in life than writing. Thank you very much Gustav Sonne, Henrik Hedelin, Malin Edvardsson, Johan Sjöström, Karl Molin, Gabriel Jonsson, Pedram Modirassari, Maria Ekstam, Jovanna Eriksson Radic, Davor Radic, Samih Almudafar, Magnus Delin, Amanda Björk, Svante Eriksson, Hugo Jernmark, Tomas Friman, André Weich, Johan Langvad, Teresia Langvad, Christian Lantz, and many others for reminding me that there was a vibrant and interesting life outside doctoral studies as well.

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[2] Buckingham (2011).

Finally, where would I be without my wise, funny and beautiful wife Elin Almestrand Linné? Somehow I managed to distract you enough so that you did not notice that I was a doctoral student on the brink of insanity when we first met. Thank you Elin, for putting up with my sometimes errant and bizarre behaviour, late night writing sessions, and fatigue. And thank you for all your encouragement and soul-soothing words. I am so fortunate to have shared some of my recent years with you, and I look forward to many more by your side.

Philip Almestrand Linné

Gothenburg,1 April 2017

’How did I die?
How did I die?
Did I die by my own hand?
or didn’t I?
How did I die?
Or didn’t I die at all?
How did we die?
or didn’t we?
didn’t we die at all?
We didn't die
We didn’t die
We are back with a different song
We didn’t die
We didn’t die
We’re just singing a different song
we are back with a change of weather
ein anderer Wind, ein neues Lied’[3]

[3] Bargeld (2014).

ABBREVIATIONS AND ACRONYMS

AIS	Automatic Identification Systems
Art.	Article
CAC	Command and control
BAT	Best Available Technology
BSAP	HELCOM Baltic Sea Action Plan
CAFE Programme	The Clean Air For Europe Programme
CIAM	Centre for Integrated Assessment Modelling
CN codes	Combined Nomenclature codes
CO	Carbon monoxide
CO_2	Carbon dioxide
Dir.	Directive (European Economic Community/European Community/ European Union)
EAP	Environmental Action Programme
EC	European Community
ECA	Emission Control Area
ECJ	European Court of Justice
EEC	European Economic Community
EEDI	Energy Efficiency Design Index
ELV	Emission Limit Value

EMEP	Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
EU	European Union
First Sulphur Protocol	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at Least 30 per cent, 1985
FOEI	Friends of the Earth International
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies
GAIRS	Generally accepted international rules and standards
GHG	Greenhouse gas
GMO	Genetically modified organism
Gothenburg Protocol	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-Level Ozone 1999
HELCOM	Helsinki Commission
HFO	Heavy fuel oil
IAM	Integrated Assessment Modelling
IAPP Certificate	International Air Pollution Prevention Certificate
ICJ	International Court of Justice
IED	Industrial Emissions Directive (Directive 2010/75/EU)

IFO	Intermediate fuel oil
IIASA	International Institute for Applied Systems Analysis
IMCO	Inter-Governmental Maritime Consultative Organization
IMO	The International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IPPC Directive	Integrated Pollution and Prevention Directive (Directive 96/61/EC)
ITLOS	International Tribunal for the Law of the Sea
LCP Directive	Large Combustion Plants Directive (Directive 2001/80/EC)
LNG	Liquefied natural gas
LOSC	1982 United Nations Convention on the Law of the Sea
LRTAP Convention	1979 Convention on Long-range Transboundary Air Pollution
m/m	meter per meter
mg/kg	milligram per kilogram
MARPOL 73	International Convention for the Prevention of Pollution from Ships, 1973
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973 *and* Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships

MARPOL 73/78 1997 Protocol	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
MARPOL 73/78 Annex VI	Addition of Annex VI to Amend the 1997 International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto
MCP	Medium Combustion Plant
MD	Marine distillate fuels
MDO	Marine diesel oil
MEPC	Marine Environment Protection Committee
MGO	Marine gas oil
MSC	The Maritime Safety Committee
MSFD	Marine Strategy Framework Directive (Dir. 2008/56/EC)
NEC Directive	Directive 2001/81/EC
NEPC	The Nordic Environmental Protection Convention 1974
NGO	Non-governmental organization
NH_3	Ammonia
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
N_2O	Nitrous oxide
O	Oxygen
O_3	Ozone

OECD	Organisation for Economic Co-operation and Development
OILPOL 1954	International Convention for the Prevention of Pollution of the Sea by Oil 1954
OPA-90	Oil Pollution Act of 1990
OSPAR Commission	Oslo and Paris Commission
Para.	Paragraph
PM	Particulate matter
ppm	parts per million
Prop.	Proposition (Swedish Government bill)
RAINS	Regional air pollution information and simulation
Reg.	Regulation
Res.	Resolution
Revised MARPOL 73/78 Annex VI 2008	Res. 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)
Revised Gothenburg Protocol 2012	The 2012 Protocol to the 1979 Convention on Long-range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-Level Ozone

RNE Directive	Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants
S	Sulphur
SECA	Sulphur emission control area
Second Sulphur Protocol	Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Further Reduction of Sulphur Emissions 1994
SEEMP	Ship Energy Efficiency Management Plan
SO_2	Sulphur dioxide
SO_3	Sulphur trioxide
SO_x	Sulphur oxides
SOU	Statens offentliga utredningar - Governmental Commission Report (preparatory works)
Statute of the ICJ	Statute of the International Court of Justice 1945, Annexed to the 1945 Charter of the United Nations
TFIAM	Task Force on Integrated Assessment Modelling
UN	United Nations
UNEP	United Nations Environment Programme
VCLT	Vienna Convention on the Law of Treaties 1969
VOC	Volatile organic compound

1st EAP (1973)	Declaration of the Council of the European Communities and of the representatives of the Governments of the Member States meeting in the Council of 22 November 1973 on the programme of action of the European Communities on the environment
2nd EAP (1977)	Resolution of the Council of the European Communities and of the Representatives of the Governments of the Member States meeting within the Council of 17 May 1977 on the continuation and implementation of a European Community policy and action programme on the environment
3rd EAP (1982)	Resolution of the Council of the European Communities and of the representatives of the Governments of the Member States, meeting within the Council, of 7 February 1983 on the continuation and implementation of a European Community policy and action programme on the environment (1982 to 1986)

4th EAP (1987)	Resolution of the Council of the European Communities and of the representatives of the Governments of the Member States, meeting within the Council of 19 October 1987 on the continuation and implementation of a European Community policy and action programme on the environment (1987-1992)
5th EAP (1993)	Resolution of the Council and the Representatives of the Governments of the Member States, meeting within the Council of 1 February 1993 on a Community programme of policy and action in relation to the environment and sustainable development - A European Community programme of policy and action in relation to the environment and sustainable development
6th EAP (2002)	Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July 2002 laying down the Sixth Community Environment Action Programme
7th EAP (2013)	Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet'

1992 Helsinki Convention	Convention on the Protection of the Marine Environment of the Baltic Sea Area 1992

OUTLINE CONTENTS

DETAILED CONTENTS

PART I – GAMBIT[4]

[4] gambit, noun. ‘**1** a chess opening in which a player sacrifices a piece or pawn to secure an advantage. **2** an opening move in a discussion etc.’ Fowler *et al.* (1990) p. 483.

‘Sulfur is the lead of the 21st century.
The biggest challenge going forward
is that unlike lead, which is an additive,
it occurs naturally in fuel.’[5]

1 Introduction

This chapter briefly introduces the regulation of emissions of sulphur oxides (SO_x)[6] from ships, and explains the background and purpose of this study. It does so by approaching the area of SO_x emissions control from the general context of air pollution, including the perspective of terrestrial air pollution control. With a point of departure in the origins and effects of SO_x emissions, and their historical and present regulation in the terrestrial and marine settings, a central aspect of regulation is highlighted: standard-setting as a component of regulatory design. The main argument in this chapter is that the examination of standard-setting in the regulation of SO_x emissions from terrestrial sources, where regulatory experience is relatively extensive, can provide useful input for the regulation of the same emissions in the marine setting, among other things for potentially improving the control of SO_x emissions from ships.

As a matter or structure, the current chapter first examines shipping and the regulation of SO_x emissions in a wider context. Thereafter, the purpose of the study and its research questions are presented. Furthermore, the statement of applicable scope and delimitations

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[5] ICCT (2011) p. 4.
[6] In general, the abbreviation SO_x is used both for sulphur oxides in the form of sulphur dioxide (SO_2) and sulphur trioxide (SO_3). However, for the most part, sulphur oxides are emitted in the form of SO_2, Finlayson-Pitts, Pitts (2000) p. 20. This is also true for *SO_x emissions from marine sources*, MAN B&W Diesel (1996) p. 4 and Winnes (2010) p. 22. Hereinafter, the abbreviation SO_x is used in most cases where SO_2 is discussed, unless it is specifically motivated not to do so.

follows. Finally, this chapter comments on previous research, contribution of the present study, target audience, and finishes with an outline of the coming chapters.

1.1 Shipping and the Regulation of SO_x Emissions in a Wider Context

It is often said that maritime transport forms the backbone of international trade. This image is no exaggeration. Shipping is estimated to be responsible for carrying over 80% by volume of total world merchandise trade,[7] which truly makes it a major sustaining factor for international trade. When compared with other available modes of transport, shipping has several advantages. It is generally both fuel- and cost-efficient,[8] and potentially a relatively clean and environmentally friendly mode of transport for the future.[9] Despite its benefits, however, shipping also has some drawbacks. Among these are the considerable environmental and human health impacts caused by SO_x emissions from the exhausts of seagoing ships.

In general, SO_x emissions both from marine and terrestrial sources are a result of combustion of compounds and fuels containing sulphur. During the combustion process, the sulphur (S) reacts with the atmospheric oxygen (O) and forms SO_x. Combustion occurs naturally on Earth, for example in volcanoes and in forest fires. However, *anthropogenic combustion*, on which this study focuses, results from various human activities that are central to the modern industrial world such as generation of electricity, heating, industrial production and, importantly, transportation.[10] In this context, the main anthropogenic source of SO_x emissions is the sulphur content in fossil fuels that is released during combustion.[11]

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[7] UNCTAD (2016) p. 6.

[8] *I.e.* shipping generally requires less energy to move an amount of cargo over an amount of distance compared to other modes of transport, Buhaug *et al.* (2009) p. 2.

[9] *E.g.* European Council Doc 10117/06 (2006) pp. 10-11 and World Maritime Day (2007) pp. 3-5.

[10] Hansson (2007) pp. 65-66 and Bodansky (2010) p. 60.

[11] Vestreng *et al.* (2007) p. 3664.

The large ships involved in international maritime transport are powered by massive diesel engines. These engines predominantly run on less expensive heavy fuel oil (HFO). Although alternative fuels, such as liquefied natural gas (LNG) are emerging, the proportion of the global fleet using such fuels is still limited.[12] In any event, when seen in a longer-term perspective, the use of yet another fossil fuel is arguably merely a bridging technology towards the objective of 'a widely decarbonised transport sector in 2050'.[13] Given the still atypical use of alternative fuels, the focus here remains on those most commonly used, in particular, HFO.[14]

The main component of HFO used for ocean-going vessels is residual oil, which is a by-product of the crude distillation process. In colloquial terms, this part of the refinery production is taken from 'the bottom of the barrel'.[15] Thus, HFO is known as a *residual fuel* with a high sulphur content. HFO typically has a sulphur content of <4.5% according to ISO classification, although it can also have a much lower sulphur content.[16] Residual fuels as a category are separated from the more expensive refined and lighter lower sulphur content fuels known as marine distillate (MD) fuels, which can be subdivided into marine diesel oil (MDO) and marine gas oil (MGO). According to ISO classification, these typically have sulphur contents of <2.0%

[12] A recent estimation projects around 95 operational LNG-powered ships of the total global fleet for 2018, World Ports Climate Initiative (2016).
[13] NABU (2016) p. 3.
[14] See also further comments regarding scope and delimitations *infra* Section 1.3.
[15] ICCT (2007) p. 18 and Eyring *et al* (2010) p. 4736. BLG 12/6/1 pp. 13 and 42. As to the inexpensiveness of HFO, its price remained below the price for crude oil in 2007, BLG 12/6/1/ p. 12. A recent estimation (2016) of the worldwide average sulphur content of residual fuels used on board provided that the concentration was 2.45%, MEPC 69/5/7.
[16] Low sulphur HFO can have a sulphur content of about 1%, depending on the sulphur content in the crude oil and the refinery steams used, Bengtsson *et al.* (2011) p. 98. Sometimes also mentioned among residual fuels are the so-called intermediate fuel oils (IFOs), which consist of HFO partly blended with lighter refined fuels to achieve a lower sulphur content, Baldi (2016) p. 8. For a summary of typical physico-chemical properties of marine fuels, including sulphur content levels in fuels, see Winnes (2010) p. 21.

(MDO) and <1.5% (MGO). Indeed, marine distillates often have even lower sulphur contents, down to as little as <0.5%.[17]

Because the composition of SO_x emissions is directly connected to the quality of the fuel combusted, and particularly the sulphur content,[18] a heavy fuel composed mainly of residual oil with a high sulphur content accordingly produces 'dirty' emissions.[19] With regard to ships, three main factors have contributed to high levels of SO_x emissions, both in a relative and an absolute sense. First, the extensive worldwide use of HFOs by the international fleet has, until recently, only been minimally restricted by regulation.[20] Second, a significant decline of SO_x emissions from *terrestrial sources* since the 1990s resulting from stricter regulation and better abatement technology, has caused shipping's proportion of overall SO_x emissions to grow.[21] Finally, the continuous growth of seaborne trade has given rise to increased SO_x emissions from ships.[22] According to a study from 2015, prepared under the auspices of the International Maritime Organization (IMO), international shipping was estimated to be responsible for 10.6 million tonnes of SO_x (as SO_2) entering the atmosphere annually, calculated over the period of 2007-2012.[23] The same study also estimated that global SO_x emissions from all shipping represented about 13% of global SO_x emissions from anthropogenic sources, and that SO_x emissions from international shipping represented approximately 12% of global total SO_x emissions.[24]

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[17] Winnes (2010) p. 21.

[18] ICCT (2007) p. 18. Another important factor that influences emission composition is the combustion characteristics of typical marine engines, Winnes (2010) p. 8.

[19] AirClim *et al.* (2011) p. 6.

[20] Eyring *et al.* (2010) p. 4736 and Smith *et al.* (2011).

[21] Smith *et al.* (2011) p. 1108. As an example, SO_x emissions have decreased by roughly 70% from land-based sources in Europe since 1990, Adams *et al.* (2009) p. 28.

[22] Eyring *et al.* (2010). Although the growth in world seaborne trade volumes was notably slower in 2015 than the historical average, world seaborne imports increased with some 4,7% annually between 1950-2005, UNCTAD (2016) p. 16 and Stopford (2009) p. 38. See also UNCTAD (2005) p. 5, showing the steady growth of international seaborne trade between 1970-2004.

[23] Smith *et al.* (2015) p. 2.

[24] Smith *et al.* (2015) p. 2.

In terms of environmental and human health impacts, the impacts of SO_x emissions from *terrestrial sources* have been well documented, leading to an increasing and increasingly successful regulation in the terrestrial setting, particularly in Europe and North America.[25] Initial concerns were sparked by the accumulating evidence of environmental impacts of SO_x emissions in the mid-1960s and forward.[26] More specifically, SO_x emissions were discovered to be the cause of 'acid rain', the colloquial term used to describe the acidification of soils and freshwater ecosystems as an effect mainly of sulphur deposition via air.[27] In recent years, the traditional focus on the environmental effects of acidification has shifted to a focus more on climate and human health impacts when SO_x emissions are deposited as fine particles ('particulate matter', or PM), via air currents.[28]

As regards climate change, the impacts of SO_x emissions are both direct and indirect, including possible heating and cooling effects from changes to incoming and outgoing radiation to Earth, and changes to cloud properties.[29] Additionally, the Intergovernmental Panel on Climate Change (IPCC) has confirmed that SO_x emissions interact with processes contributing to the so-called other climate

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[25] Vestreng *et al.* (2007) p. 3664 and Maas, Grennfelt (2016) pp. iv-v. As has been stated, in the case of Sweden 'the most successful efforts to reduce [air] emissions have been with sulphur, nearly 90% between 1980 and 2000. The decrease in other countries is of the same magnitude, even if the large decrease was earlier in Sweden. Considerable decrease of SO_2 occurred already in the 1970s' Lövblad *et al.* (2004) p. 211. See also p. 212 same source for a visual presentation of historical air emission decreases in Sweden. For a more detailed account of the history of air pollution control from a Nordic and European perspective, see further *infra* Chapter 3.
[26] Lundgren (1998) pp. 74-82 and Pleijel, Grennfelt (2007a) p. 32 and 34.
[27] Vestreng *et al.* (2007) pp. 3663-3664. In the following, references will be made both to 'acid rain' and 'acid deposition' of which the former is the broader term. This because acid deposition occurs both as wet and dry deposition. 'Wet deposition' is when an acid, for example sulphuric acid formed when SO_2 is oxidized in air, is transported to and deposited on surfaces such as soil, trees and buildings *after it* has been dissolved in an aqueous medium like rain, clouds or fog. 'Dry deposition' refers to the direct transport of acidic gases or small particles to a surface where it sticks, however not dissolved in an aqueous medium, Finlayson-Pitts, Pitts (2000) p. 294.
[28] Vestreng *et al.* (2007) p. 3664.
[29] Haywood, Boucher (2000) pp. 513-514

problem: ocean acidification. Ocean acidification, which is another kind of acidification than the 'traditional' one,[30] refers to chemical changes to the pH balance in the oceans mainly as a result of the uptake of atmospheric carbon dioxide (CO_2), but can simultaneously be worsened by air pollutants like SO_x emissions. The effects of ocean acidification are among others a lessening of the oceans' capacity to absorb CO_2 and thus to moderate climate, as well as significant threats to organisms and ecosystems including biodiversity loss.[31]

The health impacts from exposure to SO_x emissions, including PM, are increased numbers of premature deaths resulting from serious heart and lung diseases, and worsened health conditions from air pollution related illnesses in populations.[32] Apart from projected increases in premature deaths, the healthcare costs and lost working days due to air pollution related illnesses result in substantial economic costs for society.[33] Yet other impacts of SO_x emissions, such as material damage to cultural objects and buildings through corrosion, could be deemed as a damage that is both aesthetic and economic in nature.[34]

The impacts mentioned above have not solely been documented as effects of SO_x emissions from terrestrial sources. Today, it is also well documented that SO_x emissions from ships contribute to acidification,[35] climate change and adverse health impacts.[36] In the

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[30] *I.e.* the acidification of soils and freshwater ecosystems as an effect mainly of sulphur deposition via air.
[31] IPCC (2014) pp. 74 and 372.
[32] This is what is also often referred to as increased *mortality* and *morbidity* in populations due to air pollution, WHO (2016) p. 17 and 19 and WHO (2006) pp. 18-19.
[33] According to projections by the Organization for Economic Co-operation and Development (OECD), in 2060 as much as 9 million premature deaths and costs up to USD 176 billion annually from air pollution-related healthcare costs can be expected globally in the absence of more stringent policies. The regions of South and South East Asia and Sub-Saharan Africa will be particularly vulnerable, OECD (2016) p. 14.
[34] Elvingson, Ågren (2004) pp. 49-52 for a discussion about material damage due to corrosion.
[35] Both the 'traditional' kind of acidification *and* ocean acidification, IIASA *et al.* (2007) pp. 60-61 and Eyring *et al.* (2010) p. 4752.

shipping context it is important to note that nearly 70% of all airborne emissions from ships are estimated to occur within 400 km of land.[37] Coupled with the fact that SO_x emissions are long-range travelling, and can be transported up to thousands of kilometres by air currents,[38] these vessel-source emissions contribute to a considerable worsening of air quality on land, especially in coastal regions. In 2013, for example, it was estimated that SO_x emissions from ships were responsible for 10% or more (as much as 26% in Portugal) of the total sulphur depositions in several European countries. In the coastal regions of these countries in particular, the pollution load was even higher.[39] Additionally, as stated above, SO_x emissions can contribute to ocean acidification, specifically in shallower coastal waters, where shipping tends to be more concentrated.[40] Moreover, the 'transportability' of SO_x emissions from ships makes them a global problem in the sense that vessels plying the world's oceans cause problems that are similar in nature all over the world.[41]

In recent years, the adverse effects of *air emissions*[42] from ships, in particular SO_x emissions, have received a growing level of attention

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[36] *E.g.* Corbett, Fischbeck (1997), Corbett et al. (1999), Corbett, Koehler (2003), Endresen et al. (2003), Corbett *et al.* (2007), Corbett *et al.* (2008), Buhaug *et al.* (2009), Winebrake *et al.* (2009), Eyring *et al.* (2010).

[37] Corbett *et al.* (2007) p. 8512.

[38] Elvingson, Ågren (2004) p. 99.

[39] Corbett *et al.* (2007) p. 8512., Acid News No. 4 (2016) p. 22.

[40] Eyring *et al.* (2010) p. 4752 and Doney *et al.* (2007) p. 14580.

[41] *E.g.* Corbett *et al.* (2007) and Winebrake *et al.* (2009) where *global* estimations of among others SO_x emissions from ships are performed.

[42] This study makes a terminological distinction between *air pollutants* and *air emissions*. This stems from the historical scientific distinction between *air pollutants* on the one hand, and *climate influencing green house gases* (GHGs) on the other. The term 'air pollution' has traditionally been used for short-lived compounds like sulphur and nitrogen oxides (SO_x and NO_x) that are directly toxic to humans, plants or other organisms, Grennfelt, Pleijel (2007) pp. 15-18. Other compounds emitted to air, like carbon dioxide (CO_2) and nitrous oxide (N_2O), affecting the radiation balance of the atmosphere and the Earth's surface temperature have instead been labelled GHGs. Recent natural science research increasingly points to the difficulty of making clear-cut distinctions between air pollutants and GHGs, since these interact and affect the same processes as *air emissions* in the atmosphere, Grennfelt (2009) p.7. According to this author, the broader term *air emissions* corresponds best with current research

from, among others, scientists, non-governmental organizations (NGOs), policy makers, and stakeholders in the maritime industry.[43] The specific question of regulating SO_x emissions from ships is not a trivial one for shipping. It goes straight to the heart of the business because it directly affects what roughly represents half of the total so-called voyage costs for a ship, and what has been called 'the single most important item in voyage costs'[44]: *fuel*.

Regulations limiting SO_x emissions from marine fuel sources were originally specified in MARPOL 73/78 Annex VI 1997.[45] However, these regulations were subject to considerable criticism from all quarters. Stakeholders within the shipping industry considered them to be too costly, thereby potentially distorting competition and causing market disruption in relation to other modes of transport. The sulphur provisions were also criticised by the oil refining industry and oil producing countries for significantly increasing production costs, as well as by NGOs and States for being too lenient for any meaningful

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and regulatory developments as a common term for emissions that are more or less 'two sides of the same coin', Pleijel et al. (2009). However, most older and some new documents analysed in this study still refer to 'air pollution'. For these reasons, the term 'air pollution' will therefore still be used in the following chapters to denote typical air pollutants according to the traditional definition, such as SO_x. As a variation, the term *SO_x emissions* is also used, since this clearly marks the specific substance discussed, although under the umbrella of *air emissions*.

[43] *E.g.* Corbett *et al.* (2007), IIASA *et al.* (2007), ICCT (2007), Seas At Risk *et al.* (2008), Sjöfartsverket *et al.* (2007) and the Swedish Shipowners' Association (2006).

[44] Stopford (2009) p. 233. According to the same source, the main elements of voyage costs, apart from the important fuel costs, are: port dues, costs for tugs, pilotage and canal charges. It should however be noted that different ships will have different running cost profiles. Stopford's particular example for a rough estimate of ship running costs is based on the costs of a 10-year old Capesize bulk carrier under Liberian flag at 2005 prices. See also Baldi (2016) pp. 8-9, who underlines the importance of fuel costs and provides a graphical representation of price volatility of bunker fuels 2009 to post-2015. See also Ship & Bunker (2015) for a discussion regarding fuel price predictions.

[45] Addition of Annex VI to Amend the International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 Relating Thereto (MARPOL 73/78 Annex VI 1997), as annexed to 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 (MARPOL 73/78 1997 Protocol).

environmental and health protection.[46] Merely a couple of months after the entry into force of the original Annex VI in May 2005, strong concrete arguments for a revision of the very same annex had been put forward by several Member States in IMO's Marine Environment Protection Committee (MEPC).[47] After many rounds of intense negotiations, more stringent regulations for the prevention of air pollution from ships were adopted under the auspices of IMO in October 2008.[48] These revised regulations, in Annex VI[49] of MARPOL 73/78,[50] specified new progressively stricter and gradually effective fuel sulphur limits. The regulations entered into force on 1 July 2010 and will reach their final stage of implementation on 1 January 2020.[51]

When viewed in a wider substantive and temporal frame, these regulations represent only one chapter in a regulatory history that links the past, the present and the future. In terms of the past, regulation of SO_x emissions from terrestrial sources has a long history. Although the known still preserved early regulations did not particularly target SO_x emissions *per se*, a recognition of the need to regulate noxious air pollutants, including pollutants from activities that would typically result in SO_x emissions,[52] stretches back to

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[46] Tan (2006) pp. 156-161.
[47] See further *infra* Chapter 4 Section 4.1.3.
[48] IMO Briefing 48, 13 October (2008) and IMO Briefing 47, 10 October (2008). See also an assortment of reactions and critique from various stakeholders in the shipping industry of the later 2008 revisions of the original MARPOL 73/78 Annex VI 1997 sulphur provisions, in *e.g.* Sust. Shipping 12 February (2010), Sust. Shipping 31 March (2010), Sust. Shipping 21 April (2010), Sust. Shipping 18 May (2010), Sust. Shipping 19 May (2010), Sust. Shipping 22 November (2010), Sust. Shipping 26 November (2010), and Sust. Shipping 28 November (2011).
[49] Res. MEPC.176(58) (Revised MARPOL 73/78 Annex VI 2008).
[50] International Convention for the Prevention of Pollution from Ships, 1973, London, 2 November 1973, and Protocol Relating to the International Convention for the Prevention of Pollution from Ships, 1973, London 17 February 1978, hereinafter referred to jointly as (MARPOL 73/78).
[51] Reg. 14 of Revised MARPOL 73/78 Annex VI 2008 and Res. MEPC.280(70).
[52] *E.g.* low-level air pollution emitted from domestic fires, or from blacksmiths' hearths and forges.

antiquity.[53] In contrast, regulation of SO_x emissions from marine sources is a relatively recent phenomenon. In terms of the present, according to current estimations, total SO_x emissions from terrestrial sources have fallen as much as 87% in Europe since 1980.[54] For international shipping, it has been speculated that the current increase in SO_x emissions could be slowed down, and eventually decrease with the successful implementation of the Revised MARPOL 73/78 Annex VI 2008.[55] Nevertheless, in terms of the future, it is clear that regulatory requirements for SO_x emissions from marine sources will need to continue developing further in the years ahead.[56] Even the strictest limits for SO_x emissions from marine sources, currently set to come into effect on 1 January 2020, will still allow sulphur contents in marine fuels globally that are 500 times higher for ships operating outside established SO_x emission control areas (ECAs), and 100 times higher inside ECAs, than the current maximum allowed sulphur limits for road fuels in Europe.[57] Thus, limits on SO_x emissions from marine sources will still, even in 2020, be considerably less strict than the limits on SO_x emissions from terrestrial sources that already apply[58] to

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[53] For further comments regarding the historical regulation of SO_x emissions from terrestrial sources, see *infra* Chapter 3 Section 3.1.

[54] This corresponds to a drop of total European terrestrial SO_x emissions from around 53 million tonnes in 1980 to 6.7 million tonnes in 2014, EMEP (2016) p. 64 and Acid News No. 4 (2016) pp. 22-23.

[55] Klimont *et al.* (2013) pp. 4-5. A recent report regarding the health impacts of delayed lowering of global sulphur standards for marine fuels estimated that SO_x emissions from marine sources could drop as much as 77% with an implementation of lower global sulphur standards in 2020 as compared to an implementation in 2025, MEPC 70/INF.34 Annex p. 6.

[56] Brynolf *et al.* (2016) p. 405.

[57] *I.e.* 5000 parts per million (ppm) (0.5%) and 1000 ppm (0.1%) sulphur in marine fuels compared to the maximum allowed 10 ppm (0.001%) sulphur in fuels used in on road vehicles, AirClim *et al*. (2011) p. 6.

[58] In practice however, European road fuels have on average contained even less sulphur, with contents almost only half of the allowed maximum sulphur limit already in 2009. According to a recent report from the EU Commission regarding the quality of petrol and diesel fuel used for road transport in the EU, the average sulphur content in sampled diesel fuel in all Member States remained below the maximum limit of 10 ppm in 2013, COM(2015) 70 final p. 14. This is a continuation of a trend starting already in 2009 when the average sulphur content in Europe of both petrol and diesel

other important transport modes in the multimodal transport chain.[59] In the absence of further regulatory developments, the still relatively high sulphur contents in marine fuels will mean that harmful SO_x emissions will persist in the marine setting, but also in a world where millions of humans increasingly gasp for cleaner air.[60] In addition, the efficient operation of available exhaust after-treatment devices for other air emissions such as nitrogen oxides (NO_x) and PM will be hindered, since such devices require much lower sulphur contents in fuels for optimal function and durability.[61]

1.2 The Purpose of the Study

In the previous section, the importance and benefits of shipping, but also its drawbacks were presented. As was explained, SO_x emissions cause considerable environmental and human health impacts when originating from marine and terrestrial sources alike. Even though regulations have been created to control such emissions in both the terrestrial and marine setting, a picture of a basic difference between these two settings emerges: on the one hand, the difference between the long history and the largely successful experience of controlling

was as low as 6 and 8 ppm (0.0006% and 0.0008%) on average, COM(2012) 749 final p. 3.

[59] Multimodal transport or multimodal carriage may be defined as 'the carriage of goods, by at least two different modes of transport, on the basis of a single multimodal transport contract, from a place in one country where the goods are taken in charge by the carrier, to a place designated for delivery situated in a different country', Hoeks (2010) p. 6. See also generally De Wit (1995). One example of multimodal transport bridging land and sea areas is when goods are loaded from lorries onto container ships on their way to a final destination (and vice versa).

[60] A recent report from UNICEF on children's exposure to air pollution estimated that 'around 300 million children currently live in areas where the air is toxic – exceeding international limits by at least six times', UNICEF (2016) p. 8.

[61] In the context of trucks, it has been known for quite some time that fuels with a very low sulphur content (~ 10-15 ppm or 0.001-0.0015% sulphur), so-called 'ultra-low sulphur fuels', are a basic prerequisite for the optimal function of exhaust aftertreatment devices like exhaust gas recirculation, selective catalytic reduction, diesel oxidation catalysts, and diesel particulate filters. For this reason, the lowering of sulphur content in on road fuels has more or less been unavoidable since the introduction of stricter aftertreatment requirements in Europe, ICCT (2016) p. 2, ICCT (2014) and CCAC (2016) p. 10.

SO_x emissions in the terrestrial setting, and on the other, the relatively short history and apparent need for further regulatory development in the marine setting to control the same emissions. There are several aspects of this situation that are worthy of further consideration.

One important aspect is that of regulatory experience as regards the actual design of the regulations in the terrestrial and marine settings. A closer look at the historical design of regulation of SO_x emissions from terrestrial sources reveals an overall dominance of regulatory approaches or instruments belonging to traditional, or 'command-and-control' (CAC) type instruments.[62] Regulatory design according to such instruments typically involves the adoption of provisions that target their addressees in a direct and often detailed manner, underpinned by some kind of sanction intended to evoke a desired behaviour.[63] The historical dominance of CAC regulation in the context of terrestrial SO_x emissions is not surprising, but corresponds to a general regulatory trend, whereby CAC regulation has formed the cornerstone of attempts by the industrialised world to control environmentally harmful activities.[64] Indeed, it has been argued that CAC regulation is likely to remain the primary regulatory approach in international environmental law for the foreseeable future given, among other things, the political and ideological tensions associated with attempts to introduce and use alternative regulatory instruments.[65]

While the merits of alternatives to CAC regulation in the form of, *inter alia*, economic instruments or market-based measures have been discussed and encouraged in different forms and at different regulatory scales since the 1980s,[66] the actual use of such instruments

[62] See further immediately below, where the use of alternatives to CAC regulation are commented in relation to the use of 'traditional' type CAC regulation.
[63] Different types of regulatory approaches or instruments are further detailed *infra* Chapter 2 Section 2.2.5.
[64] Abbot (2006) p. 62.
[65] Sands et al. (2012) p. 121.
[66] *E.g.* Baldwin *et al.* (2012a) p. 9 and OECD (2006).

to control SO_x emissions has remained limited.[67] In the European Union (EU), for example, although policy documents have encouraged the use of other regulatory instruments, terrestrial air pollution control still relies heavily on CAC regulation.[68] This approach to regulation has also been evident in the marine setting, where the standard regulatory approach for controlling pollution from ships, including the control of SO_x emissions, has been through CAC regulation.[69]

Nevertheless, contrary to common discussions relating to the design of regulation, the choice of regulation stands not only between traditional CAC regulation and alternatives such as economic instruments, but the possibility also exists of choosing different kinds of regulatory designs *within* CAC regulation.[70] Thus, focusing one step further and considering the possibilities for variation within CAC regulation, one of the most fundamental functions or components is *standard-setting*.[71] In the context of regulation, the chosen type of standard and how this is concretely articulated often provides 'the most tangible and precise expressions of the judgements that underlie environmental policies'.[72] In other words, examining the choice of standard can reveal something significant about regulation. Additionally, standard-setting obviously takes a particularly central

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[67] As noted in Sands *et al.* (2012) p. 125, in general 'the use of economic instruments at the international level to supplement, or supplant, direct regulatory approaches to environmental protection is supported, at least in principle, by a growing number of states. *The practical application is nevertheless limited.*', emphasis added.
[68] Schmitt, Schulze (2011) p. 22 and Holzinger *et al.* (2006).
[69] Christodoulou-Varotsi (2009) pp. 169 and 174. Alternatives have however been examined, see *e.g.* NERA (2004) and NERA (2005). It can at the same time be noted that discussions surrounding economic instruments or market-based measures in the adjacent context of regulating climate changing emissions from ships, is presently suspended to a future session by IMO's marine environment protection committee (MEPC), MEPC 65/22 p. 44. See also the discussion regarding the permissibility of 'sulphur emissions averaging schemes', which was rejected as an equivalent for fulfilling the requirements of MARPOL 73/78 Annex VI 2008, *inter alia* because it could be discussed whether this is essentially *a market-based instrument* applying to a group of ships, same source, pp. 25-26.
[70] Lübbe-Wolff (2001) pp. 79-80.
[71] Further detailed *infra* Chapter 2 Section 2.2.7.
[72] RCEP (1998) p. 3.

position in CAC regulation since the chosen standard constitutes the 'command' which targets the addressees, and is underpinned by some kind of sanction to evoke a desired behaviour, the 'control'.[73]

The spectrum of possibilities in standard-setting becomes clearer as different types of CAC regulation are examined. Consider for instance CAC regulation with a standard mandating that a certain cleaning technology must be used. This provides a rather narrow margin of flexibility for an industrial operator or an authority compared to a standard that, instead, mandates a maximum emission limit for a given substance without specifying exactly how the limit is to be achieved. The greatest degree of flexibility is achieved when a quality standard is specified. In such cases an operator or an authority has to control emissions of a substance only if, and to the extent that,it is required to ensure that the emissions remain within the limits of the quality standard.[74] Hence, the choice of standard-setting in CAC regulation among other things decides whether a narrow or wide margin of flexibility is offered for an operator to comply with the standard, or put another way, decides whether regulation either emphasizes instrumental or goal-oriented traits.[75] However, standard-setting does not only decide the level of flexibility in regulation. It also significantly influences factors such as efficiency in relation to regulatory goals, for example the abatement of a certain emission, the regulation's accuracy in so doing, and the costs for implementing and complying with regulation.[76]

Given the above, it can be concluded that the choice of standard decides and affects a number of crucial aspects of regulation. It can further be concluded that the dominant regulatory approach for controlling terrestrial and marine SO_x emissions of the past, the present, and probably also the future, is CAC regulation, despite the praise of alternative approaches. Against this background a question arises: has the experience of standard-setting in the largely successful

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[73] Holder, Lee (2007) p. 362 and Abbot (2006) p. 61. See also further *infra* Chapter 2 Section 2.2.6.
[74] Lübbe-Wolff (2001) pp. 81-82.
[75] Lübbe-Wolff (2001) p. 82.
[76] Lübbe-Wolff (2001) and Goodwin, Somsen (2010) pp. 113-116.

control of terrestrial SO_x emissions with CAC regulation been put to wise use in the marine context? Or stated differently, how has the important aspect of standard-setting in CAC regulation been handled in the seemingly different contexts of controlling SO_x emissions from terrestrial and marine sources that were mentioned in the beginning of this section?

Accordingly, the purpose of this study is to identify and examine differences between standard-setting in the regulation of SO_x emissions from terrestrial sources and the regulation of SO_x emissions from marine sources. These differences will be examined across three regulatory scales (the international, regional, and national scales), with the aim of identifying the underlying rationales for the key differences in standard-setting, the regulatory effects of these differences, and the possibilities of improvement of SO_x emissions regulation in the marine setting.

1.2.1 Research Questions

To fulfil the purpose of this study, the following research questions will be addressed:

1. *Does the regulation of SO_x emissions from terrestrial and marine sources differ in standard-setting and if so how and why?*
2. *What are the effects of the key differences between standard-setting in the regulation of SO_x emissions from terrestrial and marine sources?*
3. *Whether and if so in what manner the regulation of SO_x emissions from marine sources can be improved against this background?*

The dedicated subsections below detail how the research questions will be examined in the coming chapters.[77] Each of the research questions are commented on in order to closer explain their relevance and what answering them is expected to reveal.

[77] See however further *infra* Section 1.3, for applicable scope and delimitations.

1.2.1.1 Research Question 1 - Does the regulation of SO_x emissions from terrestrial and marine sources differ in standard-setting and if so how and why?

The initial research question is deliberately formulated against the background of some early observations regarding standard-setting in the regulation of SO_x emissions from terrestrial and marine sources. More specifically, at the outset of this study, an overview assessment revealed some significant differences in standard-setting between these two regulatory contexts. This aroused further interest for the extent and effects of these dissimilarities. Therefore, building on the initial observations acknowledging some significant differences in standard-setting, the first research question is formulated to allow for a further examination of the matter.

Answering the first research question can be broken down into answering a number of sub-questions including: (a) what, if any, are the main historical differences between SO_x regulation in the terrestrial and marine contexts?; (b) what are the current differences, if any?; and (c) what are the reasons for these differences?

In terms of chapter content, these sub-questions are posed to the material presented in Chapters 3-6. In these chapters, historical and current regulation of SO_x emissions from terrestrial and marine sources across regulatory scales is presented together with a context that not only considers preparatory works and similar background documents for the regulation, but also considers other decisive factors such as technical, economic, scientific and institutional factors that have affected the design of SO_x emissions regulation. The answers to questions (a)-(c), which are detailed in the main analytical Chapter 7, are needed to fulfil the core analytical ambitions following from the purpose of this thesis, to wit, the identification and examination of differences between historical and current standard-setting in the regulation of SO_x emissions from terrestrial and marine sources across regulatory scales. For pedagogical purposes and for ease of reference, the results of analysis of standards and the drawing of distinctions between them, is presented in graphical matrices in Chapter 7 where the standards from all three regulatory scales are plotted.

Additionally, with a point of departure in the matrices, answering the three sub-questions (a)-(c), provides the fundament for the later analysis and presentation, also in Chapter 7, of the rationales for the key differences identified in historical and current standard-setting in SO_x emissions regulation.

1.2.1.2 Research Question 2 - What are the effects of the key differences between standard-setting in the regulation of SO_x emissions from terrestrial and marine sources?

This question examines what effects, if any, the identified key differences in standard-setting in historical and current SO_x emissions regulation may have. Answering this question is a continuation of answering the previous research question. As a follow-up, this question is relevant because it considers exactly those crucial and decisive aspects of standard-setting in regulation that were previously mentioned,and which are prone to be affected by the choice of standard.[78] Thus, responding to this question in Chapter 7 is for example expected to reveal whether the SO_x emissions regulation in the terrestrial and marine contexts either emphasize instrumental or goal-oriented traits? How can the abatement of SO_x emissions be expected to proceed given a certain standard? And, what can the choice of standard reveal about the regulations' accuracy in so doing?

1.2.1.3 Research Question 3 - Whether and if so in what manner the regulation of SO_x emissions from marine sources can be improved against this background?

This final research question takes the form of a forward-looking enquiry. Addressed in Chapter 7, it is more specifically relevant for looking into the possibilities of improvement of the regulation of SO_x emissions from marine sources as examined against the background of any effects of the key differences between standard-setting in the regulation of SO_x emissions from terrestrial and marine sources that have been identified in the thesis. In this respect, the answer to this final question essentially provides the conclusion of the thesis.

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[78] *Supra* Section 1.2.

1.3 Scope and Delimitations of the Study

This study has a wide-ranging scope as its purpose is to identify and examine differences in standard-setting in the regulation of SO_x emissions from terrestrial and marine sources across three regulatory scales (the international, regional, and national scales). Furthermore, in particular, the aim is to identify the underlying rationales for the key differences in standard-setting, their effect, and the possibilities of improvement of SO_x emissions regulation in the marine setting against this background. A scope this broad may seem overzealous, and an apparent problem is how to handle the combination of the many mentioned parameters and the large material this would involve. For the purpose of approaching this problem, a number of delimitations apply.

Starting with delimitations regarding the two regulatory settings, although this thesis focuses on examining the regulation of SO_x emissions from marine sources, that is ships, the regulation of the same emission type from terrestrial sources is all the same included. This is so mainly for two reasons. First, the historically longer terrestrial regulatory experience of SO_x emissions control can be expected to contain valuable lessons that could be used for the potential improvement of the relatively recent regulation of SO_x emissions in the marine setting. Second, it is natural to consider the regulation of SO_x emissions from ships in the broader context of air emissions regulation, which originally targeted emission sources in the terrestrial setting. Thus examination of both terrestrial and marine regulation is required.

In addition, it is considered necessary not only to examine current regulation in the terrestrial and marine settings, but also to include a historical perspective on regulation. This, since current regulation represents merely a continuation of earlier regulatory efforts for the control of SO_x emissions. Furthermore, in order to trace effects of standard-setting in regulation, and to use this knowledge for identifying potential improvements in the marine context, an assessment over time is required. With regard to temporal coverage for the examination of regulation, the specific history of each of the three regulatory scales, commented on immediately below, is generally guided by the idea that the starting point is set at important events leading up to or positioned close in time to the first *intentional* regulation of SO_x emissions. Furthermore, in absence of any statement to the contrary, this study covers legal developments in SO_x emissions regulation in both settings and on all scales up to 1 April 2017.

Another facet of the broad scope of this study is that it aims to analyse SO_x emissions regulation across regulatory scales or layers.[79] As regards delimitations, SO_x emissions regulation appearing on three scales are analysed: the international, regional and national scales. A study comprising analysis of multiple regulatory scales is clearly a far-reaching task. Nevertheless, interconnectivity between regulatory scales is a fact.[80] For example, it is known that regulatory measures on one scale can influence other scales profoundly due to legal tensions that may exert pressure both 'downwards' and 'upwards'.[81] This interconnectivity between regulatory scales suggests that one scale can not easily be examined in isolation without risking a loss of 'the big picture'. This is so, particularly as regards the rationales for the

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[79] Ringbom (2008) pp. 2-3 where the term 'regulatory layer' is used to describe regulation appearing on a global, regional and national level. Henceforth, references to *regulatory scale* will be used as a term synonymous with regulatory layers or levels.

[80] *E.g.* Baldwin et al. (2012b) p. 386, noting that 'Most domestic regulatory regimes rely on different levels of government for standard-setting, behaviour-modification, and information-gathering. To state that *regulation is multi-level* is, therefore, hardly novel or exciting. However, what is new and somewhat exciting nowadays is the placing of regulatory activities at increasingly numerous layers of government. Such shifting of levels, *upwards (to the supranational and international), downwards (to the regional and local)* and sideways (to specialized agencies and away from ministerial departments) is at the heart of debates regarding "who regulates" and how', emphasis added.

[81] Ringbom (2008) p. 3, where the EU maritime safety legislation is described as a cause of legal tensions both 'downwards' in relation to Member States and 'upwards' in relation to the international regime. For other tensions between regulatory layers, see also *e.g.* Tan (2006) pp. 139-147 describing the aftermath of the Exxon Valdez incident in 1989 that spurred regulatory initiatives eventually becoming global matters. The passage of the Oil Pollution Act of 1990 (OPA-90) in the US Congress meant a phase-out schedule with double hull requirements for all new and existing tank vessels coming to US ports or crossing US waters. This combined with looming unilateralism from the US put pressure on IMO to initiate discussions about international double hull requirements.

design of regulation, for example, in relation to air pollution from terrestrial and marine sources, where regulation on the highest international scale strongly influences the shape of regulation on regional and national scales.

Consequently, when it comes to the specifics of the regulatory scales, *the international scale* is here taken to mean the global international scale, *the regional scale* is delimited to Nordic international regulation between States, and EU law, while *the national scale* is restricted to Sweden. A unifying theme of delimitation with respect to these three scales is also that this thesis follows Sweden's participation through these regulatory scales via its international and regional agreements on air emissions down to the national scale, specifically with a focus on the regulation of SO_x emissions from terrestrial and marine sources. By following a trail through regulatory scales limited to global international and regional regulation that applies to Sweden down to the national scale, the intention is to provide a more complete picture of how standard-setting in air pollution regulation is designed across regulatory scales. It is also believed that the Swedish perspective on SO_x emissions regulation has a high relevance that can be generalized to other geographical contexts since many problems related to these emissions are similar in nature all over the world. The European, and in particular the Swedish perspective, also provides a good example of a country in a region where SO_x emissions have caused many problems historically, both as an effect of industrialization and due to ecological sensitivity.[82] Connecting the Swedish experience to other regulatory scales is furthermore important considering the international nature of transboundary air pollution, where large-scale solutions including regions such as Europe have historically been and are still crucial from a Nordic perspective, as the Nordic countries typically are 'net importers' of transboundary air emissions.[83]

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[82] Okowa (2000) p. 9, for a similar argument relating to Europe and North America.
[83] Whether a country is 'net importer' or 'net exporter' is determined by the amount of emissions from that country and the prevailing wind direction. In simplified terms, the fact that Sweden and Norway are 'net importers' means that these countries receive more emissions than they release to other countries, Elvingson, Ågren (2004) p. 99.

Having commented on the delimitations with regard to the regulatory settings, scales and the applicable temporal boundaries, some remarks about delimitations concerning regulatory form are suitable. Given the focus of the current study, it is first necessary to comment on regulatory form in the sense of regulatory approach or instrument. The most basic delimitation allowing for a more manageable area of examination in relation to regulatory form is that this thesis is confined to looking only at the overall dominant regulatory approach or instrument category for controlling SO_x emissions in the terrestrial and marine settings. As previously mentioned,[84] this is the traditional, or 'command-and-control' (CAC) type of instrument category. Additionally, only CAC regulation that *directly applies* to SO_x emissions from terrestrial and marine sources is examined, thus excluding other types of regulation that can be categorized as belonging to, for example, economic and information-based approaches to regulation, often recognized as *indirect* types of regulation.[85]

Considering altogether what has been stated above apropos the examination of differences between historical and current standard-setting in the regulation of SO_x emissions in two regulatory settings, on three regulatory scales, and with a focus on CAC regulation, a reasonable following question is whether this study is comparative in its examination of differences in standard-setting?

Here the answer is no. The purpose of drawing distinctions is not to engage in a comparative study of, for example, conflicts of norms between regulatory scales or different States' legal systems, but to identify differences concerning one function (standard-setting) of *regulatory design* between these settings and scales. To perform this latter task, some selected and related concepts from regulatory studies are employed.[86]

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84 See *supra* Section 1.2.
85 For a short introduction to different types of regulatory approaches or instruments, see *infra* Chapter 2 Section 2.2.5.
86 For further details regarding method, see *infra* Chapter 2 Section 2.2 with subsections.

Hence, continuing one step further regarding regulatory form, yet another delimitation is that the focus on regulatory design in SO_x emissions regulation limits itself to examining *only standard-setting*, the 'command', as one of the most obvious and central components of CAC regulation. Furthermore, as Baldwin *et al.* put it, when standards are to be formulated in rules, regulators are generally faced with two basic questions: '"Which types of standards should be used?", [and] "What level of performance should be demanded?"'.[87] As regards these two basic questions, this thesis examines matters within the domain of the first question, since the *form* or type of standard is the centre of attention, rather than a specific numerical formulation, its stringency, or how the standard was arrived at.[88] More specifically, in relation to form and types of standards, this thesis is limited to examining five categories of environmental standards in CAC regulation, of which four arguably cover a representative sample of different standard typologies identified in scholarly sources in relation to environmental pollution regulation.[89]

The four most commonly mentioned standard categories examined are: (a) product standards; (b) process standards; (c) emission standards; and (d) environmental quality standards. Nevertheless, this study also adds a fifth residual catch-all category, (e) other standards, for any standards identified *in CAC regulation* for SO_x emission control that do not fit within the first four given categories.[90] In addition, only standards as they are expressed in the substantive provisions dedicated to controlling SO_x emissions are analysed. Thus, any provisions in terrestrial and marine regulation that only incidentally relate to SO_x emissions,or are merely supportive of the dedicated main provisions, will not be analysed as regards standard-setting. All the same, the latter kind of provisions are still commented

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[87] Baldwin *et al.* (2012b) p. 296.

[88] The question about how standards are drafted has been discussed in regulatory literature. For instance, a formulated standard can be the result of systematic tests or modelling, bargaining or diplomacy, or a 'stab-in-the-dark activity' where a standard is set more or less arbitrarily, Hood *et al.* (2001) p. 25.

[89] See further comments *infra* Chapter 2 Section 2.2.8.

[90] See further comments *infra* Chapter 2 Section 2.2.8.

on to some extent in Chapters 3-6 to provide a necessary regulatory context.[91]

Yet another delimitation regarding the analysis of standards and standard-setting as an element of regulatory design is that this is not done to engage in the so-called 'rules vs standards' discussion, which is basically a discussion about the precision of norms where the term 'rules is typically used to refer to precise norms … and *standards* to less precise ones'.[92] While acknowledging the importance of this discussion, the current study however mainly focuses on other questions of regulatory form than discussing the precision of norms in the sense of 'rules vs standards', namely *standard-setting as an element of regulatory design*. Furthermore, the question of regulatory stringency, which is separate from the 'rules vs standards' discussion[93] is not examined in this thesis either. By excluding the focus on stringency in relation to regulatory design and type of standard, it is hoped that the relevance of this thesis is prolonged, as the stringency of a certain standard may change relatively fast, but the form has a tendency to remain the same over a longer period of time. Nevertheless, the fact that there is some kind of numerically

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[91] *E.g.* commenting on a certain protocol to a convention regulating SO_x emissions without first presenting the convention itself would typically risk excluding important context. See also further comments *infra* Section 1.5.

[92] Bodansky (2010) p. 105. As further noted by Bodansky 'The distinction between rules and standards is, in essence, that between *ex ante* and *ex post* decision making. Rules define in advance what conduct is permissible and impermissible. Standards, in contrast, set forth more open-ended tests, whose application depends on the exercise of judgement or discretion—for example, to determine what represents a safe driving speed in a specific context, or what represent "appropriate measures" to combat ozone depletion', same source and page, footnote omitted.

[93] As stated by Bodansky 'Very precise rules can be extremely lax. This was true of the whaling quotas adopted by the International Whaling Commission in the 1960s, during the so-called Whaling Olympics, when catch limits were set very high, allowing tens of thousands of whales to be killed. Conversely, a standard, though imprecise, can be quite stringent—for example, a standard requiring the adoption of best available technology.' Bodansky (2010) pp. 105-106.

formulated standard targeting SO_x emissions in regulation helps the initial identification of the type of standard used in CAC regulation.[94]

The focus on standard-setting moreover leads to the exclusion of analysis of other, yet significant and linked, aspects of regulatory design like information-gathering (monitoring) and behaviour-modification (enforcement).[95] As a related point of delimitation, this study has no ambitions to draw distinctions between, and analyse, the application in practice of regulation of SO_x emissions from terrestrial and marine sources by examining its enforcement or its effectiveness. These questions were not deemed feasible for analysis in the initial phases of this study, since more time would have to pass for the rather recently adopted regulation of SO_x emissions from marine sources before it could be assessed in practice or be contrasted with the regulation of SO_x emissions from terrestrial sources from such perspectives.

Nonetheless, as stated before,[96] it is acknowledged in this study that standard-setting potentially affects a number of crucial aspects of regulation, such as flexibility, efficiency in relation to regulatory goals and regulatory accuracy. Such matters are still related to for example the enforcement of regulation. The ambitions to improve the regulation of SO_x emissions from marine sources in this thesis can therefore include informed opinions that may have a bearing on these matters, albeit only to the extent that such opinions are formulated on *theoretical grounds*, relating to the effects that a chosen type of standard-setting can be expected to have in theory, rather than relating to empirical statements regarding the application in practice.

Moving on to yet other delimitations, some comments must also be added in relation to a couple of specific objects of attention in this thesis in the terrestrial and marine regulatory settings. As regards

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[94] For a discussion about the identification of type of standard in environmental CAC regulation, see further *infra* Chapter 2 where the theoretical frames, methods and materials of this thesis are introduced.
[95] For further details about the different functions of regulation and their linkages, see *infra* Chapter 2 Section 2.2.4.
[96] *Supra* Section 1.2.

terrestrial emission sources, both mobile and stationary SO_x emission sources are included in the examination of standard-setting as an element of regulatory design. The examination of regulation of SO_x emissions from non-road mobile machinery such as construction machinery, generator sets, locomotives, and wheeled agricultural or forestry tractors are, however, excluded from this study. Although linked to the terrestrial setting, SO_x emissions from the mobile emission source of aviation are also omitted from this study. When it comes to SO_x emissions from marine sources, the focus is put on the more or less exclusive mobile emission source of ships, and thus excludes other possible SO_x emissions from marine sources, for example from oil rigs. Furthermore, the examination of the regulation of SO_x emissions from marine sources does not cover regulation targeting ships used on inland waterways.

Also, the analysis focusing on SO_x emissions in this study is limited to examining the regulation of such emissions when caused by anthropogenic combustion of fossil fuels. In relation to anthropogenic combustion, the study of regulation of fossil fuels is performed with a main focus on sulphur containing fuels mostly in liquid as opposed to solid form, even though solid fuels are still used on land, for example, in Europe. Coal powered ships however are mostly an artefact of the past. The study of ships powered by liquefied natural gas (LNG) is also excluded from this thesis since such vessels are still relatively few in the context of the global fleet.[97] Furthermore, this thesis also excludes the study and regulation of nuclear power, including nuclear powered ships.

Other emissions that are often discussed together and linked to SO_x emissions, like NO_x, PM and GHGs, are generally outside the boundaries of this study, and are only examined to the extent where it is specifically necessary, for example when mentioning such emissions in a historical context together with SO_x emissions, or where it would otherwise be specifically relevant to the question of

[97] Although a promising fuel alternative in shipping for the coming years, it has been projected that only around 95 operational LNG-powered ships will exist in the total global fleet in 2018, World Ports Climate Initiative (2016).

regulating SO_x emissions. Likewise, the regulation of other emissions that simultaneously *indirectly* controls SO_x emissions is not considered in this thesis.

Getting to delimitations that are primarily related to the main analytical chapter, Chapter 7, the following specific delimitations apply.[98] As regards the plotting of standards performed in Chapter 7, it should be emphasized that its purpose is not to be a quantitative evaluation of standard-setting in the sense that it will be used to generate results about how many instances a certain type of standard is used in SO_x emissions regulation at different regulatory scales. The purpose of the plotting is instead used for pedagogical purposes and for ease of reference, aiding the following mainly qualitative analysis. The matrices with plotted standards presented in Chapter 7 thus provide an overview of the variation of *forms or types* of standard-setting that have been used in regulation, and their 'qualities' or traits, as for instance primary or subsidiary standards, or equivalent standards.[99] To this end, the plotting aims to visualize the variety of different standards that are identified in the examined substantive regulation presented in Chapters 3-6.[100]

When it comes to more specific temporal delimitations regarding the analysis of standards, this study is limited to historical and currently applicable standards. Standards in regulation that have been adopted, but have not yet entered into force will thus not be plotted or examined, although they are still commented on to some extent to provide context. Yet another practical and temporally related question is how to analyse standards in regulations that have been amended over the course of time.

Regulatory standards that remain the same, although appearing in different amendments of the same piece of legislation, will be plotted and analysed as representing a single standard. However, if yet another type of standard is introduced in parallel or replaces the first

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[98] See also further *infra* Chapter 7.
[99] For further comments regarding primary, subsidiary and alternative/equivalent standards, see *infra* Chapter 2 Section 2.2.8.
[100] See *infra* Chapter 2 Section 2.2 for more details about standard plotting in practice.

standard, in, for example, an amendment act, the standards will be separately plotted and analysed. A related matter are those instances when an examined substantive provision expresses several standards at the same time. In such cases the standards are analysed separately. Duplicates of standard types that have the same priority, that is, if they are both primary, subsidiary or alternative/equivalent, in the same piece of regulation will be plotted and analysed as a single standard. However, the same type of standard in *two different* pieces of regulation are all the same plotted as two standards, since they are expressed in separate pieces of regulation.

A couple of delimitations related to the formulation of the research questions[101] are also necessary, given their rather wide scope. Naturally, a wide scope has consequences for the depth at which the questions can be answered. Therefore, in relation to drawing distinctions and thus identifying standard-setting differences in Chapter 7, it should be noted that this thesis focuses on tracing the *key differences* in standard-setting between the regulation of SO_x emissions from terrestrial and marine sources, and thus *not all possibly identifiable differences*. The same thinking applies to the ambition of tracing the *main rationales* or the most plausible explanations for these key differences, based on the perspectives and materials used in this thesis. Here, the idea is therefore to settle for examining some chosen aspects that appear to be decisive and plausible explanations for the key differences *based on what has been presented in Chapters 3-6*.[102] This also applies to commenting on the effects of the key differences in standard-setting between terrestrial and marine SO_x emissions regulation, since commenting on all possible effects is not feasible.

Likewise, the ambition to improve SO_x emissions regulation in the marine setting is confined to considering potential improvements against the background of the key differences and the main rationales for these differences identified when analysing terrestrial and marine standard-setting together. Thus, this ambition does not purport to

[101] *Supra* Section 1.2.1.
[102] See further *infra* Chapter 7.

include all potential improvements in general. Additionally, regarding potential improvements, it should further be underlined that the deliberate attention to aspects that may improve regulation in a sense makes this thesis 'biased' towards changing regulation for the improvement of the environment, as opposed to examining views of stakeholders that would rather remain at a 'business-as-usual scenario' or would even like to weaken the regulation of environmental protection. To also include an examination of arguments against better regulation was not deemed to be feasible, since it would arguably be too complicated to get an honest view from stakeholders wanting to block or weaken regulation; the true and underlying intent of lobbying would probably less likely be openly admitted by stakeholders.

1.4 Previous Research, Contribution of the Present Study, and Target Audience

The current study may perhaps not straightforwardly be described as belonging to any one field of legal scholarship. Rather, two fields stand out more prominently than others. The first is international environmental law, with a specific focus on analysis of the design of SO_x emissions regulation.[103] The second field, where the main theory and method of this study is grounded, is 'law and regulation', also known as 'regulatory studies'.[104] For the purposes of this section, international environmental law and the regulation of SO_x emissions may in turn be subdivided into yet two fields: the regulation of SO_x emissions from terrestrial sources, and the regulation of SO_x emissions from marine sources, where the latter field in this thesis is limited to the study of ships excluding inland waterway vessels.[105] From a

[103] Nevertheless, as stated *supra* Section 1.3, this thesis also examines *regional* and *national* regulatory attempts to control SO_x emissions. All the same, a predominant part of the regulation examined in this thesis has its base in or gives effect to air pollution regulation at regulatory scales above and beyond the regional and national scales, *i.e.* regulation that chiefly belongs to international environmental law.
[104] *Infra* Chapter 2 Section 2.1.
[105] This division is made here and in the structure throughout the following chapters of this study. However, as will become increasingly apparent *infra*, a position taken in this thesis is that the regulation of air pollution from terrestrial and marine sources both *can and should be considered* as tightly linked fields for various reasons, *inter*

scholarly point of view, the latter field to a large extent involves work from the field of the law of the sea and marine environmental protection.

Starting with previous research within international environmental law and the first of its two subdivisions, one of the main studies cited in this thesis regarding the general regulation of air pollution from terrestrial sources is Okowa (2000).[106] This study deals in-depth with questions of State responsibility for transboundary air pollution in international law. Another important work, although not belonging to legal scholarship, but well worth of mention is Pleijel *et al.* (2007). This study is dedicated to the scientific understanding behind and the history of environmental policy in Europe, specifically regarding air pollution regulation. Another important contribution regarding the science and politics of air pollution regulation in Europe is further contributed by Letell (2006).

When it comes to the second subdivision and the topic of the regulation of air pollution from ships, sources are generally scarce.[107] A couple of legal academic articles and parts of two studies that treat the topic should however be mentioned. Regarding air pollution from ships, some early comments introducing the original MARPOL 73/78 Annex VI 1997 are given in Okamura (1995). Further, Honka (2011) discusses aspects of compatibility between the Revised MARPOL 73/78 Annex VI 2008 and the general EU principles of equality and non-discrimination. The shorter parts about MARPOL 73/78 Annex VI 1997 in Tan (2006) provides a valuable historical and political background to the processes surrounding the drafting of the original MARPOL 73/78 Annex VI 1997 and its subsequent revision.

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alia because they historically share a common legal heritage and relate to the same type of problems, however also because the two fields seem to increasingly have merged lately as a consequence of regulatory developments. See also further *infra* Chapter 6 Section 6.1.2.

[106] See however also the early study of Flinterman *et al.* (1986), detailing the then recent international legal developments specifically concerning transboundary air pollution.

[107] Which has also been confirmed by legal scholars, *e.g.* Molenaar (1998) p. 499 and more recently Roberts (2007) p. 47.

Moreover, the parts of Ringbom (2008) detailing especially the compatibility between international law and the EU's implementation of the so-called sulphur directive is a relevant background for the present thesis. Another study, outside legal scholarship, that is also worthy of mention is Svensson (2011) which deals extensively with the background documents and the negotiation history of the original MARPOL Annex VI 1997 and its revision, particularly regarding the global and regional regulation of SO_x emissions from ships.

From a broader perspective of the regulation of *air emissions* from ships, focusing mainly on the adjacent topic of GHG emissions, three articles are worthy of special mention. Balkin (2009) introduces IMO's work with GHG emissions from ships, Mukherjee, Xu (2009) comments on air emissions from ships in relation to climate change, and law and economics, and Christodoulou-Varotsi (2009) comments on the possible inclusion of air emissions from ships in a trading scheme.

Nevertheless, the common factor for the majority of the mentioned studies is that they do not extensively examine the regulation of air pollution from ships, and even less so regarding the specific topic of the regulation of SO_x emissions from ships.[108] Consequently, in relation to the current study, it can thus be concluded that none of the mentioned earlier works treat the regulation of SO_x emissions from the perspective of regulatory design and standard-setting. Furthermore, none of the studies draw distinctions between the two settings or contexts of regulation of SO_x emissions from terrestrial sources, and marine sources across multiple regulatory scales. Therefore, the current study and its focus stands alone among the previously performed studies, especially by drawing distinctions between the design of regulation in multiple contexts and scales.

Moreover, the current study is unique in the sense that it draws these distinctions against a rather rich surrounding explanatory context.

[108] Svensson (2011) being an exception and to some extent also Ringbom (2008), since the latter study scrutinizes some complex and rather specific compatibility issues between international and EU law *inter alia* when it comes to the regulation of SO_x emissions from ships.

This context not only includes an overview of the history and trends in the design of the regulation of SO_x emissions from terrestrial and marine sources by considering traditional legal sources such as preparatory works and similar documents, but it also highlights the influence on the shape of SO_x emissions regulation of several other important decisive factors like technical, economic, scientific and institutional factors. By providing a broader context that also stresses the linkages to and importance of such factors, for example by demonstrating how the breakthrough of certain SO_x emission cleaning techniques have influenced the shape of regulation, this thesis provides a deeper understanding of SO_x emissions regulation in general and standard-setting in the same kind of regulation in particular. Additionally, this study contributes with new research perspectives and results adding to the understanding of topics that the earlier body of research has not examined. More specifically, the added knowledge is new perspectives and systematic thinking with respect to current knowledge about standard-setting in the regulation of SO_x emissions both from terrestrial and marine sources brought forth via a multiscale mapping of regulation in context.

Regarding the second main field, the amount of literature that belongs to 'regulatory studies' is extensive. Among the more important works regarding regulation relevant to this study are Morgan, Yeung (2007), Baldwin *et al.* (2012) and Baldwin *et al.* (2012b). However, these three studies are general in orientation and none of them detail the design of environmental regulation. As regards standard-setting in environmental CAC regulation, Sands *et al*. (2012) provides a useful basic categorization of standard-setting from the perspective of international environmental law, but it does not examine such standards in a closer manner. In relation to these works, this study provides an increased understanding of the rationales behind historical and current standard-setting in environmental CAC regulation, with a closer examination of the motivations behind the choice and the type of standards as a part of the design of regulation of SO_x emissions from terrestrial and marine sources as an example. Furthermore, this study contributes with an increased understanding of the effects of the choice of standards, and their potential improvement.

Returning again to the general field of regulatory studies, some examples of previous works focusing on regulation on different regulatory scales can also be mentioned. A thorough examination of global environmental governance is for example provided by Kotzé (2012) and particularly from the marine perspective in DiMento, Hickman (2012). Regarding the subject of making the construction of regulation better, Gunningham *et al*. (1999) can be mentioned, and on the regional level (EU), Lee (2014) discusses aspects of instruments of governance in EU environmental law. Furthermore, Lübbe-Wolff (2001) specifically treats regulatory approaches in CAC regulation in relation to EU environmental law.

In the Nordic setting, some early examples of legal academic publications treating questions that today are central for regulatory studies are examined in Eckhoff (1983) examining regulatory instruments of the State, Basse (1992) looking into regulation and governance as a theoretical and methodological perspective, and Ebbesson (1996) among other things examining the choice of regulatory standards in international environmental law in the context of compatibility with national environmental law. Some more recent examples of Nordic publications regarding the importance of the 'science of legislation' are Tala (2006) and Westerlund (2006). The point of departures taken in regulatory studies by Almlöf (2014) and Hult (2015) also deserve to be mentioned in the Nordic setting. Additionally, it is also relevant to mention the legal technical study of legislation by Wahlgren (2014), and furthermore Backer (2015), who among other things discusses different criteria used for structuring environmental legislation in Norway, for example relating to legal instruments such as command and control. Together, the above mentioned studies treating regulation and legislation from different perspectives and on different regulatory scales are all contributions that can be placed within the field of regulatory studies. In relation to the current work however, none of these works specifically treat standard-setting in terrestrial and marine regulation of SO_x emissions on various regulatory scales.

Finally, as regards the question of target audience of this study, apart from the group of legal scholars interested in environmental law, air pollution, and questions regarding regulatory design, this study is expected to be relevant for other fields of research with a focus on air pollution regulation, as well as IMO Member States, maritime industry stakeholders, and NGOs with an interest in policy dialogue and regulatory development in the field of SO_x emissions control.

1.5 Thesis Outline

The general structure of this thesis consists of three parts. Part I – GAMBIT, offers two chapters. First, this introductory Chapter 1, which has briefly introduced the regulation of SO_x emissions from ships, and explained the background and purpose of this thesis. The main argument in the current chapter is that standard-setting in CAC regulation for the control of SO_x emissions is a central aspect of regulatory design worthy of further scrutiny, among other things, for the purpose of finding out whether it is possible to improve SO_x emissions regulation from marine sources against the background of the longer terrestrial regulatory experience regarding the same kind of emissions. Second, Chapter 2 establishes a theoretical and analytical framework, and explains the methodological approach used in the examination of standard-setting in the regulation of SO_x emissions from terrestrial and marine sources in this thesis. Additionally, the choice and use of materials is commented on.

In order to focus on the examination of standard-setting in regulation, a couple of basic concepts must initially be explained, and be accepted as 'gambits'. Accordingly, Chapter 2 also spells out some necessary preconditions for the later analysis in Chapter 7 of standard-setting in the regulation of SO_x emissions from terrestrial and marine sources. It does so by considering the concept of regulation, examining different types of regulation, and how CAC regulation can be defined. Moreover, it examines how standard-setting in regulation can be expressed before approaching questions of types of standard-setting in *environmental* CAC regulation.

Part II – BRIDGE, contains what could be viewed as two 'case studies' developed in Chapters 3, 4, 5 and 6. These chapters largely consist of a review and mapping of historical and current applicable regulation of SO_x emissions from terrestrial and marine sources on three regulatory scales. Put differently, the purpose of these chapters is mainly to present the legal material, that is, the actual SO_x

emissions regulation, so that it can later be analysed in Chapter 7. Nevertheless, as previously mentioned,[109] the presentation of legal material is importantly also accompanied by a rather rich surrounding explanatory context.

As a matter of structure, Chapters 3-6 bridge the beginning and the end of this thesis with a middle part. First, as regards the presentation of applicable regulation, Chapters 3 and 4 consider the historical SO_x emissions regulation in the terrestrial and marine contexts respectively, starting at the highest international scale and proceeding downwards through the regulatory scales, ending on the national scale. Likewise, Chapters 5 and 6 examine current applicable regulation in the terrestrial and marine settings. This order of chapter organization is chosen for two main reasons. First, to put the chapters regarding the historical development of regulation in the terrestrial and marine settings after each other, and letting the chapters regarding current regulation follow the same pattern, allows for a temporally consistent examination of historical and then current events in both regulatory settings. Second, the analysis performed in Chapter 7 is organized according to the same pattern, where the historical regulation in the two settings is first analysed side by side, and is then followed by the analysis of current applicable regulation in the two settings side by side.

When it comes to the surrounding context of the regulation of SO_x emissions from terrestrial and marine sources, Chapters 3-6 further trace various decisive factors influencing the shape of regulation. This will especially become apparent in the two historical Chapters 3 and 4, which thoroughly describe historical regulatory developments up to present date. Chapters 5 and 6, which describe current applicable regulation, also include some surrounding context, but are more focused since they only describe substantive current applicable regulation. The motivations for including a broad surrounding context in Chapters 3-6 is twofold: first, it would make quite a 'detached' description to simply present regulatory standards, for example, from a convention containing regulations targeting SO_x emissions, without

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[109] *Supra* Sections 1.2.1.1 and 1.4.

also presenting the framework of the convention itself. Second, the analysis in Chapter 7 requires a broader setting than just a pure account of applicable historical and current standards in regulations. By this token, not only must the standards in regulations be able to be 'extracted' via an analysis of what is presented in Chapters 3-6. Furthermore, the materials analysed must also be able to answer such questions as what the most plausible reasons are for why particular standards were chosen in SO_x emissions regulation, and the effects of these choices, since this is required by the research questions and the scope and delimitations of this thesis.[110] As mentioned above,[111] it is believed that by highlighting the influence on the shape of SO_x emissions regulation of important decisive factors of for instance a technical, economic, scientific and institutional nature, this thesis provides a deeper understanding of the choices behind the design of SO_x emissions regulation that can also particularly explain the choice of standard-setting in this specific kind of regulation.

Part III – CLOSURE, consists of two chapters. Chapter 7, which is the main analytical chapter of this thesis, provides an analysis of the materials presented in Chapters 3-6. It does so by focusing on the standard-setting in the regulation of SO_x emissions from terrestrial and marine sources with the intention of drawing distinctions between these two settings as regards standard-setting, identifying the underlying rationales for the key differences in standard-setting drawing from the broader background just described, the effect of the chosen standards, and the possibilities of improvement of SO_x emissions regulation in the marine setting. Put differently, Chapter 7 presents what can be learned for standard-setting in the regulation of SO_x emissions from marine sources from standard-setting in the regulation of SO_x emissions from terrestrial sources from the viewpoint of different perspectives. Finally, Chapter 8 offers a summary of the thesis, the main findings of the analysis in Chapter 7, and some overall concluding remarks *inter alia* regarding theoretical development and the contributions of this thesis. As a finish, Chapter

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110 *Supra* Sections 1.2.1 and 1.3.
111 *Supra* Section 1.4.

8 also offers an outlook into future issues and possible further research related to the area of SO_x emissions regulation.

‘research does not run like a mechanism;
there are rhythms, which include pauses
and periods that may seem unproductive’[112]

2 Theory, Methods and Materials

The overall purpose of this chapter is to lay the foundations that will eventually lead to the analysis performed later on in this thesis.[113] To this end, the current chapter sets out the theoretical and methodological framework employed in this study. Additionally, the use of theory and methods in relation to materials is presented. As noted in the preceding chapter,[114] the field where the main theory and methods of this study is grounded, is ‘law and regulation’, also known as ‘regulatory studies’. The analysis in this thesis thus chiefly uses concepts and tools that can be placed within the field of regulatory studies, where questions of regulatory design have specifically been a subject to scrutiny.

In terms of order, the current chapter begins with a short introduction to regulatory studies. Thereafter, the ‘methodological pyramid’ employed in this thesis is introduced. Next, the application of this pyramid is explained in relation to the utilized materials in this thesis. In addition, the specifics of central theoretical concepts and tools constituting the building blocks of the methodological pyramid are detailed. In particular, the concept of regulation is commented on, which is followed by an overview of possible categorizations and variations of regulatory instruments. Moreover, the specifics of CAC regulation are detailed, and the question of standard-setting as a component of regulatory design is discussed. Different available types of standard-setting in environmental CAC regulation are then

[112] Berg, Seeber (2016) p. 57.
[113] *Infra* Chapter 7.
[114] *Supra* Chapter 1 Section 1.4.

examined, and finally, this chapter is rounded off with some conclusions.

2.1 The Framework for the Study

The theoretical and analytical framework for this study is situated broadly within the school of regulatory studies. In recent years, the study of law and regulation or regulatory studies has increasingly grown into a distinct academic field.[115] Although the status of the field has perhaps not yet entirely been settled,[116] it is clear that various aspects of regulation, understood in a broader and more generic sense, increasingly continue to attract attention. The growing popularity of regulatory studies is not least witnessed by the fact that there are now several academic journals focusing on central questions of regulation.[117] Moreover, a number of academic publications generally introducing the field have been published.[118] The importance of questions central to the field is acknowledged in yet other works and

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[115] Morgan, Yeung (2007) p. 1. In this publication, various matters of the field of regulation is discussed under the book title of 'An Introduction to Law and Regulation'. The umbrella term 'regulatory studies' is employed for the field in Braithwaite *et al*. (2007), where the growing interest of regulation and governance is discussed. The latter source also provides a historical background to regulatory studies, tracing the academic interest in regulation as far back as to the early 1940s USA.

[116] Baldwin *et al.* (2012a) p. 13, stating that the field of regulation has however 'not yet achieved the status of true inter-disciplinarity—if this term refers to a state of play where researchers from various initial disciplines are transformed by their interchanges with fellow researchers and *thereby create a new discipline that is characterised by its own dominant understandings and research methodologies*' emphasis added.

[117] E.g. 'Law & Policy' which published its first volume in 1979, <http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291467-9930>, 'The Theory and Practice of Legislation' (formerly known as 'Legisprudence' which published its first volume in 2007) <http://www.hartjournals.co.uk/tpl/> and 'Regulation & Governance' < http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291748-5991> which also published its first volume in 2007.

[118] Some relatively recent examples of volumes regarding the generic study of regulation are Baldwin *et al.* (2012a) and Baldwin *et al.* (2012b) and Morgan, Yeung (2007).

projects,[119] and finally, the presence of regulatory studies can also be seen in university courses, programmes and at research centres.[120]

But what is regulatory studies? A look at the table of contents of a couple of volumes providing general introductions can give an overview of the scope of the field. Among other topics treated in these volumes there are theories of regulation, regulatory instruments and techniques, various aspects of regulatory design, enforcement and compliance, accountability and legitimacy and impacts of regulation in specific regulatory domains.[121] In addition, some scholars have argued that the broadened field of regulatory studies now also includes different notions of *governance*, which are not limited to a sole focus on the State as a governing authority, but which also encompasses, for example, the study of public-private governance and non-governmental organizations, as well as a multitude of forms of regulation emanating from entities other than the State.[122]

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[119] For some examples of works in regulatory studies regarding global environmental governance, see *e.g.* Kotzé (2012) DiMento, Hickman (2012). On the subject of making regulation better, Gunningham *et al*. (1999) can be mentioned, and on the regional level, the EU's programme for 'Better Regulation' <http://ec.europa.eu/smart-regulation/index_en.htm>. Finally, as commented *supra* Chapter 1 Section 1.4, examples of legal academic publications treating questions that are central for regulatory studies today, can also be found in the Nordic setting.

[120] For instance the regulatory studies specialization offered at Monash University, Faculty of Law <http://www.law.monash.edu.au/future-students/postgraduate/postgraduate-specialisations/regulatory-studies.html>, the Regulatory Policy Program offered at Harvard Kennedy School < http://www.hks.harvard.edu/centers/mrcbg/programs/rpp/about> and the research projects surrounding regulation and governance offered at the Centre for Socio-Legal Studies, University of Oxford < http://www.csls.ox.ac.uk/regulation.php>.

[121] See the tables of contents of Baldwin *et al.* (2012a), Baldwin *et al.* (2012b) and Morgan, Yeung (2007).

[122] Braithwaite *et al.* (2007) p. 3. See also Kotzé (2012) p. 83, who more or less equates broader and inclusive definitions of regulation with governance stating that 'The only conceivable difference between governance and regulation in the broad sense might be that governance is a more modern and socio-politically acceptable term than regulation, which instead is a part of older jargon. In a sense, the use of the word "governance" is therefore more fashionable than the use of the word "regulation"'. See also pp. 69-82 same source for an examination of various definitions of governance.

One significant feature of regulatory studies is that its development has generally trended towards multidisciplinarity. Today, regulatory studies as a field is central to several of the social sciences including but not limited to political science, law, economics, sociology, psychology, anthropology and history.[123] As a consequence, the field of regulatory studies has both broadened, matured and spread geographically.[124] Furthermore, it has now reached a state where it can be applied to the 'analysis of generic processes of regulation across specific sectors and across cultural contexts'.[125]

From a lawyer's point of view, regulatory studies can at the very least be considered as a discussion in which various disciplines meet to exchange ideas and examine regulation from the perspectives of their own disciplines, in a manner that suits the common and overarching theme of regulation in various forms. Regulatory studies, although engaging a broader range of sciences, can therefore be likened to other perspectives that are nowadays relatively common among legal academics, such as law and economics, and law and gender; perspectives that also draw upon and are enriched by the knowledge of other sciences. For a lawyer or a legal scholar, it is thus fully possible to engage in discussions under the umbrella or the perspective of regulatory studies, in an academically open environment which arguably helps to create 'advances in regulatory theory [that] will have an exciting integrative potential for the social sciences overall'.[126]

Why then, should researchers from various disciplines, including law, engage in regulatory studies? Shortly put, because regulation matters. As it has been stated:

'Bad regulation, after all, can do terrible damage to people. Good regulation can control problems that might otherwise lead to

[123] Braithwaite *et al.* (2007) p. 1 and Baldwin *et al.* (2012a) p. 4.
[124] For a long time, the USA was considered as the main arena for regulatory studies, but this has changed since the entrance of the European Union as an important source of new risk and competition regulation, Braithwaite *et al.* (2007) p. 1.
[125] Baldwin *et al.* (2012a) p. 5. See also p. 4, same source.
[126] Braithwaite *et al*. (2007) p. 4.

bankruptcy and war, and can emancipate the lives of ordinary people. Mediocre, unimaginative regulation that occupies the space between good and bad regulation leads to results that are correspondingly between the extremes of good and bad'[127]

Thus, the central topics of regulation mentioned above, such as regulatory instruments and techniques, various aspects of regulatory design, enforcement and compliance, and the myriad of other questions surrounding regulation *also matter*.[128]

In this thesis, regulatory studies is one of the primary theoretical and conceptual fundaments for the analysis of SO_x emissions regulation.[129] The overall motivation for utilising theories and concepts from regulatory studies is that the field offers tools appropriate for the aims and research questions formulated in this thesis. To begin with, no comparable suitable tools for completing the task of analysing terrestrial and marine SO_x emissions regulation across different regulatory scales while simultaneously considering various forms of regulatory standards are known to this author. Second, the tools located within the field of regulatory studies suit particularly well the ambitions in this thesis of analysing the design of SO_x emissions regulation. As Basse has put it, while traditional legal research perspectives have mostly focused on 'backward-looking' questions like the settlement of conflicts, intentions of the legislator and earlier settled cases, a regulation (and governance) perspective is instead 'forward-looking' in its study of regulatory instruments, systems and their application in practice.[130] The standpoint taken in this thesis, grounded in theories of regulatory studies, mainly belongs to this latter 'forward-looking' perspective. This, in the sense that questions surrounding the design of regulation in the form of standard-setting rather belong to the sphere of interest of the legislator than the judge.

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[127] Braithwaite *et al*. (2007) p. 4.

[128] For examples of the scope of matters in regulatory studies see *e.g.* table of contents from Baldwin *et al.* (2012a), Baldwin *et al.* (2012b) and Morgan, Yeung (2007).

[129] This method is further detailed *infra* Section 2.2.8. See also *infra* Chapter 7 Section 7.2.

[130] Basse (1992) pp. 123-124, author's own translation of original text.

2.2 Methodology

2.2.1 The Methodological Pyramid

A fundamental question for any scientific work is to locate methods fit for the stated purpose and research questions. At the outset, there was no apparent and readily available methodology for this study. Therefore, an initial task was to find a methodology apt for identifying and examining differences across regulatory scales between standard-setting in the largely successful regulation of SO_x emissions from terrestrial sources and the regulation of SO_x emissions from marine sources, and further, for identifying the underlying rationales for these differences, their effects, if any, and the possibilities of improvement of SO_x emissions regulation in the marine setting.[131]

The complete picture of necessary research tools and materials emerged gradually as progress was made in the research process. By approaching the purpose and the research questions in a stepwise manner however, a combination of methods seemed to provide the most sensible way for performing the research task at hand. Having settled on an analytical framework grounded in regulatory studies, three methodological steps, illustrated in Figure 2.1 below, were identified. Shortly put, these three steps are (1) identifying, (2) analysing, and (3) systematising. For pedagogical purposes, the steps are described here in consecutive order, although, as explained in greater detail in Chapter 7,[132] they communicate back and forth in practice. Regarding the application of the different methods in these steps, it is to be noted that once explained, a method's application is implicit in the rest of this thesis.[133] Thus, a method will not be explicitly referred to when used at every instance, except for where there would be a specific reason to do so.

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[131] *Supra* Chapter 1 Section 1.2.1.
[132] *Supra* Chapter 7 Section 7.2.
[133] With the exception of the demonstration of some methodological details that are better suited to be presented in context, in Chapter 7, all theories and methods employed in this study are introduced in the present chapter.

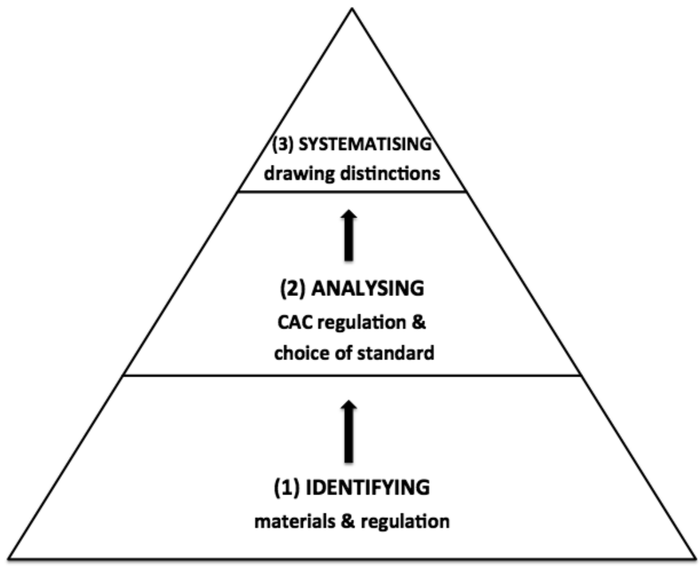

Fig. 2.1 The study's three methodological steps

The first methodological step is (1) to identify relevant material for this study. This step forms the base of the methodological pyramid. Since this study employs materials belonging both to 'traditional legal sources' and sources from other scientific disciplines, different methods have been considered for locating the relevant material in each category. Disregarding for a moment the methods used to find materials from other scientific disciplines, detailed in a dedicated section below,[134] the method or methods for locating legal materials in this thesis primarily has to fulfil two basic criteria. First, the use of the method or methods must successfully be able to identify historical and currently applicable regulation for SO_x emissions from terrestrial and marine sources. Second, the use of the method or methods should be able to identify regulation across regulatory scales.

[134] *Infra* Section 2.2.3.

A review of available legal doctrinal sources on air pollution,[135] and SO_x emissions in particular, suggests that the regulation of SO_x emissions from terrestrial and marine sources has been, and still is predominantly set out in written legal sources.[136] For a closer examination of historically and currently applicable rules in such sources, a legal dogmatic method appears suitable, since the first methodological step requires some kind of systematization and interpretation of SO_x emissions regulation.[137] Moreover such a method can be employed on several regulatory scales relatively unhindered by the fact that legal sources on the different scales vary in character.[138] Thus, as a first methodological step, a legal dogmatic method is deemed capable of fulfilling the two abovementioned basic criteria in a satisfactory manner.

The second methodological step, resting on the base of the identification of relevant (legal) materials, is (2) an analysis that constitutes the core of this thesis. In line with the research questions formulated above,[139] this analysis must firstly consider whether the regulation of SO_x emissions from terrestrial and marine sources in the identified legal material could indeed be categorized as CAC regulation, since this thesis focuses on CAC regulation, and secondly, which type of standard-setting is used in the identified CAC regulation?

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[135] *Supra* Chapter 1 Section 1.4.
[136] Further detailed *infra* Chapters 3-6.
[137] One definition of 'legal dogmatics' is provided by Peczenik (2009) p. 13, described as 'Another type of legal research, occupying the central position in commentaries and textbooks of law etc., implements a specific legal method, that is, the systematic, analytically-evaluative exposition of the substance of private law, criminal law, public law etc. Although such an exposition may also contain some historical, sociological and other points, its core consists in *interpretation and systematisation of (valid) legal norms*. More precisely, it consists in a description of the literal sense of statutes, precedents etc., intertwined with many moral and other substantive reasons. One may call this kind of exposition of the law "analytical study of law", "doctrinal study of law", etc. In the Continental Europe, one usually calls it "legal dogmatics".', emphasis added.
[138] The method employed to identify relevant material at each regulatory scale is detailed further immediately below in Section 2.2.2.
[139] *Supra* Chapter 1 Section 1.2.1.

For these purposes, some kind of conceptual frame is required. In other words, a method for analysis of standard-setting in CAC regulation is needed. As stated in Section 2.1 above, on a general level the discussion of concepts in regulation and its design has been the subject to scrutiny in the field of regulatory studies. Therefore, an initial search for definitions and conceptual tools was performed in regulatory studies literature. Environmental law sources dealing with discussions that are normally also found within regulatory studies complemented the search for useful methodological concepts. The results of this search, elaborated in more detail in Sections 2.2.4-2.2.8 below, provide a method close to what has been applied in previous legal research, and which can be applied across regulatory scales.[140] More specifically, the second methodological step involves the application of a frame of concepts, grounded in regulatory studies, to the relevant legal materials identified in the first methodological step. As stated, the purpose of this is, first, to analyse whether the identified SO_x emissions regulation is indeed CAC regulation, and second, what type of standard-setting is used in the CAC regulation controlling SO_x emissions from terrestrial and marine sources. The latter part of this analysis is presented in a dedicated analytical chapter[141] where distinctions are drawn as regards standard-setting between various regulatory scales in the terrestrial and marine settings.

This brings attention to the third and final methodological step, which is to (3) systematise and draw distinctions from the analytic results of the second methodological step. Here, it is to be noted that this is a different kind of systematization than the one mentioned when describing the first methodological step (1), where a legal dogmatic method involving another kind of systematization is initially employed to *identify* relevant legal materials.[142] One of the aims of the systematisation in step (3) is, apart from the systematisation itself, to

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[140] See *e.g.* the conceptual frame used in Morgan, Yeung (2007), which is applied across regulatory scales relatively unhindered. See also further comments regarding previous legal research *infra* Chapter 1 Section 1.4.

[141] *Infra* Chapter 7.

[142] *I.e.* the kind of systematisation that Peczenik (2009) p. 13 describes as the core of legal dogmatics: ‘interpretation and systematisation of (valid) legal norms’.

draw distinctions between the analysed standards in the previous methodological step. A related aim of the systematisation and the visualization of standard-setting in matrices, presented in Chapter 7, is further to allow for closer analysis of the regulatory standards as required by the research questions, *inter alia* also against the broader surrounding context of regulation described in the coming chapters 3-6.[143]

Once again, it must in this context be recalled that the underlying purpose of identifying and examining differences between regulation of SO_x emissions from terrestrial and marine sources is not to engage in a comparative study.[144] Instead, the purpose here is to examine differences concerning one function of regulatory design, that of standard-setting, between these scales and settings. The final methodological step is applied precisely for the latter purpose; in other words, to systematise the regulation of SO_x emissions from terrestrial and marine sources across regulatory scales with the aid of concepts from regulatory studies,[145] for the purpose of drawing distinctions between standards as required by the research questions.

2.2.2 The Methodological Pyramid, Regulatory Scales and Sources

2.2.2.1 The International Regulatory Scale

Following Sweden's legal obligations through the regulatory scales as defined for the purposes of this thesis,[146] the method and materials for the international regulatory scale as regards SO_x emissions will firstly be commented on. Taking a starting point in a legal dogmatic method, it is initially relevant to mention the 'canonical statement of formal

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[143] *Supra* Chapter 1 Section 1.2.1.
[144] *Supra* Chapter 1 Section 1.3.
[145] As is demonstrated by Morgan, Yeung (2007) pp. 303-334, it is fully possible to use a conceptual framework based on concepts from regulatory studies for analysing regulation *across regulatory scales*, including national, regional and international regulation. See also Baldwin *et al.* (2012b) pp. 373-439, for comments regarding various aspects of regulation of different levels of government.
[146] *Supra* Chapter 1 Section 1.3.

sources of international law',[147] namely Article 38 of the Statute of the International Court of Justice (ICJ). This is a commonly accepted and traditional starting point for identifying the formal sources of international law, which mentions treaties, custom, and general principles of law.[148] Since the international regulation of air emissions from terrestrial and marine sources, including SO_x emissions, is to a large extent governed by international treaties, as well as by custom and to some degree general principles of law,[149] this point of departure is appropriate for the present study when it comes to the *identification* of relevant legal materials.

To the extent that interpretation is performed in this thesis, generally accepted methods for treaty interpretation are located in the 1969 Vienna Convention on the Law of Treaties (VCLT).[150] Here, Articles 31-32 of the VCLT are of particular relevance. The general rule on treaty interpretation is found in Article 31 which provides, inter alia, that:

'1. A treaty shall be interpreted *in good faith* in accordance with the *ordinary meaning* to be given to the terms of the treaty *in their context* and *in the light of its object and purpose*.'[151]

Article 31(2) of the VCLT contains a listing of what is to be considered to be the 'context' for the purpose of interpreting a treaty. When studying and comparing international treaties these methods for interpretation are relevant to consider. For instance, in a case where the definition of air pollution is analysed in a certain legal instrument compared to how pollution is defined in other treaties. Article 31(3) contains a list of elements that shall be taken into account together with the context of a treaty. This includes 'any subsequent agreement' between treaty parties, 'any subsequent practice' in the application of the treaty and 'any relevant rules of international law'.[152] To most

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[147] Bodansky (2010) p. 98.
[148] Art. 38(1.)(a.)-(c.) of the Statute of the International Court of Justice, Annexed to the Charter of the United Nations (Statute of the ICJ).
[149] Further detailed *infra* Chapters 3 and 4.
[150] Shaw (2008) p. 933 and the VCLT.
[151] Art. 31(1.) of the VCLT, emphasis added.
[152] Art. 31(3.)(a.)-(c.) of the VCLT.

scholars of international law the last element seems to be taken to mean the formal sources of international law mentioned in Article 38 of the Statute of the ICJ.[153] This means that treaties, custom and general principles of law shall all be taken into account when a treaty is interpreted. Additionally, Article 32 of the VCLT basically states that under certain circumstances, in particular when the interpretation pursuant to Article 31(1) results in ambiguity or absurdity, recourse may be had to the negotiating history of a treaty when it is interpreted.[154]

Returning to Article 38 of the Statute of the ICJ, some other relevant sources are also listed. These sources, which are not among the formal sources of law according to Article 38, are judicial decisions and 'teachings of the most highly qualified publicists of the various nations'. Such sources are mentioned as subsidiary means for determining the content of international law.[155] As has been stated, the list of sources in Article 38 'does not wholly reflect the sources of obligation, broadly understood, which have arisen in international environmental law'.[156] To this end, case law is also taken into account where it is deemed to be relevant for the purposes of this thesis.[157]

Disregarding for a moment academic publications, something shall also be said about 'soft law' and a range of other documents, which are not among the traditional sources of international law. For the purposes of this thesis 'newer sources of environmental norms'[158] may also be taken into account. These 'soft law' sources include such non-binding documents as international declarations, codes of conduct, different guidelines, and action plans, as well as non-binding decisions and documents issued by international organizations and their sub-committees such as IMO and its Marine Environment

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[153] Linderfalk (2007) p. 177 with further references.
[154] Art. 32 of the VCLT.
[155] Art. 38(1.)(d.) of the Statute of the ICJ.
[156] Sands et al. (2012) p. 94.
[157] See *e.g.* Bodansky (2010) p. 95, where the importance of judicial and arbitral decisions in international environmental law is discussed.
[158] Bodansky (2010) p. 14.

Protection Committee, the MEPC.[159] Turning a blind-eye to these documents would mean ignoring the actual importance these documents have had and still have for the development of binding international environmental law, despite their formal non-legal or non-binding character according to a traditional view of legal sources.[160] Therefore, these sources may also be taken into account, for example where they help to shed light on the interpretation of binding instruments and their expression of standards in CAC regulation.

Finally, as regards legal materials or sources in the international realm, this study includes many references to publications of 'the most highly qualified publicists of the various nations'.[161] Such works by leading scholars are crucial when studying, for example, specific provisions of international treaties or international customary law.

In terms of applying the methodological pyramid presented in Section 2.2.1 above, after identifying the relevant sources, a frame of concepts for a two-part *analysis* of CAC regulation is applied. The first step of this analysis is the application of concepts, detailed further in Sections 2.2.4-2.2.8 below, to the identified international SO_x emissions regulation. This step assesses whether the regulation indeed fulfils the criteria for being categorized as CAC regulation. The second step of the two-part analysis is that the actual standard-setting in these instruments is scrutinized against the background of the description of typical standards used in environmental law, which are also detailed further in Sections 2.2.4-2.2.8 below. In the third and final methodological step, differences are identified in standard-setting in regulation between regulatory scales. This method consists of a

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[159] Bodansky (2010) pp. 14-15 and 94-96, where a broader view of sources of international environmental norms is presented. See also Harrison (2011) pp. 155-156 regarding the importance of formally non-binding instruments of IMO such as guidelines and resolutions for uniform interpretations.

[160] Bodansky (2010) p. 14, mentions the example of a United Nations (UN) General Assembly resolution establishing a moratorium on high seas driftnet fishing. Even though the UN General Assembly may only make recommendations, states chose to implement the resolution as if it were binding.

[161] Art. 38(1.)(d.).

systematization of the already identified and analysed standards in CAC regulation to allow for further analysis as required by the research questions, *inter alia* for the purpose of drawing distinctions between SO_x emissions regulation on the international terrestrial and marine regulatory scales.

2.2.2.2 The Regional Regulatory Scale

Regarding the materials used from the regional regulatory scale, legal sources concerning air pollution in general and SO_x emissions in particular are traced by *identifying* regional multilateral legal instruments that Sweden is a party to. This is done according to the same method described for international legal sources in the previous section.

When it comes to the specific regional sources of EU legal acts, a starting point is taken in a ‘traditional’ European legal method building on hierarchy and precedence in the case of conflict between primary, secondary and tertiary sources of EU law.[162] As regards tertiary sources, different EU soft law documents regarding SO_x emissions are to some extent taken into account, foremost to explain the historical development of EU SO_x emissions regulation.[163] Primary EU sources are also scrutinized in order to provide an overview of the EU legal basis of SO_x emissions regulation, and to some extent case law of the European Court of Justice where relevant.

Secondary EU sources constitute the bulk of relevant EU legal materials analysed in this thesis. The method for locating these sources is a combination of thorough search via EUR-Lex[164] for legal acts applying to SO_x emissions, and a search for applicable legal acts in doctrinal sources. As a complement, the air legislation listing of the

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[162] Senden (2012) p. 227. Regarding the study of a European legal method and whether it exists as a coherent method, see generally Neergaard, Nielsen (2012).

[163] The historical development of EU SO_x emissions regulation is detailed further *infra* Chapter 3. For some comments about the position of soft law among the EU sources of law, see Senden (2012) pp. 225-260.

[164] EUR-Lex is available via <http://eur-lex.europa.eu/homepage.html>.

European Commission's Directorate-General for the Environment is used to verify and identify applicable legal acts.[165]

After *identifying* the relevant regional sources, the second step is likewise the application of a frame of concepts for a two-part *analysis* of CAC regulation. Again, the first part of the second step is the application of concepts, detailed further in Sections 2.2.4-2.2.8, to the identified regional SO_x emissions regulation. This step again assesses whether the regulation indeed fulfils the criteria for being categorized as CAC regulation, although this time on the regional scale. The second part of the two-part analysis is once again the identification of the actual types of standard-setting, albeit here in regional legal instruments. The third and final methodological step is to draw distinctions between standard-setting in regulation between regulatory scales. This *systematisation* is applied both to the regional scale as well as to the international.

2.2.2.3 The National Regulatory Scale

As with the international and regional scales, the method for locating and studying relevant Swedish legal material starts in the 'traditional sources of law'. In this thesis, this means a study of written law, *travaux préparatoires* or preparatory works, any available case law, and legal doctrine regarding air emissions with a particular focus on SO_x emissions.[166] However, some soft law documents are also examined.[167]

In the case of relevant written law concerning SO_x emissions, several types of Swedish legal documents implement the European directives on air emissions. The implementation of these directives comes in forms such as acts, ordinances and instructions. The identification of which directive has been implemented in which act, ordinance or instruction has been performed by tracing the EU act in the Swedish preparatory works. To be certain about which statutes implement

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[165] The list is available at <http://ec.europa.eu/environment/air/legis.htm>.
[166] For a listing of the 'traditional sources of law' from a Swedish perspective, see e.g. Strömholm (1996) pp. 289-298 and Sandgren (2007) p. 403.
[167] *E.g.* the Swedish environmental objectives commented *infra* Chapter 5 Section 5.3.

which EU legal acts, the RIXLEX (the ‘parliamentary public database’) and the svensk författningssamling or SFS (‘Swedish Code of Statutes’) have been accessed. In the bibliographic information for each statute, the preparatory works are listed, including government bills with legislative proposals and references to the official journal of the European Union. For each Swedish statute discussed, the bibliographic information references to the official journal of the European Union have been checked to see which EU legal act that is mentioned as preparatory works. In this manner, the EU basis of a specific national act or ordinance has been controlled. This is especially relevant when tracing the origins of new legal initiatives since the Swedish government bills are not always totally clear about which EU acts a new national statute has been based on. Furthermore, in the case of Swedish ordinances, there is seldom an equivalent document to a governmental bill serving as preparatory works, in which case the bibliographic information of the ordinance can still contain the relevant references to EU law.

As in the case of the materials to be analysed on the international and the regional scales, after *identifying* the relevant national sources, the second methodological step applied to the national scale requires using the frame of concepts developed further in Sections 2.2.4-2.2.8 for a two-part *analysis* of CAC regulation. Again, the first part of the second step is the application of concepts to the identified national SO_x emissions regulation. The second part of the two-part analysis is once again the identification of the actual types of standard-setting, however in this case applied to national legal acts. The final methodological step used on the national scale is the drawing of distinctions between standard-setting in regulation between regulatory scales. This *systematisation*, already described in the previous sections, is likewise performed on legal materials from the national scale.

2.2.3 A Further Note on Non-Legal Sources

The materials or sources in this study have been divided into two main categories: ‘Legal Materials’ and ‘Other Materials’. Admittedly, there are overlaps between these two categories. For materials, it is thus possible to use the umbrella term ‘sources of knowledge’ as a label including all of these materials.[168] However, for reasons of presentation, two categories instead of one are used when commenting on how theories and methods are applied to the materials.

With respect to non-legal materials, methods other than those employed for locating legal materials are used in this study to find materials from other scientific disciplines. Since the use of materials from other scientific disciplines may be viewed as a departure from a traditional legal view on the use of sources, this subsection firstly explains why other materials are used. Thereafter, some comments follow explaining how other methods to locate materials are employed, and what these other methods and materials are.

As for the question of why this thesis uses sources from other disciplines than law, several arguments can be mentioned. To begin with, an argument from a general perspective is the belief that the solution to a scientific problem can transgress the borders of a single discipline.[169] Just like issues surrounding genetically modified organisms (GMOs) have engaged researchers from numerous fields,[170] questions regarding standard-setting in the regulation of SO_x emissions from terrestrial and marine sources require the utilization of more than just legal perspectives. This is especially true with regard to the role of natural science in defining what is to be considered an environmental problem. Here, science not only works as a 'wake-up call', but it can also help decision makers form solutions and

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[168] Gustafsson (2002) p. 73, author's own translation.

[169] As Popper puts it: 'Disciplines are distinguished partly for historical reasons and reasons of administrative convenience (such as the organization of teaching and of appointments), and partly because the theories which we construct to solve our problems have a tendency to grow into unified systems. But all this classification and distinction is a comparatively unimportant and superficial affair. *We are not students of some subject matter, but students of problems.* And problems may cut right across the borders of any subject matter or discipline', Popper (2010) p. 88, footnotes omitted.

[170] A quick look at the discussions regarding GMOs gives at hand both pro and contra arguments from various disciplines. For example, representatives from natural science, legal expertise as well as economists all participate in debates concerning GMOs. See *e.g.* Holder, Lee (2007) pp. 61-84.

proposals for political action to combat environmental problems.[171] Down the line of political action, science also has an important legitimizing function for legal measures.[172] A concrete example is the international legal regime to protect the ozone layer where science had a decisive role in the emergence of legislative initiatives.[173]

Without trying to understand, at least on a basic level, the science and theory behind air emissions and particularly the problems associated with SO_x emissions, there are imminent risks of conducting research with unacceptably simplistic perspectives. In extension, this may result in research with only a limited usefulness.[174] To mitigate such risks, and in line with previous studies in environmental law,[175] sources from other disciplines like natural science are therefore examined in this thesis to present a realistic background which legal rules, and more specifically standard-setting, operates against. At the same time, the use of materials from other sciences helps to provide a broader surrounding explanatory context needed for the purposes of this thesis.[176] In this sense, the first step in the methodological pyramid described above in Section 2.2.1 thus not only revolves around identifying suitable legal materials for this thesis, but also suitable materials from other sciences that uncover certain facets of

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171 Lidskog, Sundqvist (2007) p. 178.
172 Bodansky (2010) p. 19, stating that 'Most of the major developments in international environmental law have had their origin in science', and making particular reference to science in the case of regulating sulphur emissions and acid rain. See also Holder, Lee (2007) pp. 12-34, where the use of the scientific paradigm in legal research is problematized, and Birnie *et al.* (2009) pp. 99-100.
173 Pleijel, Karlsson (2007) p. 123, where the 1985 Vienna Convention for the Protection of the Ozone Layer and its 1987 Montreal Protocol with later amendments is discussed as 'likely … the most efficient international environmental regime that has been established so far'. See also p. 133 where the effects of science on policy to combat ground level ozone are described.
174 Hydén (2002) p. 63, where it is argued that traditional legal research in comparison with legal sociology often has been conducted without complementary perspectives that could have added an understanding for law and legal decisions in their context. The inclusion of complementary perspectives can thus be seen as a way of providing stronger connections to 'reality', Dalhammar (2007) pp. 36-37.
175 Regarding air pollutants, see *e.g.* Okowa (2000) p. 6.
176 See *supra* Chapter 1, Sections 1.4-1.5.

the interplay between for instance technology, natural science, politics and the design of regulation as regards standard-setting.

As for how other sources are used, a question that has perhaps been looming large on the horizon is whether this thesis strives to be interdisciplinary?[177] Disregarding the unclearness around the meaning of ‘interdisciplinary research’, the purpose of using sources from other disciplines is not to display excellence in several research fields. Rather, these sources are used to present a factual background and to enrich arguments and ideas connected to the thesis.[178] Additionally, and importantly, they allow for a closer analysis of the regulatory standards in Chapter 7 against a broader surrounding context, which aids answering the research questions of this thesis.[179]

Getting to which ‘other sources’ are used, notably several reports and works with a natural science background are used to advance argumentation, for example, about the importance of regulation of vessel-source air pollution.[180] A very basic level of background knowledge about maritime economics and shipping has also been acquired from non-legal sources.[181] Furthermore, reports and information from several NGOs have been studied.[182]

Apart from the NGO information resources about air emissions (and ships) available at AirClim and Clean Shipping Coalition,[183] the

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[177] A multitude of practices are covered by the term ‘interdisciplinary research’, Committee on Facilitating Interdisciplinary Research, CFIR (2004) p. 24. See also Sunnemark, Åberg (2004) p. 11, describing the salient features of ‘interdisciplinary research’ by stating that it is not a given method or theory, but rather an approach or perspective.

[178] *E.g.* Mukherjee, Xu (2009) p. 96, where the value of ’combined effort of and cooperation among different disciplines’ is underlined in the context of ship-source air pollution. See also McNeill (1999) who in line with other scholars argues, that simply citing authors from other disciplines does not amount to interdisciplinary research.

[179] See *supra* Chapter 1 Sections 1.2.1, 1.4 and 1.5.

[180] See also *supra* Chapter 1 Section 1.4, commenting on some other works regarding the scientific understanding behind and the history of environmental policy in Europe.

[181] In this case mainly Stopford (1997) and Stopford (2009).

[182] *E.g.* ICCT (2007) and AirClim *et al.* (2011).

[183] See <www.airclim.org> and <www.cleanshipping.org>.

online news and information resource Sustainable Shipping has frequently been used to keep up to date with the topic of this thesis. The latter resource is dedicated to marine transportation and the environment. Everything from news to various publications for maritime stakeholders is available for subscribers. Sustainable Shipping has thus been a useful aid for getting nuancing opinions concerning regulatory development, and for instance the recurring official briefings published on IMO's homepage.[184]

Finally, the question of the methods used for locating the 'other sources' just described must be addressed. As has perhaps implicitly already been stated, online information resources are used to identify relevant materials for this thesis. Additionally, two other essential methods for gathering other materials have been interaction within scientific networks and research visits. In this respect, the multidisciplinary research environment in the Lighthouse[185] network has in different ways provided valuable input that has had an overall positive influence on the research process. Here, interaction and activities within Lighthouse should be emphasised. Several recurring seminars between 2008-2013 *inter alia* about maritime economics, ship safety, ship construction and environmental issues surrounding ships and shipping have provided increased understanding of and communication with different research disciplines during the writing of this thesis.

Extensive use has also been made of the opportunity to communicate within the Lighthouse network via e-mail and in person with some of the world's leading experts from different backgrounds. For example, this has included discussions about air emissions from ships from the perspective of natural science, but also discussions about technical aspects of ships that have among other things aided the formulation of delimitations in this thesis. Furthermore, communication within the Lighthouse network has been an excellent way of locating other than strictly legally orientated sources which has shed light on important

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184 Sustainable Shipping, formerly available via a dedicated site, can now be reached at <www.bunkerworld.com>. Official IMO briefings are available via <www.imo.org>.

185 For more information, see <www.lighthouse.nu>.

issues that probably otherwise would have been disregarded. Additionally, contacts within Lighthouse have also facilitated the access to official IMO documents.

Regarding research visits as a method, contacts within Lighthouse helped the author to acquire observer status at MEPC 62 in July 2011.[186] By participating during MEPC 62 new insights were gained regarding the international and political aspects of this project, chiefly by being able to experience the course of actual negotiations in the MEPC. Starting in the spring of 2011, the author was also a guest researcher at the Scandinavian Institute of Maritime Law, Oslo, Norway. Recurring research visits to the inspiring environment at the institute has helped advance ideas and thinking surrounding the problems of this thesis, and several new valuable contacts and sources have been acquired. In sum, these research visits have been useful complementary methods that have heightened the overall quality of this study.

2.2.4 The Concept of Regulation

Having commented on theory, methodology and sources in the previous sections of the current chapter, the following Sections 2.2.4-2.2.8 further develop the frame of concepts, starting with the concept of regulation, used for the two-part analysis of CAC regulation employed for fulfilling the second step of the methodological pyramid of this thesis.[187]

The concept of regulation has often been described as notoriously difficult to define, and precisely what regulation is has long been contested.[188] Indeed, it has been argued that any attempt to define regulation will always suffer either from under- or over-inclusiveness.[189] Instead of a set focus on uncovering what regulation

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[186] *I.e.* The 62nd session of the IMO's Marine Environment Protection Committee.
[187] *Supra* Section 2.2.1.
[188] Morgan, Yeung (2007) p. 3. See however Koop, Lodge (2015) p. 11, arguing that shared conceptions of regulation do exist even across disciplines, although at a high level of abstraction.
[189] Baldwin *et al.* (2012a) p. 12. See also Baldwin *et al.* (2012b) p. 3 where examples of degrees of inclusiveness in regulation definitions are given. The examples range

really is and *what precise scope it has*, some legal scholars have tried to avoid common definitional obstacles by looking at important components or *functions* that are most commonly found in regulation. This approach has been described as taking a functional approach to regulation.[190]

A starting point of the functional approach, also known as the 'cybernetics perspective' to regulation,[191] has been to distinguish *three basic functions of regulation*.[192] As Hood *et al.* put it:

'…any control system in art or nature must by definition contain a minimum of the three components … There must be some capacity for *standard-setting*, to allow a distinction to be made between more or less preferred states of the system. There must also be some capacity for *information-gathering* or monitoring to produce knowledge about current or changing states of the system. On top of

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from viewing regulation as 'a specific set of commands' to the broader view of viewing it as 'deliberate state influence', and in the broadest view regarding it as including 'all forms of social control'. As for inclusiveness, it is relevant to say a few words about the concepts of 'regulation' and 'governance' in relation to each other. Although some authors have more or less equated broader and inclusive definitions of regulation with governance, *e.g.* Kotzé (2012) p. 83, this thesis acknowledges that the concept of 'regulation' should still be understood as a narrower concept than 'governance'. Although 'regulation' is understood in this thesis as including more than only traditional forms of regulation, it is still included under, but simultaneously overlapping with some parts of 'governance'. In this sense, Braithwaite *et al.* (2007) p. 3 has described this relation between regulation and governance by stating that regulation is 'that large subset of governance that is about steering the flow of events and behavior, as opposed to providing and distributing'.

190 Another term for this is the 'pattern-based definition' of regulation, where 'prototype' regulation is described in terms of necessary defining traits, Koop, Lodge (2015) pp. 10-11.

191 Morgan, Yeung (2007) p. 3.

192 As Brownsword argues, commenting on a regulation model proposed by Murray and Scott, these 'three dimensions … are fundamental to whatever strategy is adopted', Brownsword (2005) p. 6. Indeed, other widely acknowledged definitions of regulation also include these three dimensions of regulation. For example, Black (2002) p. 26, defines regulation as 'the sustained and focused attempt to alter the behaviour of others according to defined standards and purposes with the intention of producing a broadly identified outcome or outcomes, which may involve mechanisms of *standard-setting, information-gathering and behaviour-modification*' emphasis added.

that must be some capacity for *behaviour-modification* to change the state of the system.'[193]

These three basic functions, elements or dimensions of regulation[194] constitute a 'generic trio of regulation' which appears as a consequence of how questions are posed when regulation is studied and described from a cybernetic point of departure.[195] Speaking in a very simplified manner, instead of defining something by asking 'what is it?', a cybernetic point of departure rather lands in questions like 'what does it do?' or 'what can it do?'.[196] These two latter questions are also natural to pose in relation to general systems theory and the study of systems, within which the core of cybernetics may be placed.[197]

Notwithstanding the multitude of definitions of cybernetics,[198] a basic understanding is that a system is not under control in the cybernetic sense if any of the three core functions mentioned above are lacking. Two other basic assumptions relating to the core functions may however also be added. The first is that there must be sufficient room for variation of *different states* within each of the three functions, because what is regulated may go through varying phases. The second is that the three basic functions of the system must somehow *be linked and communicate* to properly be controlled in a cybernetic sense.

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[193] Hood *et al.* (2001) p. 23.

[194] To avoid confusion, this thesis will hereinafter keep to using the term *functions* as in the 'three basic *functions* of regulation'. These three functions are discussed in regulation literature also with other terms such as basic 'components', 'dimensions' or 'elements' of regulation.

[195] *E.g.* Hood *et al.* (2001) p. 23. See also Brownsword (2005) p. 7 and Murray, Scott (2002) pp. 502 and 504.

[196] Olsson (2005) p. 40, with further references. In this manner, it could be said that describing the functions of the system becomes its definition.

[197] Explaining the relations and overlaps between different schools of thought in systems and systems theory is beyond the scope of this thesis. For an introduction to these questions, see however generally Olsson (2005) pp. 31-74.

[198] *E.g.* the many definitions given at American society for cybernetics's homepage, available at <http://www.asc-cybernetics.org/foundations/definitions.htm>.

Linking the three functions is often a weak part in any control system.[199]

In any event, the purpose of introducing a broad functional or cybernetics-inspired approach to regulation in this section is not to elaborate on an advanced theory of feedback loops. Instead, the generic trio of regulation defines a starting point from which the design of regulation, with a focus on standard-setting, can later on be discussed and analysed, even across regulatory scales.[200] Departing from the waypoint of the generic trio of regulation, the next section presents some different types of regulation.

2.2.5 On the Categorization of Regulatory Instruments

It is now time to add further nuance to how regulation can be described. To this end, another basic question to consider is how different types of regulation can be distinguished from each other?

With the presentation of regulation in terms of the generic trio of regulation still in mind, the view taken in this thesis is that regulation can also further be sorted into various subcategories. When it comes to such categories, scholarly sources often begin by dividing regulation by considering regulatory instruments[201] of at least two broad categories including:

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[199] Hood *et al.* (2001) pp. 23-24. Hood *et al.* argue that linking weaknesses between the three functions are witnessed by 'frequent underlaps, conflicts, and communication failures', see p. 24 same source. For similar thoughts about the importance of linkages of regulatory components in environmental legislation, see Westerlund (2004) p. 68.

[200] For an example of application of the generic trio across regulatory scales, see *e.g.* the conceptual frame used in Morgan, Yeung (2007), departing from the generic trio, and which is applied across regulatory scales relatively unhindered.

[201] In this thesis the term 'regulatory instruments' is used to denote what is also described with several other equivalent terms in scholarly publications. For instance, regulatory instruments are also described by scholars as 'regulatory approaches' or 'regulatory techniques' e.g. Sands *et al.* (2012) p. 121, 'tools' in a 'regulatory toolbox' e.g. Morgan, Yeung (2007) p. 79 and p. 9, and as 'policy instruments' e.g. Bodansky (2010) p. 71 and Vedung (2007) p. 21.

‘traditional forms of direct regulation (frequently referred to as “command-and-control”), and techniques that make use of *economic incentives (referred to as “economic instruments”)*’[202]

In the most basic of categorizations, traditional forms of direct regulation, ‘command and control’, or CAC regulation are more or less used as the point of reference against which other (more indirect) categories of regulatory instruments are defined.[203] This is largely as a consequence of criticism since the 1980s of various deficiencies of CAC regulation.[204] As elaborated further immediately below,[205] CAC regulation typically targets its addressees in a direct and often detailed manner, underpinned by some kind of sanction to evoke a desired behaviour. A typical example of CAC regulation is a rule that prescribes a prohibition on a certain type of industry surpassing specified levels of SO_x emissions by threat of either civil or criminal.

The use of typical economic instruments such as taxes, fees, subsidies, and tradable emission units has often been motivated by merit of their flexibility and cost-advantage in contrast to the direct and specific demands of CAC regulation.[206] Such instruments ‘intend to bring about the desired behavioural change through the operation of the competitive forces of the market’.[207] Thus, economic instruments, often also referred to as ‘market based instruments’,[208] rather work *indirectly* to promote certain behaviour through market mechanisms affecting the addressees.

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202 Sands *et al.* (2012) p. 121, emphasis added. As is further added as an addition to these two categories, ’Sometimes included within the latter category are a range of information and incentive-based techniques that make available certain kinds of information to market participants or enhance the incentives markets provide for particular types of behaviour’, same source and page.

203 Indeed, as has been stated, CAC regulation ‘is often the norm against which “alternative” approaches to regulation define themselves’, Lee (2014) p. 82.

204 Baldwin *et al.* (2012a) p. 9 and Lübbe-Wolff (2001) p. 79.

205 *Infra* Section 2.2.6.

206 Stewart (2008) pp. 151-152 and Bodansky (2010) p. 80.

207 Morgan, Yeung (2007) p. 88.

208 Bodansky (2010) p. 80.

Yet another group of instruments, commonly mentioned, is 'information-based approaches' or instruments.[209] If economic instruments are regarded as less intrusive than CAC regulation by merit of instead letting market forces steer the actions of the regulatees, for example by allowing the flexibility of an actor to determine its pollution levels based on a market price of pollution,[210] information-based approaches 'leave total flexibility to actors in choosing both the environmental result and the means for achieving it'.[211] Some typical examples of information-based instruments are ecolabels, public disclosure of pollution discharges, and environmental auditing and reporting.[212] In general, this group of instruments principally builds on persuading and educating members of the regulated community so that the regulatory goals will be reached. The central element is that regulatory goals are pursued via communication of *information* about a regulated phenomenon, which can potentially lead to more informed decisions and behaviour among the regulatees.[213]

As regards the categorization of regulatory instruments, a couple of standpoints are taken in this thesis. First, it is acknowledged that a range of different regulatory instruments may be identified under the basic label of 'regulation', and that these instruments, depending on perspective, may further be subdivided into various subcategories.[214] However, as noted in Chapter 1 Section 1.3 above, this thesis focuses

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[209] Stewart (2008) pp. 152-154. See also Bodansky (2010) p. 84.
[210] Stewart (2008) pp. 151.
[211] Stewart (2008) pp. 153.
[212] Stewart (2008) pp. 153.
[213] Morgan, Yeung (2007) pp. 318-319.
[214] Although different views exist regarding what the generic trio of regulation actually embraces, this thesis acknowledges that regulation includes not only classic and direct forms of regulatory intervention, but also other forms involving 'indirect intervention, private-sector regulators, public-sector regulatees, non-binding standards, and non-economic activities', Koop, Lodge (2015) p. 11. A similar point of departure is taken in Morgan, Yeung (2007) p. 3, and their following categorization of regulation according to different underlying 'modalities'.

specifically on examining the design of standard-setting in command instruments or CAC regulation.[215]

Second, regulatory instruments may be differentiated in several ways depending on the chosen perspective. For example, some consider differentiating traits such as degree of flexibility and level of intrusiveness for regulatees,[216] while others identify regulatory instruments mainly from focusing on the underlying 'modalities' that make their mechanics work.[217] Regardless of which factors lead to a certain categorization, it is here acknowledged that no categorization can be regarded as final, even the one used in this thesis. Yet other categories or models can be created depending on context and what is to be studied.[218]

Finally, in this thesis, although CAC regulation is the centre of attention, what has been called instrument 'hybridity' always operates in the background.[219] That is, the categorization of a certain regulatory instrument as belonging to a certain category must always be seen against the reality of hybridity and instrument overlap. Regulatory instruments contain traits of each other and a certain category is therefore never absolute. For example, if they are to be accepted, it would be hard to imagine typical economic instruments like taxes and subsidies, building on economic incentives, which are not

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[215] Further detailed *infra* Sections 2.2.6-2.2.8.

[216] *E.g.* Bodansky (2010) pp. 71-84 and Stewart (2008) pp. 150-154.

[217] Morgan, Yeung (2007) p. 79-80. That is, the mechanism of a regulatory instrument that *mainly* drives behavioural change in a wanted direction. This can also be explained in terms of *form* and *function*. For instance, regulation with the underlying mechanism of 'command' can appear in diverse *forms*. These forms can however still be bundled under the same modality on the basic premise that their main feature or *modality* is that they *function* according to a 'command' mechanism. Other types of regulation can be driven by yet other mechanisms or modalities, as argued in Morgan, Yeung (2007), by way of 'competition', 'consensus', 'communication', and 'code', see Morgan, Yeung (2007) pp. 79-113. Other legal scholars have similarly proposed models that refer to modalities of regulation, however with different labels. One example is a model proposed by Lessig, in which there are four regulatory modalities (of constraint), namely: law, social norms, market and architecture, Lessig (1999) pp. 4-5 and Lessig (2006) pp. 123-124.

[218] Morgan, Yeung (2007) p. 105.

[219] Morgan, Yeung (2007) pp. 105-106 and Stewart (2008) pp. 154.

simultaneously formally supported by a legal structure of a command type. By contrast, regulation that is labelled as CAC can to a considerable extent still build on economic rationales such as cost-effectiveness.[220]

2.2.6 Command and Control Regulation

Before revisiting the definition of 'regulation' it is necessary to further define 'command and control' regulation. As noted in Section 2.2.5 above, CAC regulation or direct regulation, is often referred to as 'classical' or 'traditional' regulation.[221] As a consequence, it has been a given point of departure in regulatory discussions both for regulators and regulatory academics since the 1960s.[222] Available definitions vary in scope and content, but a starting point for the purposes of this thesis can be to define CAC regulation as:

'the state promulgation of legal rules prohibiting specified conduct, underpinned by coercive sanctions (either civil or criminal in nature) if the prohibition is violated'[223]

This state-centric take on CAC regulation captures the core features of several definitions. Principally, CAC regulation operates through 'rule-based coercion', backed by State authority, in a direct and often

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220 Here, a good example can be taken from the international regulation of SO_x emissions since 1994 within the framework of the 1979 Convention on Long-range Transboundary Air Pollution (LRTAP Convention). Since 1994, the assessment modelling underlying the concrete demands for SO_x emission reductions have specifically focused on finding the lowest cost for SO_x emission reduction measures in every geographical 'grid cell', see further *infra* Chapter 3 Section 3.1.3.

221 *E.g.* Morgan, Yeung (2007) p. 81 and OECD (2006).

222 Baldwin *et al.* (2012a) p. 8.

223 Morgan, Yeung (2007) p. 80. Another definition is provided by Abbot (2006) p. 61, stating that 'the term "command and control" refers to the prescriptive nature of regulation, *the command*, supported by the imposition of some negative sanction, *the control*. In other words, it involves the "command" of the law, backed by the authority of the State', emphasis added. Yet another definition is provided by Lübbe-Wolff (2001) p. 79, who simply states that it is 'an approach which consists in making the addressees of the law behave in the way you want them to behave by way of direct and detailed prescription of the desired behaviour'.

detailed manner.[224] Although most commonly defined for the national setting, equivalents of these core features may however also be located in regulation *across regulatory scales*, taking into account that regulation on the international scale, and the regional EU scale is created and works in other contexts/scales.[225] For the purposes of this thesis, the relevant point is that CAC regulation can be identified on scales beyond the national scale as well, notwithstanding that CAC regulation beyond the State level is not identical in character, but rather appears in forms with equivalents of those core features typically found in national scale CAC regulation.[226]

A final point to add regarding CAC regulation is that environmental law scholars have examined the specifics of *environmental* CAC regulation. Thus, the mechanics of CAC regulation have been examined from an environmental law perspective, *inter alia* leading to the categorization of certain environmental approaches or regulatory strategies *within* CAC regulation.[227] These approaches can be viewed as variations of standard-setting in CAC regulation viewed in the broader setting. Before examining environmental standard-setting in CAC regulation more closely, the next section will firstly consider

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[224] Morgan, Yeung (2007) p. 80 and Lübbe-Wolff (2001) p. 79.

[225] According to Morgan, Yeung (2007) pp. 303-304, the equivalent of national regulation on the international scale would be binding international undertakings that are voluntarily agreed on by sovereign States. On the latter scale, it is in extension still possible to talk about 'command-based techniques' in international regulation, even if important mechanisms like the coercive force of law is considerably weakened on this scale compared to the national scale, see same source pp. 313-315. The setting of international regulation is in turn different from regional regulation created by EU as a supranational entity, since the EU could be regarded as a special case with constitutional features. Indeed, the EU has its own institutions with powers to govern, regulate and adjudicate, Schütze (2012) p. 45.

[226] For instance, in the public international law setting, academics discuss CAC regulation in terms of ’command-based techniques’ Morgan, Yeung (2007) p. 314, ’command-and-control style regulation’ Long (2015) p. 183 or simply as ’command-and-control regulation’ Bodansky (2010) p. 75. Similarly, in the regional EU setting, CAC regulation is for instance discussed in terms of ’command and control approaches’ EU Commission (2015) p. 86 or simply as ’command and control’ p. 82 Lee (2014).

[227] *E.g.* Lübbe-Wolff (2001), Abbot (2006) and Sands *et al.* (2012) pp. 122-124.

some general aspects of standard-setting in regulation relevant to the analytical ambitions of this thesis.

2.2.7 Standard-Setting in the Design of CAC Regulation

Returning again to the generic trio of regulation introduced above,[228] it was stated that one of the essential functions of regulation is standard-setting. Although it is acknowledged that this function works together with the other functions of the generic trio, it is to be recalled that this thesis focuses solely on some chosen aspects of the function of standard-setting in relation to SO_x emissions when controlled by CAC regulation.[229] In this section, the specifics of these aspects are explained.

Initially, standard-setting was simply explained as the function of allowing 'a distinction to be made between more or less preferred states of [a control] system'.[230] Generally speaking, the standard-setting function of regulation has to do with setting limits, benchmarks or at least some kind of overarching aim. Reaching a less preferred state of a given system could thus mean that a violation has occurred. However, for a violation to be more certainly established, some point of reference or standard must exist that is actually violated. Points of reference through standard-setting or policy-making come in many different forms. The range spans both harder, more absolute standards, and softer less defined ones. As a practical matter, standards can be everything from stricter limit values and targets to vaguer objectives, goals and guidelines.[231]

As noted in Chapter 1 Section 1.2, when it comes to the design of environmental regulation, standard-setting is one of the most crucial aspects, especially in CAC regulation.[232] While there are many relevant questions in relation to environmental standard-setting, for example, how standards are arrived at, or their stringency, this thesis

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228 *Supra* Section 2.2.4.
229 *Supra* Chapter 1 Section 1.3.
230 *Supra* Section 2.2.4.
231 Hood *et al.* (2001) p. 25, mentioning some of these types of standards.
232 Holder, Lee (2007) p. 362.

instead focuses on examining different types (forms) of environmental standards in regulation as a way of approaching regulatory design in the area of SO_x emissions control.[233]

To begin with, 'standards' in environmental regulation, and specifically as regards pollution control,[234] can be understood in various ways. In the narrowest sense, 'standard' can simply be taken to mean 'a legally enforceable numerical limit'.[235] However, other broader understandings are available. For example, an 'environmental standard' has also been described as:

'any judgement about the acceptability of environmental modifications resulting from human activities … formally stated after some consideration and intended to apply generally to a defined class of cases … [and] because of its relationship to certain sanctions, rewards or values, it can be expected to exert an influence, direct or indirect, on activities that affect the environment'[236]

Notwithstanding the variety in definition, with a departure in this brief and general introduction to standards in regulation, and more specifically environmental standards in pollution regulation, it is now possible to introduce a more precise typology of standards that is employed in this study for analysis of standard-setting in regulation of SO_x emissions from terrestrial and marine sources.

2.2.8 Standard-Setting in the Design of Environmental CAC Regulation – A Typology of Standards

Environmental law scholars usually distinguish between a number of basic categories of standards in environmental regulation. Although typology tends to vary depending on focus,[237] this thesis utilises a five

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[233] *Supra* Chapter 1 Section 1.3.

[234] Other environmental standards could for example relate to the 'management of species, interference with habitats or methods of cultivation' RCEP (1998) p. 3.

[235] Holder, Lee (2007) p. 362 and RCEP (1998) p. 3.

[236] RCEP (1998) p. 3 and Holder, Lee (2007) p. 362.

[237] For some examples of variation in typologies, see *e.g.* Abbot (2006) p. 66-69 (two main categories: I. target standards and II. source-based standards, with five sub-categories: I.1 ambient standards, I.2 receptor standards and II.1 emission standards,

category division of environmental standards in CAC regulation. Four of these five categories arguably cover a representative sample of different standard typologies identified in scholarly sources in relation to environmental pollution regulation.[238] Additionally, these categories have been applied across regulatory scales by legal scholars.[239] Graded after what has been described as an increasing level of sophistication, or conversely, a decreasing level of crudeness,[240] the four standard categories are: (a) product standards; (b) process standards; (c) emission standards; and (d) environmental quality standards. To this a fifth residual catch-all category can be added; (e) other standards.

(a) *Product standards* are source-related standards formulated by reference to the pollution source.[241] Typically, these standards 'establish levels for pollutants or nuisances which must not be exceeded in the manufacture or emissions of a product, or specify the

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II.2 process standards and II.3 product standards, Lübbe-Wolff (2001) p. 81 (three categories: I. technical prescriptions, II. emission standards and III. quality standards) and RCEP (1998) p. 4 (nine categories: I. biological standards, II. exposure standards, III. quality standards, IV. emission standards, V. product standards, VI. process standards, VII. life cycle-based standards, VIII. use standards, IX. management standards).

[238] Abbot (2006) p. 66-69, Lübbe-Wolff (2001) p. 81 and RCEP (1998) p. 4. This thesis has no further ambitions to reconcile different typologies of regulatory standards. It is here all the same noticed that the exemplified typologies are different, and at the same time share several common features as described in scholarly sources.

[239] For an international application, see Sands *et al.* (2012) pp. 122-124. For an application, *inter alia* in a regional (EU) setting, see Goodwin, Somsen (2010) 113-114. For an application in relation to national settings, see Abott (2006) pp. 65-69.

[240] Goodwin, Somsen (2010) p. 113 arguing that 'Standards are crude when they relate to the *environmental performance* of products (product standards) or industrial installations (emission standards) *without having regard to the receiving environments* (water, air, soil) they are intended to protect. By way of example, emissions by diesel-engines have been regulated (product standards) without regard to the impact of the sum-total of the growing number of diesel-engines on climate change', emphasis added. By contrast, standards that are drafted with regard to the receiving environments, like 'alternatives tailored to ecological quality objectives', tend to be more sophisticated as they require 'much higher levels of scientific and administrative expertise', same source pp. 114 and 113. See also, Abbot (2006) pp. 68-69.

[241] Abbot (2006) p. 66.

properties or characteristics of design of a product, or are concerned with the ways in which a product is used'.[242] For instance, product standards can be formulated as a requirement that new oil tankers must be fitted with double hulls when they are built, or that the sulphur content levels in fuels must not exceed a certain concentration if they are to be used in ships or trucks.

(b) *Process standards* are also source-related standards[243] which 'can be developed and applied to fixed installations and to mobile installations and activities … [and frequently include] "installation design standards", which determine the requirements to be met in the course of operation of installations to protect the environment; and "operating standards", which determine the requirements to be met in the course of the operation of installations'.[244] For example, process standards can be formulated as requirements for certain temperatures to be reached during the course of incineration of hazardous wastes to make sure that specified substances are properly combusted, or for combustion plants as sulphur removal efficiency requirements expressed in percent.[245]

(c) *Emission standards*, are yet another type of source-related standards.[246] These standards 'set levels for pollutants or nuisances that are not to be exceeded from installations or activities'.[247] For example, these can be standards specifying requirements for NO_x

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[242] Sands *et al.* (2012) p. 123. See also RCEP (1998) p. 4 describing these kind of standards as standards 'specifying the composition of a product'.
[243] Abbot (2006) p. 66. Process standards are also known as *specification standards*, same source and page.
[244] Sands *et al.* (2012) pp. 123-124. See also RCEP (1998) p. 4 describing process standards as standards 'identifying a set or sets of techniques for a specified industrial process in order to provide a criterion for deciding what emissions to the environment should be permitted from any given site'.
[245] There are several different available technical processes that can be used to clean SO_x emissions. A common end-of-pipe/post-combustion technique is flue gas desulphurization. This is a scrubbing technique that can remove 85-95% of the sulphur in SO_x emissions, Cofala, Amann (2001) p. 4.
[246] Emission standards are also known as *performance standards*, Abbot (2006) p. 66.
[247] Sands *et al.* (2012) p. 123. See also RCEP (1998) p. 4 describing these kind of standards as standards 'defining what releases of pollutants to the environment are acceptable'.

emissions from motorcycles, or limit values for SO_x emissions from large industrial plants.

(d) *Environmental quality standards* differ from the previously mentioned standard types in that they are formulated *not* by reference to the pollution source, but *to the target being protected*, for example a lake.[248] Environmental quality standards 'prescribe the levels of pollution, nuisance or environmental interference which are permitted and which must not be exceeded in a given environment or particular environmental media'.[249] For instance, these can be standards defining a minimum quality for fresh water, or they can define critical loads of sulphur which in turn can be translated into national emission ceilings for sulphur.[250]

(e) *Other standards.* As stated before,[251] no typology can be regarded as final. Indeed, the characteristics inherent in regulatory 'hybridity' or 'instrument overlap' discussed in Section 2.2.5 above arguably also apply analogously to these regulatory standard types,[252] which may well relate to and contain traits of each other. For example, the first three standard types overlap as they are all source-related standards, and product and process standards share similarities in that they define the properties and characteristics, in the first case of a product, and in

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248 Environmental quality standards are also known as *target*, ambient or receptor standards, Abbot (2006) p. 66.

249 Sands *et al.* (2012) p. 122-123. See also RCEP (1998) p. 4 describing these kind of standards as standards 'defining acceptable concentrations of a substance in air …, water … or soil'.

250 When it comes to environmental quality standards, hybridity between instrument categories can once again be recalled. For instance, where economic instruments like emissions trading rely on a 'bubble policy' that allows for total emissions averaging in a defined bubble of polluters, the main idea is that total emissions must not exceed the limits of the bubble. In this sense, such an economic instrument builds on the same main idea as does a CAC instrument relying on environmental quality standards, that is, the important point is that a total defined limit of pollutants must not be exceeded, *supra* Section 2.2.5.

251 *Supra* Section 2.2.5.

252 In this particular case, a 'standard overlap' instead of an 'instrument overlap' could thus be discussed.

the second case of a process.[253] Thus, the initially discussed four standard types, like other categories, should rather be viewed as approximations with varying degrees of certainty. Nevertheless, in accepting that categories do not always fit squarely with what is to be categorized, these approximate categories can still be helpful research tools. Thus, recognising that regulatory reality can differ from theoretical models, a fifth category is added here to include any standards in the identified CAC regulation for SO_x emission control for terrestrial and marine sources that do not fit within the first four given categories above. These standards will be classified in a 'residual category' as *'other standards*'.

A final issue relating to the design of standards in environmental CAC regulation, is that regulation sometimes contains more than one type of standard simultaneously. As a matter of design, this may reveal something important about the flexibility of rules in relation to standard-setting. Deciding which of several standards should be applied is then often subject to certain conditions. This goes for both terrestrial and marine environmental CAC regulation, where there are instances of varying degrees of flexibilities included in the provisions. Some standards are applicable in an order of priority *only as subsidiary standards*, where for one reason or another, the primary or default standard can not be met. Here, the included subsidiary standard can be viewed as a kind of 'safety net'. The subsidiary standard/safety net can then be used in a situation where for example certain national conditions make the fulfilment of the primary or default standard hard or even impossible. In yet other cases, there can be several included standards in regulation that have *equal status*. This is another kind of flexibility, where any of the standards can be applied as alternatives to each other, as 'equivalents', given that certain conditions are fulfilled. Considering the foregoing, in the final categorization of standards to be performed in Chapter 7, it is thus not only the five articulated standard categories that will be included in the analysis. The order of priority and the question whether a standard is primary/default, subsidiary, or alternative/equivalent will also be

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[253] For an illustrative figure showing how different regulatory standards relate to each other, in this specific example regarding lead, see RCEP (1998) p. 6.

taken into consideration since this can have important consequences for the application of standards required by the SO_x emissions provisions.[254]

2.2.9 Conclusions

This chapter has introduced the theoretical and methodological foundations of this thesis. Furthermore, the choice and use of materials was presented. The overall purpose of this chapter was to lay out the foundations for the coming chapters, that will ultimately lead to the final analysis performed in Chapter 7.

Following the structure of the methodological pyramid presented above,[255] the second methodological step is an analysis that constitutes the core of this thesis. In line with the research questions and the scope and delimitations formulated above,[256] this analysis will firstly consider whether the regulation of SO_x emissions from terrestrial and marine sources in the identified legal material could indeed be categorized as CAC regulation, since this thesis focuses on CAC regulation, and secondly, which type of standard-setting is used in the identified CAC regulation. Nevertheless, before performing such a two-step analysis, the regulation to be analysed must first be known, or in terms of the methodological pyramid, be identified. Thus, it is only after this identification that a regulatory analysis can consider what types of regulation (CAC or something else?), and which standards (if CAC; then which of the five standards types could it be classified as?) that have been used for the control of SO_x emissions, and furthermore why.

Consequently, as stated above,[257] the coming Chapters 3-6 present the regulation to be analysed in Chapter 7. More specifically, Chapters 3 and 4 examine the historical development of SO_x emissions regulation from terrestrial and marine sources on three regulatory scales (international, regional and national). Next, Chapters 5 and 6 continue

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[254] See also *supra* Chapter 1 Section 1.3.
[255] *Supra* Section 2.2.1.
[256] *Supra* Chapter 1 Sections 1.2.1. and 1.3.
[257] *Supra* Chapter 1 Section 1.5.

with an examination of current SO_x emissions regulation from terrestrial and marine sources on the same regulatory scales. Additionally, Chapters 3-6 also develop a broader context used for a closer analysis of regulation and standard-setting in Chapter 7.

PART II – BRIDGE

‘Sooty smoked smiths, smattered with smoke,
Drive me to death with the din of their efforts,
Such noise a night a man never heard,
With the knaves shouting and the clatter of blows!
The crooked connivers cry “Coal! Coal!”
And blow their bellows till their brains near burst,
“Huff, puff”, says one and “Haff, paff” the other.
They spit and sprawl and spin tall stories,
They gnaw and gnash and groan together,
Are kept hot heaving hard heavy hammers.
Their aprons are of bull hide,
Their shanks are sheathed against the sparks.
Huge hammers are handled hard,
Strong strokes struck on steel stock.
“Lus, bus, las, das”, tapping in turn.
Oh the Devil end this dreadful din.
The master lengthens pieces of iron,
Twining and twisting them with terrible twanging,
“Tik, tak, hic, hac, tiket, taket, tik, tak
Lus, bus, lus, das”. Such a life they lead,
Christ punish these horse-shoe benders,
Who cake our clothes and ruin our night’s sleep’[258]

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[258] Brimblecombe (1987) pp. 13-14. This version a translation from old English of the fourteenth century prose ‘SATIRE ON THE BLACKSMITHS.’, as it appears in Wright, Halliwell (1845) p. 240. The prose is a satiric reaction to environmental nuisances attributed to blacksmiths in medieval England.

3 The Historical Regulation of SO_x Emissions from Terrestrial Sources

As briefly noted in Chapter 1, the regulation of air pollution from terrestrial sources has a long history. Although of relatively more recent vintage, the regulation of SO_x emissions from terrestrial sources in particular also has a rich history, influenced by developments relating to air pollution more generally. The purpose of this chapter is to provide a description of the historical regulation of SO_x emissions from terrestrial sources so that it can later be analysed in Chapter 7 as regards standard-setting. However, as explained above,[259] the research questions, scope and delimitations of this thesis require more than a mere presentation of SO_x emissions regulation; they also require a necessary surrounding context that will be used for further analysis.

As regards content, the current chapter initially includes a description of how air pollution first came to be defined as a problem, and the scientific discovery of long-range transboundary air pollution. Thereafter, the development of regulation of air pollution and SO_x emissions is examined, first from the perspective of the international regulatory scale, and then from the perspective of the regional regulatory scale with a main focus on EU law.[260] Thereafter a joint perspective on the development of international and regional air pollution regulation is given, since these regulatory scales have increasingly merged since the 1990s. Finally, a Swedish perspective on air pollution and the regulation of SO_x emissions is provided, and the chapter is rounded off with some conclusions.

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[259] *Supra* Chapter 1 Section 1.5.

[260] As previously stated *supra* Chapter 1 Section 1.3, the regional scale regulation examined in this thesis includes both Nordic international regulation between States (with Swedish participation), and EU law. Since the relevant Nordic international regulation of SO_x emissions only includes the 1974 Nordic Environmental Protection Convention, which is still applicable as current law, it is not commented on in the present chapter, but in Chapter 5 as current regulation to avoid unnecessary duplication.

3.1 Historical Development

3.1.1 Air Pollution from Terrestrial Sources and Its Early Regulation

As briefly noted in Chapter 1, air pollution is not a new occurrence in human history. Early regulation of air pollution has been found in English proclamations dating back to the turn of the 14th century.[261] However, the phenomenon had probably been subject to regulation even before that.[262] Atmospheric emissions in early times were mainly a local phenomenon, but with increased use of coal, and later, in times of an emerging industrial revolution, environmental damage beyond the strictly local environment occurred.[263] It is in this context, where pollution of the environment and its effects started to transgress State borders, that the legal concept of transboundary harm or transboundary environmental impacts emerged.

The fundaments of the law relating to transboundary environmental impacts, which has its base in some elementary principles and concepts of international (environmental) law like *sic utere tuo ut alienum non laedas* (use your own property in such a way that you do not injure other people's), and the concept of abuse of rights or the principle of good neighbourliness, express 'the fact that territorial sovereign rights in general are correlative and interdependent and consequently subject to reciprocally operating limitations'.[264] Furthermore, as was developed in the classic decision of the *Trail*

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[261] Brimblecombe (1987) p. 9. See also generally same source pp. 1-18.

[262] Earlier forms of regulation are probable. In Sportisse (2010) pp. 1-2, it is for example stated (unfortunately without reference to original source) that a Roman lawyer regulated emissions from a number of activities in York, the United Kingdom, already year 300 AD during the Roman Empire. This is not unlikely, since Roman law was among other things founded on maxims mandating good neighbourliness in respect of not letting various emissions such as water and smoke reach neighbours in disturbing ways, see *e.g.* Ljungman (1943) pp. 18-19, *inter alia* quoting writings by the Roman lawyer Ulpianus († 228 AD) regarding the effects of smoke from cheese-smokeries on neighbouring property.

[263] Sportisse (2010) p. 2.

[264] Handl (2008) p. 533.

Smelter tribunal, expressing interdependent environmental rights and duties, it was held that:

'Under the principles of international law … no state has the right to use or permit the use of territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence'[265]

Since the tribunal's decision in 1941, the arguments in the *Trail Smelter* dispute have been reflected and strengthened several times in important international environmental documents,[266] international litigation,[267] as well as in the work of the International Law Commission (ILC).[268] All the same, the use of established principles strengthened by such decisions as *Trail Smelter* have never achieved a strong position in the international treaties regulating *long-range air pollution*, despite the oft-cited statement regarding air pollution in the *Trail Smelter* case. Surprising, as this may first seem, there are however explanations.

First, taking the *Trail Smelter* dispute as a starting point and example of a cross frontier pollution dispute, this was as it has been expressed 'probably best characterised as a localized case of industrial nuisance',[269] even though sulphur fumes did in fact cross borders. Moreover, both the pollution source and the recipient could easily be identified, thus making it possible to establish a causal link between

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[265] Trail Smelter (US v. Canada) at p. 1965.

[266] Principle 21 of the 1972 Declaration of the United Nations Conference on the Human Environment, Principle 2 of the 1992 Rio Declaration on Environment and Development and para. 8 of the 2002 Johannesburg Declaration on Sustainable Development.

[267] Nuclear Tests cases (Australia v. France) (Interim measures) (1973), ICJ 1996 Advisory opinion on the Legality of the Threat or Use of Nuclear Weapons para. 29 and the 1997 Case Concerning the Gabčíkovo-Nagymaros Project (Hungary v. Slovakia) para. 53. See also the 2005 Iron Rhine ('Ijzeren Rijn') Railway case (Belgium v. The Netherlands), para. 59.

[268] *E.g.* Art. 7 of the 1997 Convention on the Law of Non-Navigational Uses of International Watercourses, and Art. 3 of the International Law Commission's Draft Articles on the Prevention of Transboundary Harm from Hazardous Activities 2001.

[269] Okowa (2009) p. 197, footnote omitted.

the emission and its effect. It is precisely these facts that highlight the difference between situations in which air pollution only travels a short distance and affects another State as opposed to situations where it first travels thousands of kilometres and is then deposited in another State. The essence of long-range transboundary pollution as it is defined in the LRTAP Convention, acknowledges precisely the latter situation as:

'…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'[270]

The problems of long-range transboundary air pollution that where given attention in the decades after the *Trail Smelter* dispute where characterized by the fact that a direct causal nexus between emission and effect could not be established. Additionally, a time delay between emissions and effects in the environment like acidification of soils and lakes made litigation based on the normal rules of State responsibility difficult.[271]

Second, the *Trail Smelter* situation was a bilateral conflict, with parties that had a previous negotiation and litigation history.[272] In the case of the type of air pollution problems with 'truly transboundary effects', several States can be involved simultaneously, and it is thus often a multiparty problem. Negotiating international disputes with multiple parties means difficulties, among other things, with the apportioning of responsibility between the parties, but also as to how the procedures for adjudication with multiple party claimants should be handled.[273] Moreover, the long-range air pollution conflicts post-

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[270] Art. 1(b) the LRTAP Convention. For more about the LRTAP Convention, see *infra* Section 3.1.2 and Chapter 5 Section 5.1.1.

[271] Okowa (2009) p. 198.

[272] Okowa (2009) pp. 197-198.

[273] Okowa (2009) p. 202. Further, as Okowa points out 'Issues of responsibility in international jurisprudence have largely been concerned with bilateral disputes between no more than two parties. This is apparent, for instance, from the wording of the Statute of the International Court of Justice (ICJ), which only envisages disputes

Trail Smelter have involved States that did not have the same history of cooperation in dispute settlement.[274] Finally, in these 'new' cases, litigation was also further made difficult by the fact that a victim of long-range air pollution was regularly a polluter itself.[275] Thus, in the reality of modern industrial economies, countries are de facto both importers and exporters of various air emissions.

Given the above, the legal development in the regulation of long-range air pollution has historically rather moved away from a regime of State responsibility to a regulatory regime where all affected States instead make efforts to reduce their total amount of emissions.[276] The use of this approach is an attempt to avoid some obvious legal obstacles related to air emissions, but it is has not rendered the *Trail Smelter* approach irrelevant. The *Trail Smelter* tribunal award still has value in bilateral resolution of air pollution disputes for recoverable items of loss.[277]

3.1.2 The Scientific Discovery of Long-Range Transboundary Air Pollution and the First International Agreement

While the *Trail Smelter* arbitration may serve as an early example of how air pollution crossing borders can cause international disputes, it was not until the mid-1960s that well-grounded scientific data supporting claims of long-range transboundary air pollution emerged. In the European setting, the evidence of considerable air pollution transport over national borders was founded on so-called synoptic observations[278] which showed that rain had increasingly become contaminated with sulphur, and acidic precipitation in the northwest

between two states', see pp. 202-203 same source, footnote omitted. See also Statute of the ICJ Arts. 43, 44 and 59.

[274] Okowa (2009) p. 202.

[275] Okowa (2009) p. 203.

[276] Okowa (2009) p. 198.

[277] Okowa (2009) p. 205.

[278] Synoptic observations has been explained as 'the study of synchronised pollution and meteorological data over larger regions', Pleijel, Grennfelt (2007a) p. 29.

and middle parts of Europe since the Second World War.[279] Additionally, observation sites along the coast of Sweden had detected episodes of pollution under particular weather conditions, which could only be attributed to long-range transboundary air pollution.[280]

The accumulating evidence showing the harmful effects of air pollution collected and presented by researchers and others[281] in the mid-1960s and forward paved the way for the first serious international discussions on regulating transboundary air pollution. By 1970, the research that to a large extent was led by Swedish and Norwegian scientists had gathered considerable scientific proof of long-range transfrontier air pollution. Some of this research was later presented in a case study and background document at the 1972 Stockholm Conference on the Human Environment.[282]

Following the accumulation of evidence by 1970, the increased attention to transboundary air pollution also led to the establishment of a special programme under the Organisation for Economic Co-Operation and Development (OECD), and the setting up of measurement stations across North and West Europe to keep track of sulphur in air and in precipitation.[283] In 1972, during the Stockholm Conference on the Human Environment, the Scandinavian States attempted to make long-range transboundary air pollution a matter for

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[279] A network of atmospheric monitoring stations covering much of Europe had been set up already in the late 1940s, but it was when a strong trend of declining pH value in precipitation in Central Europe, Denmark and Sweden could be shown between 1954 and 1966, that scientists really started to see worrying patterns, Lundgren (1998) pp. 74-75.

[280] Pleijel, Grennfelt (2007a) p. 29.

[281] Among the Swedish researchers, notably the work of Assistant Professor Svante Odén and Professor Sven Brohult can be noticed, Lundgren (1998) pp. 74-82. However, there were also others, such as fisheries officers and fishing enthusiasts, outside the established research community, that contributed with valuable observations and measurements leading to conclusions about the extent of SO_x emissions. For a short history of Swedish and Norwegian discoveries regarding acidification, see Lundgren (1998) pp. 225-234.

[282] Pleijel, Grennfelt (2007a) p. 30. See also Royal Ministry of Agriculture, Sweden (1971).

[283] Pleijel, Grennfelt (2007a) p. 32 and 34.

the conference, but the time was not yet ripe.[284] The question got some push forward at the Conference on Security and Co-operation in Europe 1973 to 1975,[285] and even more scientific results confirming the effects of long-range air pollution were published in 1977 in a final report of the special OECD programme.[286] Based on findings in the 1977 OECD report, the European Evaluation and Monitoring Co-operative Programme (EMEP) of the long-range transport of air pollutants in Europe was formed.

The EMEP has been and still is very important for air pollution abatement and regulation for several reasons.[287] Firstly, the EMEP already initially had a broad coverage of surveyed countries including Europe and the then Soviet Union. Secondly, EMEP worked according to the same patterns as the OECD programme on long-range transboundary air pollution; that is, making emission inventories, measurements and merging these via data evaluation and theoretical atmospheric modelling. Thirdly, the EMEP worked with commonly agreed methods and standards for many countries, which facilitated international scientific discussion. Finally, the EMEP has continued its measurements for many years making analysis of longer-term trends possible. This is not only important for theoretical development, but equally for the possibility to verify the success or failure of international efforts to curb air pollution.[288]

Shortly after the EMEP was established in 1977, it became an important integral part of the first multilateral convention regulating

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[284] Gündling (1986) p. 19. See also Lundgren (1998) p. 288.
[285] Okowa (2000) p. 25. See also Preamble of the LRTAP Convention.
[286] In its final report, the special OECD programme that had been set up in 1970 confirmed that sulphur can travel great distances in the atmosphere and that the air quality in Europe was demonstrably affected by other European countries' emissions, Pleijel, Grennfelt (2007a) p. 34. See also OECD (1977).
[287] The EMEP does not only provide scientific data supporting the LRTAP Convention, but also produces background documents for international bodies responsible for other international instruments such as the HELCOM Commission and the Oslo and Paris Commission (OSPAR) Commission, see list of publications accessible via <www.emep.int>.
[288] Pleijel, Grennfelt (2007a) pp. 37-38. For more information about EMEP, see <www.emep.int>.

air pollution, the 1979 LRTAP Convention.[289] The LRTAP Convention was negotiated at a high-level meeting hosted by the United Nations Economic Commission for Europe (UNECE) in 1979.[290] The convention's successful creation has been described as an extraordinary event for several reasons. Not only was the LRTAP Convention the first multilateral convention regarding air pollution, but it was also the first environmental protection convention to include both Western and Eastern European States, and North America, in a period of military and political opposition.[291] Importantly, the convention also gathered both 'net exporting' and 'net importing' countries of transboundary air pollution.[292] With its unique list of now over 50 participants, the LRTAP Convention may

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[289] For more details about the LRTAP Convention, see also *infra* Chapter 5 Section 5.1.1.

[290] The UNECE is one of five regional commissions under the United Nations. Its main aim is to promote pan-European economic integration by means of dialogue and cooperation in economy and chosen sectoral issues. Membership is not limited to the EU-area. Both other European non-EU countries, North America and Russia are members. For more details, see <http://www.unece.org/mission.html>.

[291] Although the United States has signed and ratified the LRTAP Convention and several of its extending protocols, the United States has arranged for special treaty solutions applying among other things to SO_x emissions in North America. The particularities of these US/North American treaty arrangements are acknowledged in the protocols to the LRTAP Convention, *e.g.* Art. 2 (5.) of the 1994 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Further Reduction of Sulphur Emissions (Second Sulphur Protocol) and Preamble of the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-Level Ozone (Gothenburg Protocol). Most comments in the sections below concerning LRTAP and its protocols rather represent a European perspective than a North American perspective. For some comments about the special North American arrangements, see Okowa (2000) pp. 44-48. For a historical perspective on North American treaty arrangements between the United States and Canada, see Martin (2004) pp. 17-20.

[292] Gündling (1986) p. 19. See also Sokolovsky (2004) p. 7-15 for a brief insight into the Cold War background of the LRTAP Convention. Whether a country is 'net importer' or 'net exporter' is determined by the amount of emissions from a country and the prevailing wind direction. In simplified terms, countries that are 'net importers' receive more emissions than they release to other countries, and for 'net exporters' the situation is the other way around, Elvingsson, Ågren (2004) p. 99.

therefore also geographically be described as a multilateral treaty covering considerable parts of Northern Hemisphere air mass.[293]

As regards the structure of the LRTAP Convention, it was drafted as a framework convention containing objectives and general principles for the prevention, reduction and control of air pollution.[294] It contains no provisions on State responsibility for damage caused by air pollution, and although sulphur is mentioned in the LRTAP Convention, no specific commitments to air pollutant reductions are contained in the treaty itself. Specific commitments have instead been formulated in eight separate protocols extending the convention by regulating the sources and emissions of sulphur, nitrogen, volatile organic compounds (VOCs), heavy metals, persistent organic pollutants and ammonia (NH_3). The very first protocol to the LRTAP Convention, however, was a protocol to secure a stable economic funding for the EMEP's activities.[295] During the years, the LRTAP Convention has received some criticism because of the inclusion of rather flexible and open obligations. All the same, the inclusion of these flexible obligations have been considered a necessary condition for not losing some major polluters as contracting parties back in 1979, such as the United Kingdom and West Germany.[296]

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[293] For a list of participants see <https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-1&chapter=27&clang=_en>. It can be noted that in a geographical sense, the LRTAP Convention is sometimes also labelled as a 'regional' treaty when it is discussed.

[294] For further comments about specific articles, see *infra* Chapter 5 Section 5.1.1.

[295] 1984 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Long-Term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP). The other respective protocols, including the protocol on long-term financing of the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP), are available at <http://www.unece.org/env/lrtap/status/lrtap_s.html>. In the following, only those protocols with relevance for SO_x emissions will be discussed below.

[296] Birnie et al. (2009) p. 345. For more details about the flexible provisions of the LRTAP Convention, see *infra* Chapter 5 Section 5.1.1.

3.1.3 The Regulation of SO_x Emissions from Terrestrial Sources 1979-1994 – An International Perspective

During the 1980s, which has been described as 'a golden age of environmental policy',[297] public opinion was generally environmentally friendly. In 1982, a conference on acidification and the environment was held in Stockholm to speed up the ratification of the LRTAP Convention signed in 1979, and to get the process of acid rain abatement rolling. Notably, it was at this time that environmental NGOs really started to engage in the developments of the LRTAP Convention. Ever since, environmental NGOs have closely followed the negotiations of the respective protocols under the convention and have undoubtedly played a vital role in moulding their content, and for observing and reporting the LRTAP negotiations to the public.[298]

In the early 1980s, two main questions related to transboundary air pollution were particularly discussed: acidification of freshwaters and forest dieback. Acidification of lakes and running water due to air pollution was a well-documented phenomenon by the early 1980s. In northern European countries like Norway and Sweden its harmful effects was first shown to cause disturbances in fish reproduction, and a little later it was also shown that air pollution caused acidification of soils.[299] Even though these effects were a well-documented phenomenon in Scandinavia by the early 1980s, some other European countries seemed to consider or at least label the problem as something more or less 'only' experienced in the Nordic countries.[300]

Regarding damage to forests, this had also been identified in most European countries in the early 1980s. A couple of years had passed since the LRTAP Convention had been signed before a larger number of convention parties were willing to accept the necessity of taking costly measures to abate long-range air pollution. However, as discussions of forest dieback gained more intensity in countries such as the former Federal Republic of Germany, and with the advent of

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[297] Pleijel, Grennfelt (2007a) p. 26.
[298] Pleijel, Grennfelt (2007a) pp. 34-36.
[299] Pleijel, Grennfelt (2007a) pp. 40-41.
[300] Jost (2004) p. 15.

new technological advances, the drafting process of the First Sulphur Protocol[301] under the LRTAP Convention could begin.[302]

In 1985, the First Sulphur Protocol was signed and it became the first protocol under the LRTAP Convention to specify concrete emission reduction undertakings. The structure of the undertakings built on a single flat rate reduction, which meant that each party agreed to achieve *at least* a fixed reduction of national annual SO_x emissions or their transboundary fluxes as soon as possible, but no later than 1993, with 1980 as reference year for emission reduction calculations. The minimum was set to at least 30% emission reductions of sulphur emissions,[303] thus creating what was colloquially referred to as 'the 30% club'.[304] The main provision in Article 2 of the First Sulphur Protocol specifying 30% reductions was linked to a provision regarding accession to the protocol after 1990. This provision left a possibility for States to ratify the protocol at a later date and implement the reductions at latest in 1995, if they were either

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301 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at Least 30 per cent, 1985 (First Sulphur Protocol).

302 Jost (2004) pp. 15-16. See also Pleijel, Grennfelt (2007a) pp. 38 and 41. Lately, the question of forest dieback due to air pollution has not attracted much attention. In retrospect, it seems that the abatement measures originally taken against air pollution motivated by forest protection from long-range pollution were taken on grounds that still do not rest on firm scientific results. Nonetheless, there is no doubt that improvement in cleaning *local* air pollution sources have done a great deal to counter continuing forest damage and damage to the environment in general. Some recent conclusions regarding air pollution and forest dieback have however held that the most severe and scientifically well-grounded cases were caused mainly by local effects as a result of large emission sources nearby the damage points. Further, forest decline has shown out to be rather heterogeneous with both different causes in different areas and cases. Not all cases have been caused by air pollution. Lastly, well-grounded scientific evidence of air pollution and its causes linked to the phenomenon of crown thinning in trees has as to yet not been shown when it comes to *long-range air pollution*, even though these effects have been scientifically confirmed locally, Pleijel, Grennfelt (2007a) p. 39.

303 Art. 2 of the First Sulphur Protocol.

304 Pleijel, Grennfelt (2007a) p. 42.

unwilling or incapable to do so according to the scheme of the primary provision.[305]

As regards the approach for achieving emission reductions, the provisions of the First Sulphur Protocol did not demand any specific measures targeting certain defined emission sources. Looking at the key provision in Article 2,[306] this was instead formulated as an obligation of result, leaving a wide margin of appreciation to each party for choosing how to actually reach the result.[307] Concerning which pollution sources that were targeted by the First Sulphur Protocol, these were not specified like they would be in subsequent protocols. Thus, the basic obligation in Article 2 mandated a national emission reduction in sulphur emissions by 30%, regardless of emission source.[308]

In evaluating the First Sulphur Protocol, both weaknesses and strengths can be found. One shortcoming that was voiced by a number of signatories, that later never ratified the protocol, was that the flat rate approach to emission reductions was more or less arbitrary. The connection between obligations and ecological gains was not clear, and among others Ireland, Greece and Portugal argued that their respective emissions were insignificant and should therefore not be linked to the reduction demands.[309] In retrospect, commentators have further also stated that the costs for some countries to take abatement measures were still not known at the time of negotiations, and not even at the time of ratification of the protocol. Additionally, the

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[305] Art. 10 (3) of the First Sulphur Protocol. See also Okowa (2000) p. 36.
[306] In the words of the article 'The Parties shall reduce their national annual sulphur emissions or their transboundary fluxes by at least 30 per cent as soon as possible and at the latest by 1993, using 1980 levels as the basis for calculation of reductions'.
[307] Okowa (2000) p. 36.
[308] It should however be noted that a breakthrough in negotiations of the First Sulphur Protocol built on the then new possibility of flue gas desulphurization to reduce SO_x emissions from large stationary point source emitters like coal or heavy oil fired power plants, Jost (2004) p. 16. As a result, even though the SO_x emission reduction measures could potentially target any emission source, it was primarily heavy stationary sulphur emitting installations that countries chose to target, Grennfelt, Pleijel (2007) pp. 19-20.
[309] Okowa (2000) pp. 36-37 and Jost (2004) p. 17.

scientific base justifying a *30% reduction* is claimed to have been rather weak.[310]

There were however also several merits with the First Sulphur Protocol, even with the criticized 30% reduction levels. It has for example been stated that it presented a distinct foundation for political negotiations. Moreover, following the implementation of the protocol, all parties did not only achieve 30% reductions, but reached as much as 50-60% reductions.[311] Finally, even though some large emitters like the United Kingdom and Poland stayed out of the First Sulphur Protocol, it all the same became a first formal codification of common ambitions of a considerable number of European countries to accomplish air pollution reductions.[312] With this foundation, later protocols could correct the initial weaknesses of the First Sulphur Protocol.

From the mid-1980s, the reduction of SO_x emissions in Europe acquired momentum. The increased attention led to clean up measures of sulphur emitting sources in West Europe during the 1980s, but heavy air pollution levels lingered in Eastern Europe. In the aftermath of political transition post 1989, emission levels however also changed rapidly in Eastern Europe. Nevertheless, these reductions were not mainly because abatement measures were taken, but rather owed to the East European industry falling apart.[313] By the end of the 1980s, other air emission caused problems had surfaced on the environmental agenda; namely ozone layer depletion and climate change. From the perspective of environmental NGOs, that also have to prioritize their work, these novel problems diverted some attention given to long-range transfrontier air pollution and its effects on forests and freshwater.[314]

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[310] Jost (2004) p. 17.
[311] Jost (2004) p. 17 and UNECE (2007) p. 24.
[312] Pleijel, Grennfelt (2007a) p. 42.
[313] Pleijel, Grennfelt (2007a) pp. 38-39.
[314] Regarding the priorities of environmental NGOs as lobbyists in environmental issues, Pleijel and Grennfelt notes that the shift in priorities did not mean that the environmental NGOs abandoned the question of transfrontier air pollution altogether. The work surrounding the development of the LRTAP Convention has been closely

In the early 1990s, discussions surrounding a second sulphur protocol to the LRTAP Convention were possible for various reasons. The political climate had changed, and both technical and theoretical development had occurred regarding SO_x emissions.[315] If one of the main shortcomings of the First Sulphur Protocol was that it used a flat rate approach that was criticised as rigid and arbitrary, the Second Sulphur Protocol, signed in 1994, was instead characterised by flexibility in many senses. In addition to reacting to the criticism over the flat rate approach, there had been a need to advance the arguments for further abatement measures of sulphur emissions for economic reasons. As a matter of regulatory strategy, when it comes to abatement measures in general, it is expected that any 'low hanging fruit' will be picked first. However, as the level of pollution reduction increases, every further step taken usually becomes costlier. This in turn means that policy makers, polluters and others who are to pay for additional measures need to be convinced with better and stronger arguments that additional costs are indeed justified.[316] In the specific context of the LRTAP Convention, *ecological differences* in the geographical area covered by the convention was and still is a relevant factor to be taken into account in setting emission limits. For instance it could be questioned why additional abatement measures should be taken in less populated areas that were also less sensitive to sulphur deposition compared to other areas?[317]

For the above reasons, the flat-rate approach of the First Sulphur Protocol was abandoned in the Second Sulphur Protocol. A new

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scrutinized by these NGOs, but the same NGOs have also chosen to shift arenas for their activities. A new arena was thus engaging in and influencing different pieces of EU environmental legislation, including air quality regulation, Pleijel, Grennfelt (2007a) pp. 35-36.

[315] Pleijel, Grennfelt (2007a) p. 43. Additionally, between the First and the Second Sulphur Protocol, two other protocols on air emissions had been drafted and signed. One concerning control of nitrogen oxides in 1988 and one concerning volatile organic compounds in 1991, see respective protocols available at <http://www.unece.org/env/lrtap/status/lrtap_s.html>. For some comments on these protocols see Okowa (2000) pp. 40-43 and Pleijel, Grennfelt (2007a) p. 42-43.

[316] *E.g.* Pleijel, Grennfelt (2007a) p. 43.

[317] Maas *et al.* (2004) p. 85.

approach that focused instead on sensitivity to acidification in different areas measured quantitatively was introduced. This new approach was the concept of *critical load*, which has been defined as:

'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'[318]

The concept thus works with an *approximate limit*, below which significant harmful effects do not occur in the environment according to certain sensitive indicators.[319] For example, the estimation of critical load is tightly connected to the weathering capacity of minerals in soils, since weathering reduces acidity by consuming hydrogen ions.[320] As it has been held, the aim with the critical load approach *was not* to identify sensitivity to acid deposition with *total certainty*. Instead, it was a way to relate reduction measures to acid sensitivity in a manner *that better reflected ecosystem differences*.[321]

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[318] Art. 1 (8.) of the Second Sulphur Protocol. A related concept also found in the protocol is 'critical levels'. It is defined as 'the concentration of pollutants in the atmosphere above which direct adverse effects on receptors, such as human beings, plants, ecosystems or materials, may occur, according to present knowledge', see Art. 1 (9.) of the Second Sulphur Protocol. The difference between *critical load* and *critical levels* is that the critical load relates to the *amount* of pollutant deposited from air to the ground. The critical levels relates to the *gaseous concentration* of a pollutant in the air. Both concepts are important, but as Pleijel notes, critical load is used mainly for emissions causing acidification *i.e.* sulphur and nitrogen emissions, whereas critical levels is used mainly for gaseous pollutants, especially ozone, Pleijel *et al.* (2007) p. 222.

[319] In the sense that the critical load concept has ecological factors as yardsticks, it is comparable to the structure of environmental quality standards.

[320] Pleijel, Grennfelt (2007a) p. 43. Weathering is the most important factor for determining how much acid deposition a certain area can withstand, Elvingson, Ågren (2004) pp. 88-89. In the context of soils and minerals, weathering has been defined as 'the physical breakdown and chemical alteration of Earth materials as they are exposed to the atmosphere, hydrosphere and biosphere … weathering is a group of physical and chemical processes that alter Earth materials so that they are more nearly in equilibrium with a new set of environmental conditions', Wicander, Monroe (2009) p. 134.

[321] Pleijel, Grennfelt (2007a) p. 44.

A noteworthy event related to the critical loads concept was the establishment of the Task Force on Integrated Assessment Modelling (TFIAM) by the LRTAP Convention's Executive Body at its fourth session in 1986. The main focus of this task force is to combine information collected from the LRTAP Convention's parties and from other convention bodies, but also importantly to assist in the development of legal instruments such as protocols under the LRTAP Convention.[322]

Considering the important change of approach between the First and the Second Sulphur Protocol to regulating SO_x emission reductions, it is worthwhile to look a little closer at the so-called Integrated Assessment Modelling (IAM). IAM has been described as 'a methodology by which advanced calculations, which produce different air pollution scenarios, can be performed and evaluated both from the perspective of environmental benefits and abatement costs'.[323] One application of integrated assessment modelling that guided the TFIAM and negotiators of the Second Sulphur Protocol was the simulation tool known as the Regional Air Pollution INformation and Simulation model (RAINS-model),[324] which was in extension used for the formulation of suitable pollution standards.

Before the Second Sulphur Protocol was drafted in 1994, it had already become clear for negotiators that there was no feasible emission reduction strategy that would bring down acid deposition

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322 For more details about TFIAM, see <http://www.unece.org/env/lrtap/TaskForce/tfiam/welcome.html>. The TFIAM works closely with the Centre for Integrated Assessment Modelling (CIAM) which is a centre under the EMEP that prepares technical background material for the task force. The CIAM is in turn hosted by the International Institute for Applied Systems Analysis (IIASA), a research institute in Austria, that has developed important tools for scenario modelling commented on immediately below.

323 Grennfelt, Pleijel (2007) p. 21.

324 The possibility to calculate deposition and critical loads is but one of the modules that the RAINS-model has used. For more information about the RAINS-model and its different modules, see <http://www.iiasa.ac.at/~rains/index-old.html?sb=32>. Today, the RAINS-model has been extended to cover multiple pollutants and multiple effects and has developed into a Greenhouse Gas and Air Pollution Interactions and Synergies model (GAINS-model). For further information about the GAINS-model, see <http://www.iiasa.ac.at/rains/gains/model%20description.html>.

below all the defined critical loads in Europe. Another approach, the *target load* approach, was tried as an alternative to the critical load approach but it turned out either to be too unreliable or too complicated to use.[325] The negotiators finally settled for the so-called *gap closure* approach for target setting, which built on using critical loads as references. The idea was to close the gap between the then sulphur depositions and accomplishing the long-term goal of exceeding none of the critical loads.[326] One of the RAINS-model scenarios using the idea of gap closure became the departure for settling the commitments in the Second Sulphur Protocol.[327] A target was set to *cut all exceedances of critical loads by at least 60%* until 2010,[328] which meant that the then present sulphur depositions above the critical loads had to be reduced by at least 60% in every 'EMEP grid cell'.[329]

By taking into account the varying sensitivity to acid deposition in Europe guided by the critical loads concept, the Second Sulphur Protocol could include a more cost-efficient abatement strategy. That is, the reduction of overstepping of critical loads could be achieved according to a strategy finding the least cost for sulphur reduction measures in each EMEP grid cell.[330]

In substantive terms, the key provision of the Second Sulphur Protocol is found in Article 2, which stipulates the long term goal that:

'The Parties shall control and reduce their sulphur emissions in order to protect human health and the environment from adverse effects, in particular acidifying effects, and to ensure, as far as possible, without entailing excessive costs, that depositions of oxidized sulphur

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[325] Maas *et al.* (2004) p. 88.
[326] Maas *et al.* (2004) p. 88.
[327] For a short historical account of the RAINS-model and its role in negotiations, see <http://www.iiasa.ac.at/Admin/INF/OPT/Summer98/negotiations.htm>.
[328] Art. 8(2.)(c) and Annex II of the Second Sulphur Protocol.
[329] The EMEP grids used to calculate the emission reduction targets under the Second Sulphur Protocol comprised an area of 150x150 km^2, Pleijel, Grennfelt (2007a) p. 44. The EMEP later changed these grid cells to comprise lesser area per grid allowing even more accurate measuring of pollutants, see <http://www.emep.int/grid/>.
[330] Pleijel, Grennfelt (2007a) p. 44. See also Maas *et al.* (2004) pp. 85-89.

compounds in the long term do not exceed critical loads for sulphur given, in annex I'

In the shorter term, the parties had to reduce and maintain annual SO_x emissions according to a certain scheme with sulphur emission ceilings given in Annex II for the years 2000, 2005 and 2010.[331] The targeted emission sources of the Second Sulphur Protocol were mainly *major new* stationary combustion sources, and with certain applicable time limits *major existing* stationary combustion sources, however, lighter sulphur content fuels (gas oils) like diesel for on-road vehicles and other fuels were also targeted.[332] For the major stationary combustion sources, emission limit values and desulphurization rates were specified.[333]

The inclusion of critical load as a concept in Article 2 allowed for the consideration of the differences in States' emission contributions, and the variation in effect of these emissions in the States. To aim for the goal of cutting all exceedances of critical loads by at least 60% in the EMEP area by 2010, different States accordingly had to reduce their emissions by different amounts.[334] However, this was only one of the flexible qualities of the Second Sulphur Protocol. It did not pose the same demands on all countries, but even *within a country* the demands could vary. This opened up the possibility of focusing on pollution 'hot spots' when implementing the protocol's demands.[335] Flexibility could also be found among some other measures included in the protocol. For instance, the reference to 'best available control technologies not entailing excessive cost' shows that the protocol acknowledged that measures and their effects had to be balanced in

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331 Art. 2 (1.) and 2 (2.) of the Second Sulphur Protocol. See also Annex II of the Second Sulphur Protocol.
332 Art. 2 (5.) (a), (b) and (c) of the Second Sulphur Protocol respectively. See also Annex V (B.) for specified sulphur content limits in fuels.
333 Annex V (A.) of the Second Sulphur Protocol. The desulphurization rates were specified as possible subsidiary ways to fulfilling the emission limit values in some cases were the parties could not fulfil the primary standards, see same protocol Annex V (A.)(iii).
334 For the specified reductions for each party, see Annex II of the Second Sulphur Protocol.
335 Art. 2 (3.) and Annex II of the Second Sulphur Protocol.

relation to their costs, thus also showing a flexibility in technology demands weighed against costs.[336] Other obligations found in the protocol were that the States should reduce their SO_x emissions, among other things with measures that increased energy efficiency and the use of renewable energy. Additionally, the States were also to encourage the use of low sulphur fuels,[337] apart from taking measures to reducing the sulphur content in some fuels (gas oils) as mentioned above.[338]

In conclusion, the Second Sulphur Protocol was in many senses more advanced than the First Sulphur Protocol. The Second Protocol was drafted with more flexible provisions, *inter alia* thanks to a more realistic scientific approach that helped formulate cost-effective demands on the parties.[339] It also increased the demands on the contracting parties, leading to more specifications and annexes, not only relating to reduction, but also more advanced demands as regards monitoring, reporting and compliance.[340] For example, an implementation committee was set up in order to ensure the compliance with the parties' undertakings according to the protocol.[341]

3.1.4 Pre-1999 Regulation of SO_x Emissions from Terrestrial Sources – A European Perspective

At the time when the Second Sulphur Protocol was in place, the first more concerted initiatives on air quality issues had started to take form in Europe, and by the mid-1990s several European efforts to tackle air pollution were in place. Before these are commented on

[336] Art. 2 (4.) of the Second Sulphur Protocol.
[337] Art. 2 (4.) of the Second Sulphur Protocol.
[338] Art. 2 (5.)(c) and annex V of the Second Sulphur Protocol. The specified standards for gas oil was to be applied nationally no later than two years after the date of entry into force of the protocol, and be at least as stringent as the standards in Annex V of the same protocol: a maximum of 0,05% sulphur content for diesel for on-road vehicles, and 0,2% sulphur content for other types of gas oils.
[339] Birnie *et al.* (2009) pp. 346-347. See also Lidskog, Sundqvist (2007) pp. 189-190 describing how the Second Sulphur Protocol started a new era in the LRTAP regime through a strengthening of the science-based approach.
[340] Art. 5 and Art. 7 of the Second Sulphur Protocol.
[341] Art. 7 of the Second Sulphur Protocol.

however, some earlier regulatory events in the European Union ought to be mentioned.

From a historical point of departure, the regulation of air pollutants in the then European Economic Community (EEC) started in the beginning of the 1970s, when the environment more consciously emerged as an EEC policy area.[342] At this point in time however, there was no explicit legal base for environmental legislation in Community law, and regulation in the environmental sphere in Europe was performed within a predominant internal market framing.[343]

Looking back and considering the first EEC directives on air emissions, that did not yet include SO_x emissions, *mobile emission sources* were the first emission sources to be regulated in the 1970s. Nonetheless, early European regulatory initiatives with environmental content have been described as only *incidentally* having environmental motivations. Rather, they were primarily created for the purpose of harmonising the common market to remove technical barriers to trade, and to ensure the free circulation of products among the EEC Member States.[344] Starting, however, in 1975, the EEC issued its first directive aimed at setting limits on the sulphur content in *certain liquid fuels*, including fuels that where used in certain land-based installations.[345] Nonetheless, the directive applied to *gas oils only*.[346]

In a series of subsequent directives repealing and amending this first directive, the aspirations became to progressively limit sulphur emissions from several sources, both mobile and stationary, that in

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342 Jans, Vedder (2012) p. 3. As Jans argues, there were initiatives before the 1970s that 'could perhaps be regarded as environmental measures'. However, these measures foremost had common market motivations.

343 Lee (2014) pp. 2-3.

344 Dir. 70/220/EEC, Jans, Vedder (2012) p. 3 and Krämer (2015) p. 308.

345 Dir. 75/716/EEC. According to Liefferink, the early measures regarding the sulphur content of fuels were product norms and not air quality norms, see Liefferink (1996) p. 79. See also Case 92/79 in which the validity of Dir. 75/716/EEC was challenged. In its judgment, the European Court of Justice (ECJ) defended the validity of the directive and simultaneously stated that a lack of harmonization of national environmental regulation could appreciably distort competition.

346 Art. 1 of Dir. 75/716/EEC.

some way used liquid sulphur containing fuels.[347] However, it would take until 1999 before *heavy fuel oils* with high sulphur content were targeted by EU regulation,[348] partly it seems, due to the dependence of such fuels and resistance to their regulation by some Member States.[349]

Apart from the early directive targeting certain liquid fuels for land-based installations, the first initiatives regulating air pollutants from industrial installations in Europe were spurred by air pollution and acid rain discussions in the early 1980s.[350] For example, an early directive, Dir. 84/360/EEC, for combatting air pollution from industrial plants *inter alia* in the form of SO_x and NO_x, made reference to the international LRTAP Convention which the then Community had become a party to.[351] As regards content, this early Community regulation regarding air pollution from industrial plants built on introducing a structure for taking 'further measures and procedures designed to prevent or reduce air pollution',[352] among other things instructing Member States to set limit values for certain

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[347] Dir. 87/219/EEC amending Dir. 75/716/EEC and later Dir. 93/12/EEC repealing Dir. 75/716/EEC. In the preamble of Dir. 93/12/EEC it was stated that 'the Community has to take measures to reduce progressively the sulphur content of gas oil used for self-propelling vehicles, including aircraft and vessels, and for heating, industrial and marine purposes'. It should be noted however that many important pollution sources like vessels, aircraft and vehicles were still excluded in this directive when crossing a frontier between a third country and a member state, Art. 2 of Dir. 93/12/EEC. Dir. 93/12/EEC has now been repealed via Dir. 2009/30/EC, also amending Dirs. 98/70/EC and 1999/32/EC.

[348] Dir. 1999/32/EC further commented on *infra* Section 3.1.5, and in its latest consolidated form as Dir. (EU) 2016/802 in Chapter 5 Section 5.2.3.

[349] According to Liefferink, Member States like Italy and France 'would accept costly standards for heavy fuel oil only if the sulphur content of solid fuels was also regulated'. Coal originating in Western Europe has a relatively high sulphur content and would be at a competitive disadvantage compared to coal from other countries outside the Community. Moreover, the approach of using end-of-pipe solutions on land to reduce sulphur emissions was dominant in regulatory discussions compared to targeting the fuel in the early 1980s, Liefferink (1996) pp. 88-89.

[350] Krämer (2015) p. 299.

[351] Annex II of Dir. 84/360/EEC and Preamble of the same directive. See also Council Decision 81/462/EEC.

[352] Art. 1 of Dir. 84/360/EEC.

emissions,[353] and requiring prior authorization from competent national authorities for operation of certain industrial plants.[354]

An important following step for reducing and controlling air pollution in Europe was taken in 1988 when Dir. 88/609/EEC was introduced to further specify the requirements of Dir. 84/360/EEC. The former directive set limits for emissions of certain pollutants into the air from large combustion plants, *inter alia* for pollutants in the form of SO_x emissions.[355] Furthermore, in 1989 two directives for the prevention of air pollution from municipal waste incineration plants were adopted. These set limits, among other things for SO_x emissions from waste plants, both from new and old plants.[356]

As regards legislation primarily regulating *air quality*, the first European directives targeting some common pollutants were adopted in the beginning of the 1980s.[357] Firstly, in 1980 SO_2 and particles where regulated in a directive containing the initial Community wide mandatory air quality standards through limit and guide values. Two years later, an air quality directive on lead was adopted. In 1985, another directive on air quality standards for NO_x followed.[358] By the beginning of the 1990s, attention was given to increasing levels and effects of ground-level ozone in Europe. A directive on air pollution

[353] In this particular directive, no particular sulphur limits were specified as such, only the structure for further measures was provided.
[354] Art. 3 of Dir. 84/360/EEC.
[355] Art. 1 of Dir. 88/609/EEC, noting that the directive applied to combustion plants with a rated thermal input equal to or greater than 50 MW. Ceilings (however not the kind of emission ceilings giving effect to environmental quality standards) and reduction targets *inter alia* for SO_x emissions were given in Annex I, III, IV and V. In some cases where a high sulphur content of indigenous fuels would render the specified emission limits unreachable, *subsidiary requirements* for rates of desulphurization during the incineration process were given, *e.g.* Annex VIII of Dir. 88/609/EEC. The directive on large combustion plants has been amended and recast over the years, most recently via Dir. 2006/105/EC, see also *infra* Chapter 5 Section 5.2.3 for further comments.
[356] Dir. 89/369/EEC and Dir. 89/429/EEC respectively.
[357] Wettestad (2006), p. 287.
[358] Dir. 80/799/EEC, Dir. 82/884/EEC and Dir. 85/203/EEC respectively.

by ozone was adopted in 1992, which demanded Member States to establish a network for gathering information on ozone levels.[359]

More concerted efforts to deal with air pollution problems in Europe started to take form in the period of the early 1990s. Although air pollution prevention and reduction had been mentioned in earlier Environment Action Programmes (EAPs),[360] it was during the fifth environment action programme running between 1993-2001 that various important directives became effective that would lead to a less fragmented air pollution control in Europe.[361] The 5th EAP specifically called for amendments of existing air quality legislation based on recognized health risks from air pollution.[362]

Furthermore, the objective of 'no exceedance ever of critical loads and levels' was laid down in the action programme as regards acidification.[363] Parallel to the steps taken in the 5th EAP, the European Commission started its work in a programme that would later come to be known as the 'European Auto/Oil Programme'. Its purpose was to provide a foundation for discussions for new legislative proposals to reduce emissions from transport, taking into consideration the technical expertise in this area of stakeholders from the automotive industry.[364] Linked to this programme, a directive

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[359] Dir. 92/72/EEC and Wettestad (2006), p. 287.

[360] Already in the first action programme 1st EAP (1973) running between 1973-1976, both air pollution and sulphur compounds were mentioned. The same was the case for the 2nd EAP (1977) running between 1977-1981, the 3rd EAP (1982) between 1982-1986 and the 4th EAP (1987) between 1987-1992.

[361] 5th EAP (1993) formally running between 1993-2000, but extending to and including the year 2001. See Jans, Vedder (2012) pp. 339-341 for some short comments about the first six environmental action programmes. See also Krämer (2015) pp. 57-59.

[362] Table 9 of the 5th EAP (1993) p. 49. Reference was also made to World Health Organisation (WHO) guideline values for air quality to become mandatory at Community level, see same Table, same document. See also Section 5.2 of the same document, specifically devoted to 'Acidification and air quality', p. 44.

[363] Table 8 of the 5th EAP (1993), p. 48.

[364] COM(96) 248 final, p. 22. It can be noted that not all atmospheric pollutants were covered by the Auto/Oil programme. For instance, in the air quality modelling, carbon monoxide (CO), particulate matter (PM) benzene, nitrogen dioxide (NO_2) and tropospheric ozone (O_3) was covered, but not sulphur dioxide, see p. 23 of COM(96)

relating to the quality of petrol and diesel fuels was introduced in 1998. This directive, Dir. 98/70/EC, which became the main directive for automotive fuel quality for vehicles with petrol and diesel engines, among other things introduced sulphur content limits for fuels.[365]

After a revision of the EU air quality policy in the mid 1990s, an air quality framework directive was adopted in 1996.[366] As the name implies, this directive created a framework and it included a set of basic principles for assessing and managing ambient air quality in Europe.[367] The general aim in the words of the directive was to 'avoid, prevent or reduce harmful effects on human health and the environment as a whole … assess the ambient air quality in Member States on the basis of common methods and criteria … [to make information] available to the public … [and to] maintain ambient air quality where it is good and improve it in other cases'.[368] In the directive, a list of pollutants was included for which air quality standards and objectives would later be developed and formulated.[369] The precise air quality objectives linked to the framework directive were later formulated in four so-called daughter directives starting in 1999 and continuing past the millennium. The first daughter directive set limit values for SO_2, NO_2, NO_x, particulate matter and lead in ambient air.[370] The second set limit values for benzene and carbon monoxide.[371] The third established target values for ozone,[372] and the fourth daughter directive completed the list of pollutants in the

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248 final. However, sulphur was also taken into consideration as one of the substances that would have to be further regulated, see *e.g.* p. 12 and 15.
365 Annexes I-III of Dir. 98/70/EC.
366 Dir. 96/62/EC.
367 'ambient air' was defined as 'outdoor air in the troposphere, excluding work places', see Dir. 96/62/EC.
368 Art. 1 of Dir. 96/62/EC.
369 Annex I of Dir. 96/62/EC.
370 Dir. 1999/30/EC.
371 Dir. 2000/69/EC.
372 Dir. 2002/3/EC.

framework directive by regulating arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.[373]

As has been argued by Krämer,[374] a turning point occurred in community policy during the 1990s in that emission standards went from being *Community covering* and *harmonized* to *permit specific*, thus considerably affecting the regulation of air emissions. A starting point for the permit based system for installations can be found in the overarching integrated pollution prevention and control directive (IPPC Directive), originally adopted in 1996,[375] but since this time amended several instances and later on codified.[376]

Finally, in the end of the 1990s, the European Commission presented two strategies that would later lead to change in the area of air pollution by further regulating the sulphur content in fuels, emissions from large combustion plants and by introducing an EU directive on national emissions ceilings.[377] The two strategies were 'a Community strategy to combat acidification',[378] and the 'Ozone Position Paper'.[379]

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[373] Dir. 2004/107/EC. EU Air quality legislation has since this been updated into a directive that merges several directives, Dir. 2008/50/EC, see further comments *infra* Chapter 5 Section 5.2.4.
[374] Krämer (2015) pp. 299-300.
[375] Dir. 96/61/EC. It is to be noted that the air quality framework, Dir. 96/62/EC, and the IPPC Directive mutually refer to each other and to a 'combined approach'.
[376] Dir. 2008/1/EC codifying four amendments of Dir. 96/61/EC. In its latest form, the IPPC Directive has once again been recast and merged with six waste and emissions directives into one industrial emissions directive (IED), see Dir. 2010/75/EU further commented *infra* Chapter 5 Section 5.2.3.
[377] These changes are commented on immediately below in Section 3.1.5.
[378] COM(97) 88 final.
[379] Ad-Hoc Working Group on Ozone Directive and Reduction Strategy Development (1999).

3.1.5 International and European Regulation of SO_x Emissions from Terrestrial Sources 1999-2017[380]

In the EU, increasing attention had been given to the importance of updating air pollution regulation since the 5th EAP, and later on, with the two strategies to combat acidification and ground-level ozone presented in the late 1990s.[381] In 1999, partly due to the influence of the acidification strategy from 1997, a revised directive on sulphur content in liquid fuels was adopted,[382] making its demands stricter than the predecessor directive.[383] Compared to the former directive, Dir. 93/12/ECC, the revised directive, Dir. 1999/32/EC, among other things set lower maximum limits for the sulphur content in gas oil, and for the first time *for heavy fuel oil*. For heavy fuel oil, a main requirement of 1,00% maximum limit of sulphur by mass would apply as from 1 January 2003.[384] Adoption of revised versions of the directives on waste incineration and large combustion plants also followed closely in 2000 and 2001, making the demands on these industrial activities stricter.[385]

Regarding air pollution regulation on the international level, negotiations since the mid-1990s originally set to prepare a second

[380] Attentive readers might have noticed that the last section about international sulphur emissions regulation for terrestrial sources, Section 3.1.3, ended chronologically in 1994, when the Second Sulphur Protocol had been adopted. Nevertheless, the period between 1994-1999 on the international scale is briefly commented on in the beginning of the present section.
[381] For instance, the 1997 Community strategy to combat acidification presented in COM(97) 88 final, proposed a plan for the development of a directive on national emission ceilings, and further also that the Community should ratify the 1994 Second Sulphur Protocol to the LRTAP Convention, see COM(97) 88 final pp. 11-12. Both of these proposed measures were later followed up.
[382] Dir. 1999/32/EC. Note also the preambular references in the directive to 'acidification' and 'acid rain' in (3)-(5), (8), and to the 1997 acidification strategy in (9).
[383] *I.e.* Dir. 93/12/EEC.
[384] Art. 3 of Dir. 1999/32/EC. To some extent, the same directive also regulated gas oil when used for marine purposes. This is commented on further *infra* Chapter 4 Section 4.1.2.
[385] Dir. 2000/76/EC and Dir. 2001/80/EC. For further details about the latter directive and revisions, see comments *infra* Chapter 5 Section 5.2.3.

nitrogen protocol within the LRTAP framework following the Second Sulphur Protocol instead ended up in another type of protocol.[386] This other protocol to the LRTAP Convention, signed in Gothenburg in 1999 (Gothenburg Protocol),[387] included but was not limited to targeting nitrogen emissions. This new protocol targeting many emissions at the same time (including sulphur) was now possible *inter alia* because it had become obvious during the negotiations that a *multi-effect* and *multi-pollutant* approach to environmental problems could cost less than just targeting one pollutant at a time.[388]

The eighth protocol to the LRTAP Convention, being at the same time the third protocol regulating SO_x emissions under the convention, was thus not drafted as a *single pollutant* and *single effect protocol* like the first and second sulphur protocols. As already mentioned, it was during the negotiations to what was supposed to be a second protocol for controlling nitrogen oxides that it had become evident that further sulphur emissions abatement could now also be achieved. Moreover, in considering the most cost-efficient measures to reduce *acidification*, one of the effects controlled by the protocol, further reductions also of SO_x emissions represented a better alternative than focusing only on further measures to control nitrogen emissions. Thus, a balancing of requirements between these two emission types was possible, since both SO_x and NO_x emissions contribute to acidification.[389]

With respect to emissions, the Gothenburg Protocol not only ended up regulating SO_x emissions and acidification. It further included emissions of nitrogen, ammonia and VOCs, affecting eutrophication, and the formation of ground-level ozone. All in all, binding national emission ceilings for 2010 with 1990 as a base year were set for the four pollutants of SO_2, NO_x, VOCs and NH_3.[390] As expressed in the Preamble of the protocol, the parties were resolved to take a *multi-*

[386] Pleijel, Grennfelt (2007a) p. 50.
[387] Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-Level Ozone.
[388] Pleijel, Grennfelt (2007a) pp. 50-51.
[389] Pleijel, Grennfelt (2007a) pp. 50-51 and Elvingson, Ågren (2004) pp. 92-93.
[390] Annex II of the Gothenburg Protocol.

effect and *multi-pollutant* approach to prevent and minimize the critical loads and levels of the regulated compounds. With this new approach the complexity of the protocol increased and simultaneously made it the most advanced of the LRTAP Convention protocols at the time.

In the Gothenburg Protocol, which will be commented on more in detail in Chapter 5,[391] the multi-effect and multi-pollutant approach is reflected in its key provisions. For instance, the protocol states that its objective is to:

'control and reduce emissions of *sulphur*, *nitrogen oxides*, *ammonia* and *volatile organic compounds* that are caused by anthropogenic activities and are likely to cause adverse effects on human health, natural ecosystems, materials and crops, due to *acidification*, *eutrophication* or *ground-level ozone* as a result of long-range transboundary atmospheric transport'[392]

The Gothenburg Protocol *inter alia* requires each party to reduce and maintain annual emission reductions following the emission ceilings and dates for each State specified in Annex II of the protocol.[393] These set emission ceilings were based on information given from each party, *inter alia* regarding critical loads of sulphur.[394] Thus, the concept of critical load remained important also for this protocol when formulating the concrete emission reduction commitments.[395] Included in the obligations are among other things SO_x emission limit values for stationary emission sources, as well as sulphur limits for different fuels used both in stationary and mobile emission sources (gas oils, petrol and diesel).[396] Although undertakings and

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[391] *Infra* Chapter 5 Section 5.1.2.
[392] Art. 2 of the Gothenburg Protocol, emphasis added.
[393] Art. 3 (1.) of the Gothenburg Protocol. See also annex II of the same protocol.
[394] *E.g.* the Gothenburg Protocol Annex II, I. Art. A. (1.).
[395] Like in the Second Sulphur Protocol, the related concept of *critical level* also continued to bear relevance for the Gothenburg Protocol.
[396] *E.g.* emission limit values for boilers given in Table 1., Annex IV of the Gothenburg Protocol. In the same table, sulphur removal efficiency requirements as alternatives to the emission limit values are also given. See also the sulphur limit

recommended measures concerning mobile emission sources had been formulated in earlier protocols to the LRTAP Convention,[397] the Gothenburg Protocol included demands in a multi-effect and multi-pollutant setting for the first time.

Getting back again to events on the EU-scale, it was not only within the LRTAP framework that a combined approach to air pollutants was considered. Ever since the EU strategies on acidification and ground-level ozone had been launched in the late 1990s, work had also begun regarding an EU directive on national emission ceilings (NEC Directive) targeting several pollutants simultaneously.[398] Parallel to the development of the NEC Directive, the EU Member States, and other countries working within the LRTAP framework created the 1999 Gothenburg Protocol.[399] It is therefore no coincidence that familiar terms from the Gothenburg Protocol like 'emission ceilings' and 'critical loads' are also found in the EU NEC Directive. The NEC Directive transposed the requirements of the 1999 Gothenburg protocol into EU law regarding the same pollutants: that is for sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia.[400] However, in comparison, the emission ceilings in the NEC Directive were equal to or even more ambitious than the ceilings set in the Gothenburg Protocol.[401]

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values for gas oils given in Table 2., Annex IV of the Gothenburg Protocol and Annex VIII, Tables 8-11 where specifications for sulphur content in other fuels are specified.

[397] *E.g.* Art. 2 (2.) (b) and the Technical Annex of the 1988 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution Concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes and Art. 3 (5.) (b) (v) and Annex VII of the 1998 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants.

[398] Wettestad (2001) pp. 36-37 and Dir. 2001/81/EC. See also Krämer (2015) pp. 306-307.

[399] <http://ec.europa.eu/environment/air/pollutants/ceilings.htm>.

[400] Art. 4 of Dir. 2001/81/EC.

[401] *E.g.* national emission ceilings for SO_2 to be obtained by the EU countries in 2010 in Annex I of Dir. 2001/81/EC and Annex II of the Gothenburg Protocol. Also, the previously mentioned revised directive on large combustion plants, Dir. 2001/80/EC, had emission limits formulated in connection to the limits set by the Gothenburg Protocol, see Preamble, (2)-(5) of Council Decision 2003/507/EC.

The basic idea of the regulatory approach used in the NEC Directive was to safeguard agreed targets for improving the protection of the environment and human health in the EU. This included achieving equal relative environmental improvements across the EU, while simultaneously taking considerable leaps forward in improvement for areas considered heavily affected by pollution.[402] In order to meet the aim of the general relative improvement, a gap closure approach was used concerning the long-term objectives with no exceedance of critical loads. This was the same rationale used in the earlier Second Sulphur Protocol to the LRTAP Convention, to the extent that gradual improvements were to be achieved by *closing the gap between an initial environmental state and a decided 'ideal' environmental state*, where none of the critical loads should be exceeded.[403]

Getting to the substantive provisions of the NEC Directive, the aim of the directive is to improve the protection of the EU environment and human health against adverse effects of acidifying and eutrophying pollutants and ozone precursors. As mentioned above, four air pollutants, including SO_x emissions,[404] are targeted within the territory of Member States and their exclusive economic zones, however *not covering* international maritime traffic.[405] Reduction of these compounds was to be achieved stepwise with interim environmental targets that had to be attained in 2010, and the long-term targets is to be attained in 2020.[406]

For the first targets for 2010, the purpose of the national emission ceilings was to meet broadly a set of interim environmental objectives. For example, in the case of acidification the directive stated that 'The areas where critical loads are exceeded shall be

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[402] The Swedish NGO Secretariat on Acid Rain (2004) p. 14.
[403] The Swedish NGO Secretariat on Acid Rain (2004) p. 14. See also *supra* Section 3.1.3.
[404] Art. 4 of Dir. 2001/81/EC. See also Annex I for the specifically formulated country ceilings, same directive.
[405] Art. 2 of Dir. 2001/81/EC.
[406] Arts. 1 and 4 of Dir. 2001/81/EC. The NEC Directive, and the emission ceilings, have recently been revised as a consequence of EU air policy revisions. See further details about the revised directive in Chapter 5 Section 5.2.5.

reduced by at least 50 % … compared with the 1990 situation'.[407] When it comes to the long-term targets, none of the ceilings for the pollutants are allowed to be exceeded after 2010.[408]

To implement the directive the Member States are required to draw up national programmes. The scheme of the directive required that the first national programmes should be set up in 2002, and where needed, these should be revised in 2006 with the aim of meeting the fixed national emission ceilings by 2010 and afterwards. Moreover, the Member States has to report their emission inventories to the European Environment Agency and the European Commission to show progress and to verify compliance.[409]

If the 5th EAP is said to have started a process for a more consistent approach to air pollution regulation in the EU, the 6th EAP, adopted in 2002, took several steps forward on such a path. Departing from the over-arching structure of the 6th EAP, it *inter alia* lay down that environmental concerns should be integrated into *all Community policies*.[410] The topic of *air pollution* could thus now potentially be considered a matter of concern in all policy areas. Nevertheless, on a more specific level, the 6th EAP also mentioned *air quality* and *air pollution* under the heading of 'action on environment and health and quality of life'.[411] Further, in the same document, a mandate was given to create thematic strategies and a *thematic strategy on air pollution* was envisaged:

'Objectives and priority areas for action on environment and health and quality of life …

- achieving levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment …

2. These objectives shall be pursued by means of the following priority actions: …

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[407] Art. 5 of Dir. 2001/81/EC.
[408] Art. 1 of Dir. 2001/81/EC.
[409] Arts. 6-8 of Dir. 2001/81/EC.
[410] Art. 2 (1.) in the 6th EAP (2002).
[411] Art. 7 (1.) and 7 (2.) (f) in the 6th EAP (2002).

- *a thematic strategy* to strengthen *a coherent and integrated policy on air pollution* to cover priorities for further actions, the review and updating where appropriate of air quality standards and national emission ceilings with a view to reach the long term objective of no-excedence of critical loads and levels and the development of better systems for gathering information, modelling and forecasting'[412]

An initiative connected to the 6th EAP, launched by the Commission in 2001 was named the Clean Air For Europe Programme (CAFE Programme).[413] This programme had previously been presented in the proposal for the 6th EAP,[414] and it was created as a tool to implement the coming action programme's aspirations in the area of air quality.[415] The CAFE Programme's general aim was stated as:

'developing a long-term, strategic and integrated policy to protect against the effects of air pollution on human health and the environment'[416]

Moreover, it included a number of specific objectives:

'(1) to develop, collect and validate scientific information relating to the effects of ambient, i.e. outdoor air pollution, emission inventories, air quality assessment, emission and air quality projections, cost-effectiveness studies and integrated assessment modelling, leading to the development and updating of air quality and deposition objectives and indicators and identification of the measures required to reduce emissions;

(2) to support the implementation and review the effectiveness of existing legislation, in particular the air quality daughter directives, the decision on exchange of information, and national emission ceilings as set out in recent legislation, to contribute to the review of international protocols, and to develop new proposals as and when necessary;

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412 Art. 7 (1.) and 7 (2.) (f) in the 6th EAP (2002), emphasis added.
413 COM(2001) 245 final.
414 COM(2001) 31 final p. 47.
415 Letell (2006) p. 34.
416 COM(2001) 245 final.

(3) to ensure that the measures that will be needed to achieve air quality and deposition objectives cost-effectively are taken at the relevant level through the development of effective structural links with the relevant policy areas;

(4) to determine an overall, integrated strategy at regular intervals which defines appropriate air quality objectives for the future and cost-effective measures for meeting those objectives;

(5) to disseminate widely the technical and policy information arising from implementation of the programme.'[417]

As expressed by the CAFE Programme's general aim, it was created to develop an integrated long-term and strategic policy in order to protect human health and the environment from significant negative effects of air pollution. In pursuing this aim, the CAFE Programme became a platform both for technical analysis and policy development that *inter alia* resulted in a thematic strategy on air pollution as a follow-up to the 6th EAP.[418] Some other features of the CAFE Programme's work are that it has concentrated on *five major air pollutants*, sulphur dioxide being one these,[419] and *five major effects of pollutants*, acidification being one.[420] Furthermore, the CAFE Programme has developed different scenarios picturing the health and vegetation impacts due to air pollution until year 2020. Two of these are the 'business-as-usual' scenario and a maximum technically feasible reduction scenario.[421] The scenarios are in turn related to the

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[417] COM(2001) 245 final.
[418] COM(2005) 446 final.
[419] The five major pollutants that the CAFE Programme has concentrated on are: primary particles, sulphur dioxide, nitrogen oxides, VOCs and ammonia, see Letell (2006) p. 38. It can be noted here that there have been earlier policy initiatives in the European Community (EC) to combat *acidification*, see the 1997 Community strategy to combat acidification presented in COM(97) 88 final.
[420] The five major effects of pollutants the CAFE Programme has focused on are: health effects caused by particles and ground-level ozone, effects on vegetation caused by ground-level ozone, acidification and eutrophication, see Letell (2006) p. 38.
[421] SEC(2005) 1132 p. 4. Other terms that are also used interchangeably with the 'business-as-usual' scenario are 'baseline' or 'current legislation' scenario.

aims of the 6th EAP in the area of air pollution and air quality.[422] This mode of work, to develop baseline scenarios and relate them to alternative policy choices, is similar to how the making of policy works in the LRTAP regime on the highest international level. In fact, the CAFE Programme not only works in close co-operation with the UNECE and its work with the LRTAP Convention,[423] it also to a large extent relies on data and expertise acquired from the same sources.[424]

Lastly, some words should be said about the thematic strategy on air pollution created in the CAFE Programme as a follow up to the 6th EAP. Promptly described, the thematic strategy lay down objectives for different kinds of air pollution and suggested measures to reach these objectives by 2020.[425] This included modernising, simplifying and streamlining already existing legislation,[426] and integrating air quality concerns into other policy areas including transport.[427] The

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[422] Letell (2006) p. 38.

[423] As the European Commission has expressed 'The need to enhance co-operation with UN/ECE Convention on Long-Range Transboundary Air Pollution (CLRTAP) has been one of the strongest messages arising from discussions with national and stakeholder representatives. Clearly, such co-operation must not lead to any dilution of Community competence or control over EU policy in this area. Nevertheless, *there is an increasingly large overlap in both policy and geographical terms between CLRTAP and EU air quality policy, and enhanced co-operation with CLRTAP will therefore be essential if CAFE is to add real value to policy-making and avoid wastage of resources*. In particular, it will be essential to *create and maintain strong structural links to ensure good co-operation and co-ordination between the technical analysis work carried out by the two programmes*. Co-operation and co-ordination at the technical level will thus be the key to exploiting synergies and avoiding duplication. At a political level, it will be essential to achieve the best possible co-ordination of Member States positions in CLRTAP negotiations. The Commission will make every effort to ensure that positions being taken by Member States in Geneva are always fully compatible with evolving Community policy in the area', see COM(2001) 245 final at 5.9.1, emphasis added.

[424] These sources being *e.g.* IIASA and the EMEP. Another important partner for the CAFE Programme is the World Health Organization that has provided recommendations for air quality standards related to health aspects of air pollution, see Letell (2006) pp. 38-39 and 48 and Krämer (2015) p. 301.

[425] COM(2005) 446 final at (3.), (4.1) and (4.1.1).

[426] COM(2005) 446 final at (3.).

[427] COM(2005) 446 final at (4.2). Other policy areas to be included were also energy and agriculture.

strategy also set health and environmental objectives and emission reduction targets for some key pollutants to be met gradually. Some long-term objectives for 2020 included a 47% reduction in loss of life expectancy as a result of exposure to particulate matter and reduction in excess acid deposition of 74% and 39% in forest areas and surface freshwater areas respectively by decreasing *inter alia* the emitted amounts of SO_2, NO_x and VOCs.[428] Finally, the strategy called for continued international co-operation within the framework of the LRTAP Convention, but also opened up for increased co-operation with China to combat air pollution.[429]

As regards more recent regulatory initiatives for land-based sources, the former EU framework directive on air quality and most of its daughter directives have been revised and merged into a single directive which was adopted in 2008.[430] In 2010, a new EU directive on industrial emissions (IED) was adopted, which merged the former IPPC Directive with several older sectoral directives concerning waste incineration, large combustion plants, activities using organic solvents and production of titanium dioxide.[431] Additionally, the sulphur directive, Dir. 1999/32/EC has been amended and updated, most recently by Dir. (EU) 2016/802.[432]

Within the framework of the LRTAP Convention, a revised version of the 1999 Gothenburg Protocol was adopted in 2012 (not yet in force) including new emission reduction commitments to be achieved in 2020 and beyond.[433] Closely connected to the Revised Gothenburg Protocol 2012, there has also recently been a revision of EU air

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428 COM(2005) 446 final at (3.).
429 COM(2005) 446 final at (4.2.5).
430 Dir. 2008/50/EC. For further comments about this directive, see *infra* Chapter 5 Section 5.2.4.
431 Dir. 2010/75/EC. For further comments about this directive, see *infra* Chapter 5 Section 5.2.3
432 For further comments about terrestrial application of this directive, see *infra* Chapter 5 Section 5.2.3.
433 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the Convention on Long-range Transboundary Air Pollution, as amended on 4 May 2012 (Revised Gothenburg Protocol 2012), not yet in force. For further comments about this protocol, see *infra* Chapter 5 Section 5.1.2.

policy. Notably, a revision of the directive on national emission ceilings is an ongoing important part of the thematic strategy on air pollution.[434]

For transport, which historically has been regulated mainly by setting requirements for the vehicles themselves or the fuels used, the EU launched a new strategy in January 2013 for alternative fuels, labelled 'Clean Power for Transport: A European alternative fuels strategy'.[435] As a follow up, a directive came into effect in late 2014 that established 'a common framework of measures for the deployment of alternative fuels infrastructure in the Union in order to minimise dependence on oil and to mitigate the environmental impact of transport'.[436] The directive sets out minimum requirements for the strengthening of alternative fuels infrastructure among other things for the distribution of alternative fuels or power sources like electricity, hydrogen, biofuels and natural gas including liquefied natural gas.[437]

In November 2013, the EU's 7th EAP was presented. This continues to build on priorities and goals already set in the 6th EAP. Among other things, clean air is mentioned in the thematic priorities as a part of the EU's 'natural capital' in 'Priority objective 1: To protect, conserve and enhance the Union's natural capital'.[438] Furthermore, 'Priority objective 3: To safeguard the Union's citizens from environment-related pressures and risks to health and well-being' specifically underlines the urgency of tackling air pollution.[439] Additionally, it is stated that in the process to:

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434 For further information about the revision process see <http://ec.europa.eu/environment/air/review_air_policy.htm>. See also COM(2005) 446 final p. 5.

435 COM(2013) 17 final.

436 Art. 1 of Dir. 2014/94/EU.

437 Arts. 1 and 2 of Dir. 2014/94/EU. Since this directive regards the infrastructure for distribution of fuels rather than the regulation of *e.g.* sulphur limits for the fuels themselves, this directive will not be commented on any further.

438 Annex of the 7th EAP (2013) p. 11.

439 Annex of the 7th EAP (2013) pp. 40-42.

‘safeguard the Union's citizens from environment-related pressures and risks to health and well-being, the 7th EAP shall ensure that by 2020:

(a) outdoor air quality in the Union has significantly improved, moving closer to WHO recommended levels, while indoor air quality has improved, informed by the relevant WHO guidelines;’[440]

Which requires in particular

‘(i) implementing an updated Union air quality policy, aligned with the latest scientific knowledge, and developing and implementing measures to combat air pollution at source taking into account the differences between the sources of indoor and outdoor air pollution’[441]

In late 2013, work with the new EU ‘Clean Air Quality Package’ resulted in the strategy document ‘A Clean Air Programme for Europe’.[442] The proposed measures in the new strategy continue to build on those already presented in the 2005 Thematic Strategy on Air Pollution, and further connects to the objectives of the 6th and 7th EAP’s. Among other things, two new legislative proposals has led to the already mentioned update of the NEC Directive, and a new directive for the control of emissions from medium sized combustion plants.[443]

3.1.6 The Regulation of SO_x Emissions from Terrestrial Sources – A Swedish Perspective[444]

As initially mentioned in this chapter, the problem of air pollution is not new, and different rules have been developed historically to come to terms with its effects. In Sweden, the pre-industrial regulation of pollution and other disturbances from terrestrial sources developed in case law, *inter alia* from rules of the law of neighbours, which in turn

[440] Annex of the 7th EAP (2013) p. 47.
[441] Annex of the 7th EAP (2013) pp. 48.
[442] COM(2013) 918 final.
[443] COM(2013) 920 final 2013/0443 (COD) and COM(2013) 919 final 2013/0442 (COD). See also further *infra* Chapter 5 Section 5.2.3.
[444] All translations of titles and text from national legal acts are the author’s own translations, unless available translations have been found in other sources.

was founded on a heritage of rules regarding the lawful use of real property elaborated in Roman law approximately 400 B.C.[445] Essentially, Swedish regulation targeting terrestrial emission sources, for example emitting air pollutants, originate partly from the law of neighbours, based on the principle of *sic uture* applied to local disturbances, and partly on rules for controlling so-called *immissions*.[446]

Firstly, regarding the rules under the law of neighbours, these were basically applied to solve conflicts between neighbours regarding various activities connected to real property. More specifically, the rules dealt with conflicts caused by activities leading to a certain degree of disturbance to the real property of others that could not be tolerated as it transgressed the property boundaries where the disturbing activities took place.[447]

Secondly, regarding immissions, during the rise of industrialism in 19th century Sweden, the legal control of immissions developed mostly in case law and was based partly on public health rules and partly on the law of neighbours.[448] Immissions, which have shortly been described as 'the effects of emissions'[449] (when transgressing

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445 Michanek, Zetterberg (2017) pp. 60-61. For a short introduction to Roman law in this regard, and to even earlier sources of law also expressing rules of good neighbourliness, see also Ljungman (1943) pp. 11-19.

446 Larsson (1999) pp. 253-254. As Larsson notes, there is no precise and equivalent term in English for 'immissions', but it has been suggested by Ljungman (1943) p. 52, that the term 'annoyance' could be used. Larsson further notes that the term 'nuisance' could encompass immissions, but that it is a substantively broader concept in law than immissions. Larsson settles with using the terms 'immissions' and 'disturbances' interchangeably, Larsson (1999) p. 252. The approach of the latter author is also chosen for the purposes of this thesis.

447 Michanek, Zetterberg (2017) p. 61 and Larsson (1999) p. 252.

448 Larsson (1999) p. 253 and Michanek, Zetterberg (2017) pp. 60-61. As noted in SOU 1966:65 (Statens offentliga utredningar (SOU), Governmental Commission Report 1966:65; hereinafter SOU 1966:65), public health rules as a base for measures against immissions had a public law background, chiefly resting on the first Swedish public health act Hälsovårdsstadga (Public Health Act) SFS 1874:68. The rules under the doctrine of good neighbours rested principally on unwritten rules that developed in a civil law context, SOU 1966:65 pp. 49-50, 93.

449 Larsson (1999) p. 252.

borders to neighbouring property), have typically been defined as including the following kinds of older and more recent phenomena:

‘transfer of smoke, soot, ash, sparks, dust, gases and steam, as well as physical influences of noise, smell, heat, cold, vibration, light, electricity and other similar disturbances. Aesthetic, emotional and economic immissions could also be included’[450]

Additionally, as has been stated, some additional constituents of the definition of what qualifies as an ‘immission’ are:

‘requirements of intangibility (escapability), at least some persistency (permanence) of an effect (influence), and finally that origin and effects of immissions do not occur within the same real property. Traditionally, only immovable sources are addressed … [and] also include such infrastructural constructions as roads, railways and airports, but the disturbance caused by an individual movable source is not included’[451]

When it comes to early Swedish case law from the mid-1800s and forwards regarding conflicts due to immissions with more extensive effects, among others from air pollutants, such conflicts are said to have been rather troublesome for Swedish courts to resolve in the beginning. When disturbances of a greater magnitude appeared in the path of emerging industrialization in Sweden, the courts essentially faced new phenomena.[452] As has been stated, early case law from the mid- and latter part of the 1800s suggests that the courts generally treated immissions from industrial sources rather strictly, and in several cases agreed on claimants’ requests for prohibitions of disturbances and/or compensation for damages.[453] At the same time,

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[450] Larsson (1999) p. 253 with further references to Ljungman (1943). As Larsson notes, ”A comprehensive and final enumeration of immissions is not possible, or even necessary”, same source and page.
[451] Larsson (1999) p. 253.
[452] Ljungman (1943) p. 166.
[453] Ebbesson (2015) p. 14. For cases involving air pollution see *e.g.* cases NJA 1875:257 and 1877:389 (smoke and soot from chimneys of a bath and a brazier respectively), NJA 1900:189 (smoke and noise from a bakery), all cases shortly commented on in Ljungman (1943) pp. 167-168, 171-172 and 213-214.

an analysis of immission cases suggests that 'a few cases from this period reveal that no clear distinction between permitted and non-permitted disturbances was made'.[454]

During the first half of the 1900s, a more tolerant attitude towards disturbances started to emerge in case law.[455] Depending on factors such as what level of disturbance was common according to local circumstances, and what should be considered a 'substantial disturbance', case law now developed into the direction that a certain level of disturbances from for example smoke or noise had to be tolerated.[456] During the same period, the body of Swedish environmental regulation evolved sector by sector.[457] This among other things included proposed legal initiatives for control of water and air pollution prepared by governmental commissions which were discussed in the Swedish parliament on several occasions between 1902-1946. However, the question of *air pollution* did not become a topic for specific regulation during this period.[458]

By the end of the 1960s, there was clearly a need for more comprehensive regulation to deal with industrial emissions to water, land and air in Sweden.[459] In 1969, *Miljöskyddslag* (the 'Framework Environmental Protection Act') was enacted.[460] The act, which applied to 'environmentally dangerous activities', built on the idea of taking a common approach to activities that caused or *had the potential to cause* disturbances and harm.[461] By taking such a common approach, the law is said to have been an early example of the system

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[454] Larsson (1999) p. 258, with further reference to eight immission cases from Swedish higher courts, footnote omitted.
[455] Ebbesson (2015) p. 15.
[456] Ebbesson (2015) p. 15 and Ljungman (1943) p. 215. See also further some short comments on a couple of cases regarding air pollution between 1900-1940 in Ljungman (1943) pp. 213-219.
[457] Michanek, Zetterberg (2017) p. 61.
[458] SOU 1966:65 pp. 93-99.
[459] Michanek, Zetterberg (2017) p. 62.
[460] SFS 1969:387.
[461] Larsson (1999) p. 264. As Larsson states, the inclusion also of risk of disturbances and potential harm within the applicable field of the act simultaneously meant that 'an early precautionary principle was expressed in the Act', Larsson (1999) same page.

that would later be introduced at the European level with the integrated pollution prevention and control directive or the IPPC Directive.[462] According to the *travaux préparatoires*, *Miljöskyddslag* introduced the term 'air pollution' in legislation for the first time in Sweden and it was defined to include gaseous substances such as sulphur dioxide, chlorine, thiols and hydrocarbons as well as particles such as soot, dust, ash and metal oxides.[463] However, the Act only recognized air pollution when occurring in amounts of components and persistency causing or potentially able to cause *substantial interference* to health and comfort, or to real property.[464]

Although *Miljöskyddslag* contained the first Swedish general rules that referred to *air pollution*, SO_x emissions to air had already been regulated in a more specific order from 1968 limiting the sulphur content in fuel oil, *Förordning om begränsning av svavelhalten i eldningsolja* (the 'Ordinance on the limitation of sulphur content in fuel oil').[465] This ordinance was mainly aimed at controlling the sulphur content in fuel oil used in industries, for house heating, and in power plants, thereby reducing SO_x emissions to air.[466] A level of a maximum of 2,5% sulphur content in fuels used in Sweden was generally established.[467] In 1970, a linked decree stipulated applicable maximum levels of sulphur content in fuel oil used in the larger cities of Stockholm and Göteborg to 1%.[468] From an international perspective, it can be noted here that the *travaux préparatoires* of both *Miljöskyddslag* and *Förordning om begränsning av svavelhalten i eldningsolja* mentioned air pollution in an international perspective. Although the main driving force for the creation of these two acts was rather national than international, the knowledge of transboundary air pollution, the importance of international cooperation to mitigate air

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462 Michanek, Zetterberg (2017) p. 62.
463 Prop. 1969:28 p. 255, see also Section 1(3.) of SFS Miljöskyddslag (1969:387).
464 Larsson (1999) p. 265. See also Prop. 1969:28 p. 255.
465 SFS 1968:551.
466 Prop. 1968:122 p. 11.
467 Section 1 of SFS 1968:551.
468 Section 1 of SFS 1970:621.

pollution, and the international processes that had started in the area in the 1960s were discussed in the *travaux préparatoires*.[469]

From the mid 1990s and onwards, the legal developments of air pollution regulation in Sweden is probably most easily described as progressing in several parallel pieces of legislation. This is to a large extent owed to the Swedish EU membership and the legal developments that followed with the introduction of European Community environmental law in Sweden. During the same period, a successor act to *Miljöskyddslag* was prepared, partly because of the Swedish EU membership, and partly because the body of Swedish environmental law had become increasingly complex and difficult to overview.[470] In 1999, a new central environmental code, *Miljöbalk* (the '*Environmental Code'*) took effect.[471] The code *inter alia* included rules intending to implement some central pieces of EC legislation regarding the areas of air quality, industrial emissions to air and integrated pollution prevention control.[472] In the following discussion, a brief overview is given of different historical legal acts that have applied to air pollution in the form of SO_x emissions since the end of the 1990s. The overview is structured according to themes including stationary emissions, ambient air quality, national emission ceilings, and mobile emission sources, ending in current legislation for all themes.

For stationary source emissions, *Miljöbalk*, as was just mentioned, introduced rules generally applying to air pollution in the form of for example industrial emissions and introduced requirements according to integrated pollution prevention control of the then IPPC Directive. Such rules are still reflected in *Miljöbalk* today, most recently implementing the IED together with the parallel implementation in *Industriutsläppsförordning* (the 'Ordinance on industrial

[469] For *Förordning om begränsning av svavelhalten i eldningsolja* see Prop. 1968:122 p. 11 also generally referring back to SOU 1966:65, see however specifically pp. 185-186. For *Miljöskyddslag* see Prop. 1969:28 pp. 61 and 180.
[470] Michanek, Zetterberg (2017) pp. 74-76.
[471] SFS 1998:808.
[472] Prop. 1997/98:45 pp. 247, 250, 332 and 334. The *travaux préparatoires* among others mentioned Dir. 80/779/EEC, Dir. 84/360/EEC and 96/61/EC.

emissons').[473] Another important piece of legislation, that with time came to be the main vehicle for implementing EU regulation on sulphur content in liquid fuels (both marine and terrestrial uses), was *Förordning om svavelhaltigt bränsle* (the 'Ordinance (1998:946) on sulphurous fuel').[474] This order basically implemented the requirements on sulphur content in liquid fuels, for example when used in stationary installations, as required both by early and more recent EU sulphur directives.[475] The latest update of provisions reflecting EU law most recently appear in *Svavelförordning* (2014:509) (the 'Sulphur Ordinance (2014:509)').[476]

Swedish rules regarding large combustion plants and waste incineration reflecting EU requirements, *inter alia* for sulphur emissions, have earlier been found in instructions.[477] Requirements for these emission sources are most recently found in two ordinances, *Förordning (2013:252) om stora förbränningsanläggningar* (the 'Ordinance (2013:252) on large combustion plants') and Förordning (2013:253) om förbränning av avfall (the 'Ordinance (2013:253) on incineration of waste').[478]

Ambient air quality, has been regulated in separate acts in Sweden. Originally via *Förordning om miljökvalitetsnormer* ('Ordinance on environmental quality standards').[479] Most recently, Swedish ambient air quality regulation is mainly found in *Luftkvalitetsförordning* (the 'Air Quality Ordinance').[480] Additionally, *Naturvårdsverkets*

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[473] SFS 2013:250. For more comments about current Swedish legislation, see *infra* Chapter 5 Section 5.3.
[474] SFS 1998:946.
[475] In its original form, the *travaux préparatoires* listed in the bibliographic information for SFS 1998:946 was *inter alia* OJ L74/93 p. 81, which is the early sulphur directive, Dir. 93/12/EEC. Since SFS 1998:946 as updated via SFS 2000:372, a reference is also found to OJ L121/1999 p. 13, which is Dir. 1999/32/EC.
[476] SFS 2014:509. See also *infra* Chapter 5 Section 5.3.1 for further comments about current regulation of the sulphur content in liquid fuels.
[477] NFS 2002:26 and following amendments for large combustion plants and SNFS 1993:14 and following amendments for waste incineration.
[478] SFS 2013:252. For further comments see *infra* Chapter 5 Section 5.3.1.
[479] SFS 1998:897.
[480] SFS 2010:477.

föreskrifter om kontroll av luftkvalitet (the 'Environmental Protection Agency's instructions on control of air quality') specify measurement methods.[481] These acts aim to implement EU requirements in the area of ambient air quality.[482]

Regarding national emission ceilings, *inter alia* for sulphur emissions, *Förordning om nationella utsläppstak för luftföroreningar* (the 'Ordinance on national emission ceilings for air pollutants')[483] has been and still is one part of the Swedish implementation of Dir. 2001/81/EC, the NEC-directive (with updates). Another part of the implementation of Dir. 2001/81/EC is still performed via Sweden's environmental objectives. These two documents simultaneously aim to implement overlapping Swedish LRTAP requirements.[484]

Finally, as regards mobile emission sources and sulphur in vehicle fuels, *Lag (2001:1080) om motorfordons avgasrening och motorbränslen* (the 'Act (2001:1080) on motor vehicles exhaust emission control and motor fuels')[485] earlier contained sulphur limits that are today specified in *Drivmedelslag* (the 'Fuel act')[486] that regulates automotive fuel quality, *inter alia* by setting specifications for petrol and diesel. The latter act has been updated to reflect relevant EU law for automotive fuel quality.[487]

3.2 Conclusions

As regards the manner of regulating SO_x emissions on the international scale, this started in a rather simple fashion, with a single flat rate reduction specifying emission standards. With time, technical and theoretical advances however led to the adoption of more flexible treaty standards, including the concept of critical load.

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[481] NFS 2016:9.
[482] For further comments about these acts, see *infra* Chapter 5 Section 5.3.2.
[483] SFS 2003:65.
[484] See *infra* Chapter 5 Section 5.3.3 for further comments.
[485] SFS 2001:1080.
[486] SFS 2011:319.
[487] The *travaux préparatoires* listed in the bibliographic information SFS 2011:319 is inter alia OJ L350/1998 p. 58, which is Dir. 98/70/EC, the main EU directive on automotive fuel quality.

Looking specifically at the history of air pollution regulation in the EU, this started in the 1970s when the environment emerged more consciously as a policy area in the then EEC. In the early 1980s the process of regulatory development gained momentum as an effect of air pollution and acid rain discussions, and EU air quality legislation targeting SO_x emissions and other air pollutants was introduced. Several important events for the regulation of air pollution in the EU took place during the 1990s. From the end of the 1990s, air pollution regulation development within the LRTAP framework and the EU more and more merged into joint processes. The level of complexity in regulation rose and the interlinkages between pollutants became more apparent with increased scientific knowledge, not least in the sense that cost-effectiveness could be achieved when targeting several pollutants at the same time with a kind of 'balanced bargaining' between negotiated pollutant requirements.

The Gothenburg Protocol was introduced in 1999 as a multi-effect and multi-pollutant instrument within the LRTAP regime to combat acidification, eutrophication and ground-level ozone as a result of long-range transport, *inter alia* of SO_x emissions. This combined approach to tackle pollutants and their effects was also present in the EU ever since the late 1990s when the strategies on acidification and ozone had been launched. For instance, the NEC Directive targeted several pollutants and the familiar concepts of critical loads and emission ceilings were also used in this piece of EU legislation.

Lately, both the LRTAP framework and EU air pollution control legislation have been revised and updated with emission limits for 2020 and beyond. The result of some 30 years of work in air pollution regulation in Europe since the LRTAP Convention entered into force in 1983 has led to significant decreases in several of the most common air pollutants. For instance, in Europe, SO_x emissions to air decreased from around 53 million tonnes a year in 1980 to 15 million tons a year in 2000.[488]

When it comes to the history of air pollution regulation in Sweden, the origins of regulation of terrestrial emission sources is essentially

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[488] Elvingson, Ågren (2004) pp. 94-95.

found in the law of neighbours, based on the principle of *sic uture* applied to local disturbances, and partly on rules for controlling so-called immissions. However, the question of air pollution did not become a topic for specific regulation until the end of the 1960s. From the mid 1990s and onwards, the legal developments of air pollution regulation in Sweden progressed in several parallel pieces of legislation. This to a large extent owed to the Swedish EU membership and the legal developments that followed with the introduction of European Community environmental law in Sweden. In mapping different historical legal acts that have applied to air pollution in the form of SO_x emissions since the end of the 1990s, it can be concluded that Swedish regulation of air pollution from terrestrial sources covers several themes that appear in several pieces of legislation. These include specific rules for stationary source emissions, ambient air quality, national emission ceilings and mobile emission sources, all of which to different degrees reflect and implement relevant EU law under the mentioned themes.

‘…we have come to know that while
the sea is fickle and unforgiving, it is
a fragile environment susceptible to
human depredation on a scale as
unimaginable to our ancestors as the
ships and other technologies we have
created to make it so.’[489]

4 The Historical Regulation of SO_x Emissions from Marine Sources

Having left the historical regulation of SO_x emissions in the terrestrial setting, the current chapter provides an account of the historical development of the origins of SO_x emissions from marine sources and its regulation. Furthermore, some important surrounding factors affecting regulation are also examined. With respect to the latter, this chapter begins by examining some historically decisive factors for the increase of SO_x emissions from marine sources, and then continues to detail the first attempts to regulate such emissions at the highest international, regional and Swedish scales. The current chapter mirrors the examination in Chapter 3, for the purpose of identifying common themes in the regulation of SO_x emissions from marine sources.

[489] Paine (2015) p. 599.

4.1 Historical Development

4.1.1 Pre-1997 Regulation of SO_x Emissions from Marine Sources – An International Perspective

The historical development of the regulation of SO_x emissions from marine sources has been and still is related to the regulation of SO_x emissions from terrestrial sources. The following sections accounting for the history of the regulation of SO_x emissions from ships must therefore be understood against the background that the regulation of SO_x emissions in the marine setting is more or less a extension of or reaction to regulatory events on land.[490]

On a general level, the same basic principles of international environmental law, previously described in Chapter 3,[491] apply as a point of departure also to harmful emissions from ships.[492] Briefly put, this means that State responsibility for significant transboundary environmental harm at the outset also applies to harmful emissions from ships when they act as flag States.[493] That is, the power and primary responsibility to create and enforce rules for ships belonging to the flag State[494] also includes the basic principles regarding State responsibility for significant transboundary harm. However, for

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[490] Christodoulou-Varotsi (2009) pp. 171-172, where the importance of considering regulation of air emissions from ships in the general regulatory framework of air emissions is underlined. See also Honka (2011) p. 234.
[491] *Supra* Chapter 3 Section 3.1.1.
[492] Gold (2006) pp. 61-63.
[493] Molenaar (1998) pp. 42-43. Molenaar states that 'it seems not objectionable to extend a State's responsibility to activities under its jurisdiction or control'. This position has later also been taken in Birnie *et al.* (2009), where simultaneous reference is made to the International Law Commission's fifty-third session report. In accordance with these sources the meaning of activities under a state's 'jurisdiction or control' is said to include for example *ships*, aircraft and spacecraft, see Birnie *et al.* (2009) p. 143 and ILC Report (2001) pp. 383-385. A flag State is a 'State which has granted a ship the right to sail under its flag', Tanaka (2015) p. 157 and Art. 92(1) of the 1982 United Nations Convention on the Law of the Sea (LOSC). Furthermore, a ship has the nationality of the State whose flag it is entitled to fly, Art. 91(1) of the LOSC.
[494] Art. 94(1)-(3) of the LOSC and de la Rue, Anderson (2009) p. 812. For further details about the LOSC, see *infra* Chapter 6 Section 6.1.1.

similar reasons of impracticality to settling disputes appearing in the terrestrial setting regarding long-range transboundary air pollution, the use of this classic approach in the marine setting has given way to other regulatory solutions. As one author has put it:

'Customary rules alone are inadequate to deal with the complex problems of marine pollution. The traditional principles of state responsibility for transboundary pollution, for instance, are premised upon the establishment of a clear obligation of states not to allow injury to another state. Such principles make little provision for the responsibility of non-state actors like shipowners, nor for recourse action by non-state victims. In addition, the maritime practice of registering ships under "flags of convenience" renders it practically difficult to attach customary responsibility and liability on the flag state for damage caused by a ship'.[495]

Hence, there are similar apparent difficulties to applying the traditional State responsibility concept to emissions from ships. As will be developed further below, the regulation of SO_x emissions from ships has therefore followed a similar approach used for SO_x emissions from terrestrial sources, where focus has instead been put on decreasing the overall amount of emissions from all actors instead of relying on classic principles of State responsibility for transboundary harm.

4.1.1.1 Some Historically Decisive Technical and Economic Factors for the Origins of SO_x Emissions from Ships

The decades post World War II were marked by a trend of increasing oil consumption. A proliferation of and increased dependency on different petrochemical products occurred.[496] The refinery industry expanded and met new market demands while better refining technology emerged. Soon, the introduction of new means of transport like jet planes, diesel locomotives and trucks followed. As refineries

[495] Tan (2006) pp. 30-31.
[496] Yergin (2009) pp. 523-524.

reaped the benefit of the economies of scale, there was also a heavy growth *inter alia* in the tanker fleet.[497]

When it comes to the history and origins of the regulation of air pollution from ships in general, legal and other scholars have not researched this area as thoroughly as the history of regulating different air pollutants from terrestrial sources. Available literature therefore mostly tends to focus on relatively recent events in time, starting from around 1997.[498] Nevertheless, in order to get a more thorough understanding of the history of regulating air pollution from ships, and particularly SO_x emissions, it is needed to look not only into the legal history of regulating air pollution, but also into some decisive technical and economic factors related to ships.

As regards technical factors, in the beginning of the 20th century, ships with marine diesel engines began to compete with steamships. As a result, *liquid*, instead of solid fuels for ship propulsion started to gain a foothold at sea.[499] In the 1930s, two-stroke diesel engines gained popularity as a means to power increasingly larger and faster ships. These marine diesel engines were operated with liquid fuels that due to the engine and fuel properties at the time *had to be distillate fuels*. As explained earlier in Chapter 1,[500] distillate fuels have lower sulphur content than heavy fuel oils, HFOs, and accordingly result in lower SO_x emissions when combusted.[501] In the early 1950s, however, a series of diesel engine innovations changed the playing field regarding which marine fuels were possible to use. Among these innovations were pre-heating of fuels, that was, and still is, necessary if the highly

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[497] Yergin (2009) p. 524 and Eyring *et al.* (2009) p. 9. As is noted in the latter source, 'the world merchant fleet increased rapidly and the ship number more than doubled in the period between 1960 and 1980. Part of this ship boom was the tanker business, which reached its peak around 1973–1975'.
[498] 1997 marked the adoption of the air pollution annex to MARPOL 73/78, Annex VI, which is commented on in more detail *infra*. See however Okamura (1995) who shortly touches events before 1997 and the description and analysis given in Svensson (2011) and Svensson (2014), which cover the historical negotiation process and the background arguments for a global fuel sulphur cap for ships before 1997.
[499] Chevron (2007) p.1.
[500] *Supra* Chapter 1 Section 1.2.
[501] Goodger (1982) p. 241. See also *supra* Chapter 1, Section 1.2.

viscous HFOs are to be used. Another innovation was that engine wear rates due to corrosive acids formed during the combustion of HFO could now be countered with highly alkaline lubricants.[502] Accordingly, innovations such as these opened up for the possibility to use HFOs at sea and a new trend took form. Furthermore, as already explained in Chapter 1, heavy fuels have higher sulphur content than distillate fuels. Thus, an increased use of heavy fuel oils at sea led to higher SO_x emissions from ships than previously.

Yet another factor as to why heavy fuel oil became popular in the 1950s and onwards, subsequently increasing air pollution from ships, can be found in economic considerations. Today, fuel costs are a given vital part of a ship's running costs. Roughly half of the total so-called voyage costs can be attributed to fuel oil and it has been noted as 'the single most important item in voyage costs'.[503] Even though oil prices have fluctuated heavily since the 1950s,[504] it is all the same a fact that fuel costs have increasingly become more and more relevant as a part of a ship's running costs, particularly since the 1970s. As it has been noted, between the years 1970-1985 fuel prices rose by 950%.[505]

In the volatile business of shipping, the cost for running a ship is one of the key variables that ship owners work with to survive

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502 Chevron (2007) p. 1 and Goodger (1982) p. 241.

503 Stopford (2009) p. 233. According to the same source, the main elements of voyage costs, apart from the important fuel costs, are: port dues, costs for tugs, pilotage and canal charges. It should however be noted that different ships will have different running cost profiles. Stopford's particular example for a rough estimate of ship running costs is based on the costs of a 10-year old Capesize bulk carrier under Liberian flag at 2005 prices. See also Baldi (2016) pp. 8-9, who underlines the importance of fuel costs and provides a graphical representation of price volatility of bunker fuels 2009 to post-2015, and Ship & Bunker (2015) for a discussion regarding fuel price predictions.

504 BP (2013) p. 15, charting crude oil prices between 1861-2012.

505 Stopford (2009) p. 233 and figure at p. 226. As Stopford argues, 'Leaving aside changes in fuel efficiency of vessels, this meant that, if fuel accounted for about 13% of total ship costs in 1970, by 1985 it had increased to 34%, more than any other individual item', same source p. 233.

financially.[506] Thus, if the important part of fuel costs can be lowered, *it will be done*. The trend of using HFOs had started because it became technically possible to use them in the 1950s, but with time, economic considerations arguably also strengthened this trend. The high sulphur content HFOs have historically been sold at lower prices than the refined low sulphur distillate fuels. In fact, HFOs containing residuals have historically even been priced at a level *below that of crude oil*.[507] Consequently, the increased use of residual fuels at sea, and the subsequent rise in air pollution cannot only be explained because it became technically possible to use these fuels in the 1950s. With time, it likewise became a cheap way to cut ship operating costs that unfortunately increased air pollution as a result of the high sulphur content in marine fuels.

4.1.1.2 The Legal History of Regulating Air Pollution from Ships at IMO

As regards the legal history of regulating air pollution from ships, the topic was mentioned as early as 1968 in a Council resolution from the then Inter-Governmental Maritime Consultative Organization (IMCO). In this resolution, where the topic was mentioned in terms of 'contamination of the air by or from ships and vessels', the work methods of the organization for the near future was considered. As was stated, IMCO's future work would *inter alia* concern:

'the effects of the behaviour of ships and vessels and other equipment operating in the marine environment upon interests, by:

(a) *placing restraints upon the contamination of* the sea, land and *air* or other similar injury *by or from ships and vessels* and other equipment operating in the marine environment'[508]

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[506] Stopford (2009) p. 219. For a later example confirming the importance of fuel costs, see also Sust. Shipping 11 August (2014).

[507] BLG 12/6/1 (2007) p. 12, listing prices from January 1986 to January 2006.

[508] Res. C.42(XXI) p. 3, emphasis added. This is the earliest reference to air pollution that the author has been able to locate among the documents of the then IMCO. However, even older documents that unfortunately are not digitized and easily available may contain further references. Since the referred document Res. C42(XXI) is a Council resolution, it is assumed here that its content was discussed before being

Further, in another document, an Assembly resolution from 1969, the IMCO Assembly decided to convene:

‘in 1973, and international Conference on Marine Pollution for the purpose of preparing a suitable international agreement for *placing restraints on the contamination of the* sea, land and *air by ships, vessels and other equipment operating in the marine environment*’[509]

The topic under the heading of ‘air pollution from ships’ was thus included in the preparatory stages for adopting the 1973 MARPOL Convention.[510] Nevertheless, in the process of settling the final subject matter for the conference on marine pollution, air pollution from ships was dropped from the agenda.[511]

While international efforts to control air pollution from terrestrial sources started to take shape in the years following the 1972 Stockholm Conference on the Human Environment,[512] the question of regulating air pollution from ships seems to have lied at rest in IMO. All the same, this slumber was to be influenced not only by acid rain discussions, and its regulation in the terrestrial setting, but also by the successful regulation of ozone depleting substances via the Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol.[513]

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put down in a final document as a Council resolution, at least in the working group that is mentioned in the document.

[509] Res. A.176(VI) p. 125, emphasis added.

[510] International Convention for the Prevention of Pollution from Ships, 1973, London, 2 November 1973 (MARPOL 73).

[511] IMO (1998) p. 25. See also MSC XXIV/3/1. The annex of the latter document from 1971 spells out an agenda for the 1973 international Conference on Marine Pollution. Judging from a reference on pp. 1-2 in the document to discussions during the ninth session of the Sub-Committee on Marine Pollution and to following discussions during the IMCO Council’s twenty-sixth session (7-10 June 1971), the topic of air pollution from ships as an agenda point for the International Conference on Marine Pollution was probably dropped sometime before or during these sessions.

[512] *Supra* Chapter 3 Section 3.1.2.

[513] Okamura (1995) pp. 184-186. See also the 1985 Vienna Convention for the Protection of the Ozone Layer and the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer.

A combination of events led to the issue of air pollution resurfacing in IMO. During the 1980s, national regulators had become increasingly aware of the problem of acidification on land. The LRTAP Convention had been adopted in 1979 and its First Sulphur Protocol was adopted in 1985.[514] The attention and raised awareness of acidification on land led to questions of how big a share shipping had in air pollution and its resulting effects. When it came to marine contributions, the combustion of sulphur-containing fuels in ships was pointed out as the culprit.[515] Some North Sea countries[516] were particularly active in pushing forward the regulation of air pollution in the marine setting. Norway brought up the issue of regulating the sulphur content in marine fuels during the second North Sea conference in 1987, and it was included in the resulting conference declaration.[517] This step was important for the question to eventually be raised at IMO.[518] Again, Norway took the lead by submitting a proposal to include air pollution from ships in the future work programme of the MEPC.[519] Other actors such as the Baltic Sea States, Friends of the Earth International and the LRTAP Convention parties backed up this initiative.[520] It was subsequently agreed that the subject would be included in the future work programme of the MEPC, and particularly that improving the standards for HFO should be discussed.[521]

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[514] *Supra* Chapter 3 Section 3.1.3.
[515] Tan (2006) p. 155.
[516] In this context to be understood as the countries active in the so-called North Sea Conferences such as Belgium, Denmark, France, Germany, The Netherlands, Norway, Sweden and the United Kingdom.
[517] Declaration of the Second International Conference on the Protection of the North Sea (1987) at 31., where it is stated that the conference participants agreed to 'initiate actions, within the appropriate international bodies concerned such as the International Maritime Organization and the International Standards Organization as may be appropriate, leading to improved quality standards of heavy fuels, and actively support this work aimed at reducing marine and atmospheric pollution'.
[518] Tan (2006) p. 156 and Svensson (2011) p. 28.
[519] MEPC 26/22. See also MEPC 26/INF.30.
[520] Tan (2006) p. 156.
[521] MEPC 26/25 at para 24.3.

Already here, it can be noted that the question of air pollution from ships in the MEPC was considered in the context of *fuel oil quality*, a topic that had previously been brought up in the MEPC in connection to a review of discharge requirements in MARPOL Annex I in the mid-1980s.[522] In addition, work done in HELCOM in 1988 pointed in the same direction in the sense that 'standards of marine fuels' were noted as an important area of cooperation.[523]

During an MEPC session in 1989, different possibilities to reduce air pollution from ships were proposed, *inter alia* in submissions from Norway and the Baltic Sea States. It was decided that the best solution was to reduce the sulphur content in fuels rather than using on-board abatement technology, among other things because the latter alternative was considered to be too complex, and too costly in small-scale applications at the time, and moreover because it caused disposal problems.[524] It was furthermore agreed that SO_x emissions were central to consider in association with environmental problems caused by fuel oil quality.[525] During the coming years, various views regarding air pollution from ships would be presented and debated back and forth. Notably, questions about shipping's contribution to air pollution and in particular SO_x emissions were debated. Furthermore, the necessity of regulating air pollution, financial implications, cost-effectiveness and the scope of application of air pollution regulation was debated. In the below, only some key events leading up to the adoption of the original MARPOL 73/78 Annex VI 1997 will be commented.[526]

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[522] IMO (1998) p. 25.
[523] The 1988 Declaration on the Protection of the Marine Environment of the Baltic Sea. Particularly, it was stated in the declaration that the HELCOM parties declared their firm determination to 'COOPERATE within appropriate international bodies to promote the development of environmentally sound standards of marine fuels'. This declaration was subsequently submitted to the MEPC in MEPC 26/INF.19.
[524] Svensson (2011) p. 28.
[525] Svensson (2011) p. 28 and Tan (2006) p. 156.
[526] MARPOL 73/78 Annex VI 1997, as annexed to the MARPOL 73/78 1997 Protocol. For a more detailed account of events during this period in the MEPC and the related preparatory documents, see Svensson (2011) pp. 29-52.

In 1991, a unanimous IMO Assembly adopted Resolution A.719(17) on the prevention of air pollution from ships. At this point in time, the work regarding air pollution from ships had shifted to cover *all aspects of air pollution* and did thus not only limit itself to the question of SO_x emissions. As the resolution stated, the Assembly 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* including ozone-depleting CFCs and halons, exhaust gases resulting from harmful fuel components and incineration and combustion processes, and volatile organic compounds'[527]

It may be noted that the resolution made clear reference to instruments regulating air pollution from terrestrial sources like the Montreal Protocol on Substances that Deplete the Ozone Layer as well as the LRTAP Convention and its protocols.[528] In the process of drafting air pollution regulation for ships, these instruments would later remain relevant as inspiration and a backdrop.[529] Moreover, the resolution stated that the best way of achieving the objective of preventing air pollution from ships would be to establish a new annex to MARPOL 73/78. This annex would 'provide rules for restriction and control of

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[527] Preamble of Res. A.719(17), emphasis added.

[528] Preamble of Res. A.719(17).

[529] Indeed, later on, representatives from the executive body of LRTAP would participate in discussions about the importance of the air pollution annex to MARPOL 73/78, Svensson (2011) p. 46 with further references to MEPC documents. It is also noteworthy here that other instruments in the more general setting of environmental protection influenced and strengthened the development of the new annex on air pollution. This is the case for the 1992 Rio Declaration, and its accompanying Agenda 21. 'The precautionary approach' as reflected in Principle 15 of the Rio Declaration, and in Chapter 17 of Agenda 21, was explicitly referred to in a dedicated MEPC resolution adopted in 1995. This acknowledgement of 'the precautionary approach' probably had a certain positive influence on MEPC negotiations in the sense of taking action despite remaining scientific uncertainty surrounding air pollution from ships, Res. MEPC.67(37). See also Svensson (2011) p. 38 and the reference to Principle 15 of the Rio Declaration in the Preamble of MARPOL 73/78 1997 Protocol.

emission of harmful substances from ships into the atmosphere'.[530] Regarding SO_x emissions, the Assembly requested the MEPC in co-operation with the Maritime Safety Committee to:

'establish fuel oil quality requirements with regard to environmental aspects and to reduce the sulphur content'[531]

Additionally, some interim measures were decided for regarding air pollution from ships. Governments were urged 'to take the necessary steps, without waiting for the development of international regulations, to implement … measures for prevention of air pollution from ships'[532], *inter alia* by prohibiting the addition of chemical wastes to bunker fuel oil by 1 January 1992, and by reducing SO_x and NO_x emissions in exhaust gases.[533]

Six years after the adoption of resolution A.719(17), a new annex to MARPOL 73/78 was ready for adoption. It had been decided that it should be adopted as a protocol to MARPOL 73/78, which included the new Annex VI: MARPOL 73/78 Annex VI 1997. A conference, the Third Conference on Marine Pollution, was held in 1997 for the purpose of adopting the new protocol and accompanying annex.[534] The results, which where the product of lengthy discussions and tough negotiations in the MEPC *inter alia* ended up with the regulation of SO_x emissions from ships via a combination of a global cap and a 'special areas solution'. A global cap was set at 4,5% sulphur content for any fuel oil used on board ships. The special areas at the time only included sulphur emission control areas (SECAs), in which there was a maximum allowed limit of 1,5% sulphur content in fuel oil used on board ships.[535] The requirements of SECAs could however also be

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[530] Preamble of Res. A.719(17).
[531] Res. A.719(17) Preamble and para. 1(e).
[532] Res. A.719(17) para. 2.(c)
[533] Res. A.719(17) para. 2.(c)
[534] The conference was formally known as Conference of the Parties to the International Convention for the Prevention of Pollution from Ships, as modified by the Protocol of 1978 relating thereto, MP/CONF.3.
[535] Reg. 14(1) and 14(4)(a)-(c) of MARPOL 73/78 Annex VI 1997. The annex did not contain a definition of 'fuel oil', but did however contain the expressions 'fuel oil used on board ships' (Reg. 14(1)) and 'fuel oil for combustion purposes … used on

fulfilled by use of an exhaust gas cleaning system with a specified total emission limit of sulphur oxides from ships of 6.0 g SOx/kWh or less, or by application of another technological method for emission reduction that could achieve an equivalent result of the exhaust gas cleaning system.[536]

The outcome of the negotiations, even though unanimously adopted, was a disappointment for many States with environmental ambitions. Even though the world average of sulphur in bunker fuel was estimated to lie around 2,8-3,5% at the time, a lower cap than the compromise of 4,5% sulphur content in fuel had been impossible to reach agreement about, mainly because of strong objections from the oil industry and oil producing and refining States.[537] Thus, the 4,5% sulphur cap did not get a function to actually limit and at the same time lower the world average of bunker fuel sulphur content. This consequence made many States regard the limit as practically meaningless.[538] Another point of dissatisfaction for some States was that the North Sea had not been designated as a SECA at the conference,[539] something that would however later become a reality.[540]

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board ships' (Reg. 18(1)). At the time of adoption in 1997, only one SO_x Emission Control Area, SECA, was listed in Annex VI: the Baltic Sea area, Reg. 14(3)(a) of MARPOL 73/78 Annex VI 1997.

536 Reg. 14(4) of MARPOL 73/78 Annex VI 1997.

537 Tan (2006) pp. 159-160. As Tan notes, the oil industry was reluctant to let go of the fuel market linked to shipping as this was one of the few remaining markets for HFO. This makes sense, since as described *supra* Chapter 3 Section 3.1.4., many (European) States had started their work to limit the use of high sulphur oil grades on land since the end of the 1980s and onwards. See also Okamura (1995) p. 193 noting that 'During the entire development of the new Annex, IMO has been confronted with astronomical figures for the cost implications to the oil industry'.

538 Tan (2006) pp. 160-161. In this context, it may also be noted that the original discussions in the MEPC surrounding a global cap did in fact not revolve around a global cap having this kind of limiting function so as to lower average sulphur content. On the contrary, the global cap was introduced in the discussions because there was a fear that the sulphur content in marine fuels could *increase* even further with time, Svensson (2011) p. 36.

539 Svensson (2011) p. 52.

540 See further *infra* Section 4.1.3.1.

On a more positive note, connected to marine environmental regulation in a broader perspective, the adoption of MARPOL 73/78 Annex VI in 1997 marked a new phase in IMO's regulation of ship source pollution. As it has been noted, prior to this time, IMO's focus had been on more visible sources of pollution like for instance oil, as opposed to the diffuse kind of pollution represented by SO_x emissions to the air.[541] Even though the results of MARPOL 73/78 Annex VI 1997 may be regarded as weak, the early regulation of diffuse emission sources from ships must therefore also be seen against the background that the 'harmful long-term effects of ships' exhaust gases were not so immediately visible [as e.g. oil spills] and were not, at that point in time fully understood'.[542]

Moreover, even though criticism of apparent weaknesses could be raised against the new annex, some kind of platform for regulating of air pollution from ships was now all the same in place. This platform had the possibility to evolve into something stricter, which would also eventually happen. Two out of totally eight resolutions adopted at the Third Conference on Marine Pollution are specifically important to mention in this context. Resolution 1, that laid down a date for review of Annex VI if the conditions for entry into force had not been met by the 31 December 2002,[543] and Resolution 4 that invited the MEPC 'in co-operation with interested organizations, to develop guidelines for monitoring the world-wide average sulphur content of residual fuel oil supplied for use on board ships'.[544] Finally, in relation to possible developments of Annex VI, an important legal point regarding the inclusion of the annex to MARPOL 73/78 was that the annex could later be changed with the so-called *tacit acceptance procedure,* allowing for quicker changes of the requirements within the annex.[545]

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[541] Balkin (2009) pp. 63-64.
[542] Balkin (2009) p. 64.
[543] Conference Resolution 1 in MP/CONF. 3/34.
[544] Conference Resolution 4 in MP/CONF. 3/34.
[545] According to Art. 16(2)(f)(iii) of MARPOL 73/78, an amendment to an annex can be performed with the tacit acceptance procedure. A specific date is then set for entry into force of the amendments, unless before that date an agreed number of States parties object to the amendments.

4.1.2 The Regulation of SO_x Emissions from Marine Sources Until 1999 – A European Perspective

Just like air pollution from marine sources must be considered in the general context of the regulation of air pollution from terrestrial sources, European efforts to regulate air pollution from marine sources must be regarded in an international context, namely the context of IMO as an international forum for the regulation of various activities at sea. More specifically, the following part describing the historical development of European marine environmental regulation must be seen against the background of an interplay and balance between EU regulatory interests and the international regulatory interests expressed and negotiated at the highest international scale at IMO. Before delving into the specifics of regulating SO_x emissions from marine sources in Europe, a background with some comments about the history of European marine environmental protection in general will however initially be given.[546]

The ambition to protect and preserve the marine environment has been present ever since the then European Community adopted its first environmental priority policy plan in the form of the 1st Environment Action Programme (EAP).[547] Despite a historically present political will to protect the marine environment, its regulation on the European level has all the same been described as 'limited, fragmented and indirect'.[548] In general, marine environmental protection has historically had a rather weak position in EU law and policy, covering

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546 Only the main traits will be discussed in this study. For a more thorough description of marine environmental protection and its history in the EU, see Frank (2007) pp. 77-106. See also Ringbom (2008) pp. 31-51, the latter source commenting specifically on EU maritime safety regulation, but which all the same also contains reflections that are relevant for the EU's regulation of marine environmental protection.

547 1st EAP (1973), where it is *inter alia* stated that 'Of all the different forms of pollution, marine pollution constitutes now, and to an even greater extent in the long term, one of the most dangerous, because of the effects it has on the fundamental biological and ecological balances governing life on our planet'. See also Jans, Vedder (2012) pp. 339-341 for some short comments about the first six environmental action programmes.

548 Frank (2007) p. 77.

European seas more or less with a sector-by-sector approach that has created a patchwork of regulation. Instead of creating its own regulation, the European Union has relied on the international ocean regime and multilateral cooperation within this regime as the most effective way of working with oceans issues, mainly via instruments such as the 1982 United Nations Convention on the Law of the Sea, the LOSC, Agenda 21 (Chapter 17), and regional seas agreements.[549]

Several explanations for this situation can be found. One obvious reason for fragmented regulation is the cross-sectoral nature of marine issues. For example, ocean preservation concerns both areas such as water policy, fishing and transport.[550] It has therefore been noted that the most direct and concrete action to protect and preserve the marine environment in the EU has actually 'been taken within areas outside the environmental policy, such as transport and fisheries, and, to a certain extent, the internal market and agriculture'.[551] Another reason that generally applies to the history of ocean preservation and remains relevant to this day is the lack of reliable data and considerable knowledge gaps about the marine environment compared to available knowledge about the terrestrial environment.[552] Moreover, several other reasons at the EU-level of 'legal, political and institutional nature have for a long time prevented the establishment of a comprehensive marine environmental policy and the necessary legislation'.[553]

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[549] Frank (2007) pp. 84 and 105.

[550] Furthermore, as noted in Frank (2007) pp. 79-80, the common water policy has historically focused on the status of freshwaters.

[551] Frank (2007) p. 80. As Ringbom notes, especially in early days of the European Community, economic co-operation, *and not environmental issues*, took centre stage in EC policy and regulation, see Ringbom (2008) p. 31.

[552] Frank (2007) p. 80.

[553] Frank (2007) p. 80. Frank *inter alia* mentions the shared responsibility for oceans and seas by several Directorates-General (DGs), economic interests and sovereignty of EU Member States, potential competitive disadvantages of EU unilateral regulation compared to global regulation, and questions of subsidiarity and proportionality as limiting factors for EU marine environmental protection, see same source pp. 81-85. On a related note, regarding maritime safety, which presumably also bears relevance for marine environmental protection, Ringbom additionally explains potential legal conflicts between the creation of unilateral EU regulation applying irrespective of flag

To this end, it is therefore no surprise that regulation of air pollution from marine sources in the EU is historically first encountered in regulation that was *not* specifically created to protect the marine environment, but in regulation that was created primarily with regard to air pollution from terrestrial sources. Here, the early regulation of *certain liquid fuels* (originally only gas oils) from terrestrial emission sources, which was commented on in detail above, must be recalled.[554] Based on arguments for 'the establishment and functioning of the common market' and 'public health and the environment' already Dir. 75/716/EEC stated that 'the sulphur content of gas oils must be progressively and significantly reduced at Community level'.[555] However, this early directive from 1975 did not apply to gas oils used in shipping.[556]

Furthermore, its successor directive, Dir. 93/12/EEC, although also having an ambition 'to reduce progressively the sulphur content of gas oil used for self-propelling vehicles, including aircraft and *vessels*',[557] however excluded the use of gas oils 'contained in the fuel tanks of vessels, aircraft or motor vehicles crossing a frontier between a third country and a Member State'.[558] Simultaneously, Dir. 93/12/EEC nevertheless requested that the Commission submitted a proposal

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and the *pacta tertiis nec nocent nec prosunt* rule of international law by which 'an agreement creates neither rights nor obligations for third parties'. The *pacta tertiis* rule as a point of departure in international law is not automatically set aside because a group of states (*i.e.* EU Member States) decide to create rules that apply to a specific area irrespective of flag, Ringbom (2008) pp. 3-4. Moreover, Ringbom further points out that certain aspects relating to the nature of applicability and enforcement of regulation within the EU framework has made individual EU Member States reluctant to take the risk of *indirectly* enforcing international conventions via a harsher and more powerful EU enforcement framework against themselves. This situation could well become a reality if the union would have been party to a certain IMO convention that would then be implemented in EU law instead of at the individual Member State level, see same source pp. 7-14.

554 *Supra* Chapter 3 Section 3.1.4.

555 Preamble of Dir. 75/716/EEC.

556 Art. 1(2.) of Dir. 75/716/EEC.

557 Preamble of Dir. 93/12/EEC, emphasis added. It can be underlined that at this point in time, the Community was a contracting party to the 1979 LRTAP Convention via Decision 81/462/EEC.

558 Art. 1 (2.) of Dir. 93/12/EEC.

prescribing *inter alia* lower limits for the sulphur content in gas oil the 1 October 1999 at latest.[559] As was explained in detail above, in the setting of the regulation of air pollution from terrestrial sources,[560] with the advent of such policy documents as the 5th EAP and the 1997 Community strategy to combat acidification, an increasing focus was put on air pollution abatement in the EU. For instance, in the 1997 Community strategy to combat acidification, measures that concerned ships were *inter alia* proposed. A revision of Dir. 93/12/EEC was discussed and concerning *marine fuels*, special limits for the Baltic Sea and the North Sea of 1,5% sulphur were also discussed.[561]

With the introduction of Dir. 1999/32/EC new limits were set for gas oils and *marine gas oils* used in EU territory, the latter however with some limitations. As from July 2000 the sulphur content in gas oils, including marine gas oils, could not exceed 0,20 % sulphur by mass, and by the 1 January 2008 a limit of 0,10% sulphur would apply.[562] For marine gas oils, this however excluded oils 'used by ships crossing a frontier between a third country and a Member State'.[563] Additionally, as previously stated,[564] limits were set for the first time for HFO, the main requirement being a 1,00% limit by mass as from 1 January 2003.[565] Nevertheless, this limit for heavy fuel oil *did still not apply to ships*.[566]

Of course, the actual effect of only limiting the sulphur content in gas oils when used for marine purposes could be discussed. This, since the extent of HFO use was considerable at the time, and limiting *only* gas oils would probably not make any major difference for SO_x emissions from seagoing vessels.[567] On the other hand, it was still a

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559 Art. 2 (2.) para. 2 of Dir. 93/12/EEC.
560 *Supra* Chapter 3 Section 3.1.5.
561 COM(97) 88 final pp. 13-14 and 15-16. See also pp. 19-20 same source.
562 Art. 4 of Dir. 1999/32/EC.
563 Art. 1(2.)(a) of Dir. 1999/32/EC.
564 *Supra* Chapter 3 Section 3.1.5.
565 Art. 3 of Dir. 1999/32/EC.
566 Art. 1(2.)(a) and Art. 2(3) of Dir. 1999/32/EC.
567 In a later amendment proposal of Dir. 1999/32/EC from 2002, which will be commented on in Section 4.1.3.1 immediately below, the EU Commission, after consultations with industry, concluded that the most widely used type of marine fuel

breakthrough that the sulphur content of HFO was now regulated, *even if only from terrestrial pollution sources*. Moreover, the directive made open reference to IMO discussions regarding the limitation of the sulphur content in fuels for ships, and it also expressed the Community's determination to advocate more effective protection of areas sensitive to SO_x emissions and the reduction of sulphur in bunker fuels in forthcoming negotiations at IMO.[568]

4.1.3 International and European Regulation of SO_x Emissions from Marine Sources 1999-2017[569]

4.1.3.1 The Years After Adoption of the MARPOL 73/78 1997 Protocol

Following the adoption of the original MARPOL 73/78 1997 Protocol, and its Annex VI, the next important step was to achieve an entry into force. The protocol was subject to the conditions that after signature and ratification it should:

'enter into force twelve months after the date on which not less than fifteen States, the combined merchant fleet of which constitute not less than 50 per cent of the gross tonnage of the world's merchant shipping, have become Parties to it in accordance with article 5 of the present Protocol.'[570]

Nevertheless, the process towards entry into force of the 1997 Protocol proceeded slowly.[571] As may be recalled, one of the

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was heavy fuel oil, and that the limits for marine gas oils were effective for inland waterway vessels, but had an effect that was less clear when it came to seagoing vessels, p. 6 of COM(2002) 595 final Volume II.

[568] Preamble (21) of Dir. 1999/32/EC.

[569] Attentive readers might have noticed that the last section about the *international* regulation SO_x emissions from marine sources, Section 4.1.1, ended chronologically in 1997, when the original MARPOL 73/78 Annex VI 1997 had been adopted. Therefore, the period between 1997-1999 on the international scale is also briefly commented on in the beginning of the present section.

[570] Art. 6 of MARPOL 73/78 1997 Protocol. See also Art. 5 of the same protocol.

[571] The slowness of the process could be explained by at least two factors. As proposed by Birnie *et al.* one factor could be the general trend of flagging out to open registries which has with time made the '50% of world tonnage' requirement

resolutions from the Third Conference on Marine Pollution, where the MARPOL 1997 Protocol was drafted, regarded measures in case of a slow entry into force,[572] and in November 2001 the IMO Assembly adopted a resolution to speed up the process.[573] The resolution on entry into force of Annex VI among other things urged governments to ratify the 1997 Protocol at 'the earliest possible opportunity'.[574] On the 18 May 2004, the number of States and tonnage requirement was finally met when Samoa acceded to Annex VI. In accordance with the normal procedure, it would thus enter into force twelve months later, on 19 May 2005.[575]

A process that occurred simultaneously during the years towards the entry into force of the MARPOL 73/78 1997 Protocol was that the first monitoring of the worldwide average sulphur content in residual fuels oils was initiated. The development of sulphur monitoring guidelines had been planned since the Third Conference on Marine Pollution as stipulated by Resolution 4,[576] and in July 1999 'Guidelines for Monitoring the World-Wide Average Sulphur Content of Residual Fuel Oils Supplied for use on Board Ships' was adopted in an MEPC Resolution.[577] The monitoring would be performed by measurement and calculation of fuel sulphur content as yearly and three-year rolling averages. Once three years had passed, a reference value for monitoring would be set.[578] If a rolling average would then exceed the established reference value by a number equal to or greater than 0,2%, the MEPC should

'consider the need for further measures to reduce SO_x emissions from ships, so as to decide whether it should be considered a high priority

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increasingly difficult to achieve, Birnie et al. (2009) pp. 403-404. Another factor specifically connected to the aftermath of the negotiations of the MARPOL 73/78 1997 Protocol was the disappointment and difficulty to accept the 4,5% sulphur cap for many States with higher environmental ambitions, Tan (2006) pp. 160-161.

572 *Supra* Section 4.1.1.2.

573 Res. A.929(22).

574 Res. A.929(22) p. 2.

575 MEPC 52/24 p. 22.

576 Conference Resolution 4 in MP/CONF. 3/34 and *supra* Section 4.1.1.2.

577 Res. MEPC.82(43).

578 Paras. 4 and 5 of Res. MEPC.82(43).

item for the Committee. MEPC shall continually review this excess value, (now 0.2%) once the reference value has been set'[579]

The first ever three-year rolling average was established in 2002 for the period 1999-2001 and was calculated at 2,7% sulphur content in fuel.[580] A second three-year rolling average was established in 2003 and was estimated to be 2,67% sulphur content in fuel.[581]

As regards the EU and the North Sea States, during the time until the entry into force of MARPOL 73/78 Annex VI 1997, initiatives surrounding air pollution from ships continued, some with ambitions that were already looking ahead of the results of negotiating the 1997 Protocol. Here, it has to be recalled that the EU States, and especially the North Sea States, had partly been disappointed with the final results of negotiating MARPOL 73/78 Annex VI 1997, since the North Sea and the English Channel had not been included as a SECA in the final version of the 1997 Protocol. Furthermore, the earlier mentioned EU 1997 Community strategy to combat acidification had supported higher environmental ambitions with economic arguments, especially when it came to the support of SECAs in the Baltic Sea and the North Sea and English Channel.[582]

The increasing attention to air pollution from ships raised on the European level took many shapes, and in 2002 the EU Commission presented 'A European Union strategy to reduce atmospheric emissions from seagoing ships'[583], and 'Proposal for a Directive of the European Parliament and of the Council amending Directive 1999/32/EC as regards the sulphur content of marine fuels'.[584] The Union strategy to reduce atmospheric emissions from ships was clearly linked to what was going on in the general setting of air pollution regulation in the EU, as witnessed by open references to recently adopted directives targeting *inter alia* SO_x and NO_x

[579] Para. 6 of Res. MEPC.82(43).
[580] MEPC 48/INF.4 p. 2.
[581] MEPC 49/4/1 p. 2.
[582] *Supra* Chapter 3 Section 3.1.5. See also COM(97) 88 final pp. 15-16 and 36.
[583] COM(2002) 595 final Volume I.
[584] COM(2002) 595 final Volume II.

emissions. The directives mentioned in the strategy were: the directive regarding national emission ceilings for certain atmospheric pollutants, emissions of certain pollutants into the air from large combustion plants, air pollution by emissions from motor vehicles, and the EU sulphur directive from 1999.[585] As the strategy initially stated:

'For a number of pollutants, ships' emissions in EU sea areas are now relatively high, compared to land-based emission sources where action has already been taken, so ships now offer more scope for emissions reduction'[586]

The main objective of the strategy was 'to deal with the effect of the emissions on the land [sic!], and on global aspects (climate change and depletion of the ozone layer)'[587] from seagoing ships. Under the heading of 'The Way Forward' some of the goals were among other things to:

'To reduce ships' emissions of SO2 where they contribute to exceedances of critical loads for acidification, and where they affect local air quality…[and]…To reduce ships' emissions of primary particles where they affect local air quality'[588]

Moreover, the Commission expressed its ambition to continue working at IMO with common EU positions to achieve further reductions for emissions to air from ships and also recommended EU Member States to ratify MARPOL 73/78 Annex VI 1997 as soon as possible.[589] As mentioned earlier, the European Union strategy to reduce atmospheric emissions from seagoing ships was accompanied by a proposal for a new sulphur directive with the aim to 'deliver significant reductions in ship emissions' contribution to acidification and problems of local air quality'.[590] Reductions in the maximum

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585 COM(2002) 595 final Volume I, p. 2. See also *supra* Chapter 3 Sections 3.1.4-3.1.5.
586 COM(2002) 595 final Volume I, p. 2.
587 COM(2002) 595 final Volume I, p.3.
588 See COM(2002) 595 final Volume I, p. 16.
589 COM(2002) 595 final Volume I, p. 16.
590 COM(2002) 595 final Volume I, p. 17.

sulphur content for *all marine fuels*, including HFO, were discussed in this proposal for amending Dir. 1999/32/EC.[591] Dir. 1999/32/EC was also to be aligned with MARPOL 73/78 Annex VI 1997, by setting a maximum of 1,5% sulphur limit in sulphur emission control areas. At the time, these areas covered the Baltic Sea, the North Sea, and the English Channel, the latter two being areas that had been approved in 2000 with a view for future adoption when MARPOL 73/78 Annex VI 1997 had entered into force.[592] Furthermore, a 1,5% sulphur limit in fuels for passenger ships of all flags on regular services to or from any Community port was proposed from 1 July 2007.[593] Other more stringent reduction measures for sulphur were also discussed on the way to adopting the final version of the directive, but it ended up in a compromise proposal, although foreseeing yet further reviews of sulphur limits in 2008.[594]

The amendment directive to Dir. 1999/32/EC in its final form, Dir. 2005/33/EC, principally introduced parallel requirements in the EU for those limits already applying according to MARPOL 73/78 Annex VI. It did so with motivations that had been brought forward in the strategy to reduce atmospheric emissions from seagoing ships, such as harm to human health, damage to the environment, but also as a way to comply with and complement the NEC Directive, Dir. 2001/81/EC, which *did not cover* emissions from international maritime traffic.[595] Dir. 2005/33/EC stressed the importance of finding international solutions to the problems with SO_x emissions from marine sources within IMO. At the same time, it stated that the changes in the amendment directive should only be regarded as a first step in an ongoing process to reduce emissions from marine sources, a process

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591 COM(2002) 595 final Volume II p. 6.

592 COM(2002) 595 final Volume II p. 5 and proposed amendments in Art. 4a 1., p. 23 same document. See also para. 11.29.6 of MEPC 44/20 and Annex 5 of the same document.

593 COM(2002) 595 final Volume II p. 16 and proposed amendments in Art. 4a 2., p. 23.

594 The stringent measures included an extension of ‘the 1.5-per-cent sulphur limit to cover all EU sea areas, and to establish a second phase lowering of the sulphur limit to 0.5 per cent’, Acid News No. 2 (2005) p. 7.

595 Preamble (4)-(6) of Dir. 2005/33/EC and Art. 2 of Dir. 2001/81/EC.

which would be reinforced by EU Member States' positions in IMO negotiations to achieve even further reductions in view of a coming revision of MARPOL 73/78 Annex VI 1997.[596]

Getting to the actual requirements of the amendment directive, these were now set so as to be aligned with the maximum 1,5% sulphur content limit *for all marine fuels* in SECAs according to MARPOL 73/78 Annex VI 1997, applying to ships of all flags.[597] However, a difference in the directive was that it included an early implementation of the North Sea SECA *if* the designation, entry into force and the following period before the effective date of the SECA according to MARPOL 73/78 Annex VI 1997 would pass a certain date.[598] Furthermore, Dir. 2005/33/EC introduced a maximum sulphur limit of 1,5% for passenger ships of all flags operating on regular services to or from a community port.[599] This sulphur limit applied to all marine fuels in EU Member States' 'territorial seas, exclusive economic zones and pollution control zones' *irrespective* of if the passenger ships would operate in a SECA, and additionally, with effect from the date of application of the directive, 11 August 2006.[600] This ship class specific requirement applying even outside SECAs had no equivalent in MARPOL 73/78 Annex VI 1997.[601]

In addition, the directive introduced a new 0,1% maximum sulphur 'at berth' requirement for fuels used by ships at berth in EU ports from 1

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[596] Preamble (11), (14)-(15) of Dir. 2005/33/EC. See also Art. 7 regarding a planned review in 2008 of the same directive. Here it is *inter alia* stated that 'The Commission shall give particular consideration to proposals for: (a) the designation of additional SOx Emission Control Areas; (b) the reduction of sulphur limits for marine fuel used in SOx Emission Control Areas possibly down to 0,5 %'.

[597] Art. 4a of Dir. 2005/33/EC and Art. 1 of MARPOL 73/78 Annex VI 1997.

[598] Art. 4a 2.(b) of Dir. 2005/33/EC. As it later turned out, the North Sea SECA became applicable the 11 August 2007 according to Dir. 2005/33/EC in Europe while the international designation according to MARPOL 73/78 Annex VI 1997 made the area applicable on 22 November 2007. See also Ringbom (2008) pp. 427-430 for some comments about the motivations and legality of this measure in relation to the LOSC.

[599] Art. 4a 4. of Dir. 2005/33/EC.

[600] Art. 4a 4. of Dir. 2005/33/EC.

[601] For some comments about the motivations and legality of this measure in relation to the LOSC and MARPOL 73/78 Annex VI 1997, see Ringbom (2008) pp. 430-438.

January 2010.[602] Neither this requirement had an equivalent in MARPOL 73/78 Annex VI 1997. As regards marine distillate fuels, that had already been regulated to some extent in the earlier Dir. 1999/32/EC, the sulphur limits for marine gas oils and marine diesel oils placed on the EU market were now set at 0,1 % from 1 January 2010 (marine gas oils) and 1,5 % from 11 August 2006 (marine diesel oils).[603] Finally, like in the case of MARPOL 73/78 Annex VI 1997, the changes to Dir. 1999/32/EC via Dir. 2005/33/EC also allowed for alternative or equivalent ways of complying with the requirements. In the EC directive, equivalents were permissible in the form of an approved emission abatement technology achieving emission reductions 'at least equivalent to those which would be achieved through the limits on sulphur in fuel specified'.[604]

As regards the EU requirements going further than MARPOL 73/78 Annex VI 1997, it can be recalled that the EU was not, and is still not a party to MARPOL 73/78, although many EU Member States are parties to the convention as individual contracting parties. This has caused some discussion about the tensions between regulations at the EU scale going *further* than international law in the form of MARPOL 73/78 Annex VI 1997. As to yet, the legal challenges have stopped at a preliminary ruling from the ECJ where *inter alia* the question of the validity of the 'passenger ship rule' in the light of MARPOL 73/78 Annex VI 1997 was brought up. However, the Court held that although there are indeed situations where Member State participation in international agreements will have 'consequences for the interpretation of European Union law, in particular the provisions of secondary law which fall within the field of application of such an agreement',[605] the Court also held that 'To interpret the provisions of secondary law in the light of an obligation imposed by an international agreement which *does not bind all the Member States*

[602] Art. 4b of Dir. 2005/33/EC.
[603] Art. 4b 3. and 4a 7. of Dir. 2005/33/EC.
[604] Art. 4c 1. and 4. of Dir. 2005/33/EC.
[605] Para. 45 in Request for a preliminary ruling *Mattia Manzi, Compagnia Naviera Orchestra v Capitaneria di Porto di Genova* (Case C-537/11). See also Case C-308/06 *Intertanko and Others* paras. 47 and 57.

would amount to extending the scope of that obligation to those Member States which are not contracting parties to such an agreement'.[606] Thus, the challenges to the EU implementation of MARPOL 73/78 Annex VI 1997 for going further than international law did not hinder the regulation of SO_x emissions from marine sources in this case.

4.1.3.2 The Years of Revision of MARPOL 73/78 Annex VI 1997 Until the Adoption of the Revised MARPOL 73/78 Annex VI 2008

Returning again to events at the international scale, during the years since the adoption of the MARPOL 73/78 1997 Protocol, several developments had taken place. As already mentioned, a new SECA comprising the North Sea and the English Channel had been approved in 2000 with a view to future adoption at IMO. Furthermore, different proposals to amend MARPOL 73/78 Annex VI 1997 had been submitted to the MEPC since 1997.[607] At MEPC 52 in October 2004, the Committee had invited parties to submit proposed amendments to MARPOL 73/78 Annex VI 1997 and the NO_x Technical Code for consideration at the coming MEPC 53 in July 2005.[608] Only a couple of months after the entry into force of the original Annex VI in May 2005, arguments for a revision of the very same annex had really started to accumulate. These arguments were connected both to SO_x and NO_x emissions, since these two pollutants were discussed together in the setting of air pollution control.

At MEPC 53, the revision discussions reached a critical point. There were now several arguments for an update of MARPOL 73/78 Annex VI 1997. Already at the adoption of the MARPOL 73/78 1997 Protocol, one of the accompanying conference resolutions concerned a planned review of *NO_x limits* at a minimum of five-year intervals after

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[606] Para. 47 in Request for a preliminary ruling *Mattia Manzi, Compagnia Naviera Orchestra v Capitaneria di Porto di Genova* (Case C‑537/11), emphasis added.
[607] E.g. Friends of the Earth International's (FOEI's) proposal MEPC 47/4/4. See also FOEI's MEPC 52/4/4 and the proposal of the Islamic Republic of Iran MEPC 52/4/12 both commented on in paras. 4.21-4.24 of MEPC 52/24.
[608] Para. 4.23 of MEPC 52/24.

the entry into force of the protocol.[609] Moreover, new scientific results about the worsening contribution and effects of air pollution from ships were now also available.[610] Additionally, over 70 proposals of unified interpretations regarding the implementation of Annex VI had been submitted to the MEPC, suggesting that there were serious practical problems with the application of the annex on board ships.[611] In a joint submission to the MEPC by several countries, it was moreover noted that the regulation of air emissions from terrestrial sources had become stricter since 1997 as regards engines and fuel quality, and that the contribution of ship emissions to air quality problems was on the increase. This, combined with the fact that engine manufacturers had been able to comply with the MARPOL 73/78 Annex VI 1997 *NO_x requirements* already in the year 2000, and that technological developments in emission reductions had continued, were all concrete arguments to begin a revision of the annex.[612]

Consequently, it was proposed that the MEPC should initiate 'a process to investigate how Annex VI could be updated to better respond to the present and future environmental challenges and technology developments'.[613] The MEPC decided that a *general review* of MARPOL 73/78 Annex VI 1997 and the NO_x Technical Code should be initiated with an estimated duration of two or three years. For reasons of an already considerable workload of the MEPC, the revision task was delegated to the IMO Sub-Committee on Bulk Liquids and Gases with a target date for completion in 2007.[614]

The coming years of revision were marked by intense debates and a large number of submitted documents. Only the main arguments from the MEPC and BLG sessions leading up to the revised MARPOL

[609] Conference Resolution 3 in MP/CONF. 3/34.
[610] E.g. Corbett, Fischbeck (1997), Corbett *et al.* (1999), Corbett, Koehler (2003).
[611] Para. 4.46. of MEPC 53/24.
[612] MEPC 53/4/4 p. 2.
[613] MEPC 53/4/4 p. 3.
[614] Para. 4.50. of MEPC 53/24.

73/78 Annex VI 2008 will be commented here.[615] Some central questions discussed back and forth were among other things: should the sulphur content limits be lowered even further? Should the limits be lowered both globally and in SECAs? Should additional SECAs be designated? What about fuel availability and refinery capacity to produce lower sulphur fuels? Could exhaust gas cleaning be an alternative to emission reductions? What about environmental benefits, cost-effectiveness of reductions and potential modal back shifts to land-based transports?

With discussions and issues still unresolved in July 2007, the establishment of an 'Informal Cross Government/Industry Scientific Group of Experts' was proposed and accepted. This group would make a study 'to evaluate the effects of the different fuel options proposed under the revision of MARPOL Annex VI … [and] gather and present facts and data that will facilitate the Committee's decision-making process'.[616] The group of experts would be composed of experts serving in their personal capacity, and would be chosen by Member Governments and industry and environmental organizations. Importantly, influential and concerned industries such as the petroleum industry would be represented and offer its expertise in the group.[617]

The group of experts delivered comments considering such topics as emissions and fuel markets, impacts for the shipping and petroleum industry and health and environmental impacts.[618] New scientific reports on ship emissions supporting the revision of Annex VI were also submitted *inter alia* by the European Commission and later on by FOEI.[619] The study submitted by FOEI was an important study by Corbett *et al.* that had estimated approximately 60,000 premature deaths per year globally due to PM air pollution from oceangoing

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[615] For a more detailed review of the arguments and documents during this period, see Svensson (2011) pp. 57-77.
[616] MEPC 56/4/15 p. 2.
[617] MEPC 56/4/15 p. 3. and ANNEX.
[618] MEPC 57/4. See also BLG 12/INF.10 and BLG 12/INF.11. For some specific comments about the reports, see Svensson (2011) p. 66-69.
[619] E.g. the list in MEPC 56/INF.13 and FOEI submission BLG 12/6/9.

ships.[620] This study was later also followed up by another significant study by Corbett *et al.* regarding 'Avoided global premature mortality resulting from reduction of sulphur in marine fuel', also submitted to the MEPC by FOEI.[621]

In October 2008, a Revised MARPOL 73/78 Annex VI 2008 was finally unanimously adopted at MEPC 58 via a resolution.[622] Some principal actors driving the revision of Annex VI forward had been the US and the EU Commission together with coordinated EU Member States.[623] As regards the EU and its position, a planned revision of Dir. 2005/33/EC in 2008 had been postponed to deliberately wait for the completion of a Revised MARPOL 73/78 Annex VI 2008. Nevertheless, the EU Commission had made it clear before the adoption of the revised Annex VI that it would not postpone the directive's revision much longer. This 'threat' of EU unilateral measures was thus used as a pressure to reach a round up of the MARPOL 73/78 Annex VI 1997 revision process at IMO.[624] The final results for the sulphur limits may be summarised as follows:[625]

[620] FOEI submission BLG 12/6/9. See also Corbett et al. (2007).
[621] MEPC 57/4/15. See also Corbett et al. (2008).
[622] Res. MEPC.176(58).
[623] Svensson (2011) p. 89.
[624] E.g. para. 4.9 of MEPC 57/21 reiterating a European Commission statement: 'should it not be possible for the Organization to maintain the established timelines, the Commission retained the right to initiate appropriate action to protect the environment'. See also Svensson (2011) p. 89.
[625] Reg. 14.1 and Reg. 14.4 of the Revised MARPOL 73/78 Annex VI 2008. See also further comments about the substantive requirements of the annex *infra* Chapter 6 Section 6.1.2.

Outside an ECA established to limit SOx and particulate matter emissions	Inside an ECA established to limit SOx and particulate matter emissions
4.50% m/m prior to 1 January 2012	1.50% m/m prior to 1 July 2010
3.50% m/m on and after 1 January 2012	1.00% m/m on and after 1 July 2010
0.50% m/m on and after 1 January 2020*	0.10% m/m on and after 1 January 2015

Table 4.1 Fuel oil sulphur limits according to Regulation 14 of the Revised MARPOL 73/78 Annex VI 2008 at adoption. Source: www.imo.org

Looking at changes since the original MARPOL 73/78 Annex VI 1997, the global sulphur limit was now going to be lowered from 4,50% to 3.50% from 2012, and further reductions were to take effect in 2020 or at latest 2025, depending on to the outcome of a fuel availability review to be concluded in 2018.[626] In SECAs or emission control areas, ECAs, the change would first be a lowering of sulphur limits from 1,50% to 1,00% in 2010, and later on to 0,10% from 2015.

4.1.3.3 The Years After Adoption of the Revised MARPOL 73/78 Annex VI 2008

As regards more recent regulatory initiatives for vessel-source emissions to air, both the Revised MARPOL 73/78 Annex VI 2008, and the EU sulphur directive have been updated. The Revised MARPOL 73/78 Annex VI 2008 now also hosts a new chapter on regulation of greenhouse gas emissions to air and the final date for the

[626] As already mentioned *supra* Chapter 1 Section 1.1, it was recently decided (fall 2016) that the gradual sulphur limits will reach their final step on 1 January 2020, Res. MEPC.280(70). See also *infra* Chapter 6 Section 6.1.2 for further details about current applicable regulation.

globally applicable sulphur limits has been set.[627] Dir. 1999/32/EC has been amended again via Dir. 2012/33/EU and later on consolidated via Dir. (EU) 2016/802. The former amendment directive basically aligned Dir. 1999/32/EC with the Revised MARPOL 73/78 Annex VI 2008, although with some additional EU specific arrangements.[628]

Seen in a broader setting, the EU adopted an overarching Marine Strategy Framework Directive (MSFD) in 2008.[629] This directive provides a common European framework and objectives for the protection and conservation of the marine environment and is a part of the EU's 'Integrated Maritime Policy'.[630] The common objectives of the directive are to be pursued via Member State evaluation of the requirements of marine areas for which they are responsible. Marine strategies shall then be created for each region, in cooperation with other Member States and third countries, and their application shall be monitored. The marine strategies should protect and preserve the marine environment as well as prevent its deterioration, *inter alia* by preventing and reducing direct and indirect inputs into the marine environment. On a general level, the directive covers atmospheric inputs into the marine environment, for example in the form of SO_x emissions from ships.[631]

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627 Res. MEPC.203(62) adding a new chapter 4 to Revised MARPOL 73/78 Annex VI 2008 adopted at MEPC 62 in July 2011 and Res. MEPC.280(70) setting the final date for global sulphur requirements.

628 The sulphur limit of the EU 'passenger ship rule' is still present, but it is left at 1,5% until 1 January 2020 when a new global limit will apply. As regards this global limit, it was decided already in 2012 that a 0,50% sulphur limit would apply in the EU irrespective of the results of the feasibility review that could have postponed the global limits to 2025, Art. 4a(4.) of Dir. 1999/32/EC as amended via Dir. 2012/33/EU. For further comments about the now consolidated sulphur directive, see *infra* Chapter 6 Section 6.2.4.

629 Dir. 2008/56/EC. See further comments *infra* Chapter 6 Section 6.2.2.

630 As noted by the European Commission, the MSFD 'is the environmental pillar of the cross-cutting Integrated Maritime Policy (IMP), which was presented by the Commission in October 2007', < http://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/index_en.htm>. For more about the Integrated Maritime Policy, see <http://ec.europa.eu/maritimeaffairs/policy/index_en.htm>.

631 For further comments, see *infra* Chapter 6 Section 6.2.2.

Lately, with the adoption of the 7th EAP,[632] the EU's ambitions to promote clean air as a thematic priority has continued, and the relatively recent EU 'Clean Air Quality Package' considers the contribution of shipping to air emissions in the EU. For instance, in the earlier mentioned strategy document 'A Clean Air Programme for Europe', shipping is mentioned in connection to the revision of the directive on national emission ceilings.[633]

4.1.4 The Regulation of SO_x Emissions from Marine Sources – A Swedish Perspective[634]

From a historical perspective, the Swedish regulation of marine environmental protection has developed partly according to specific national needs, and partly according to the requirements of international agreements that Sweden has joined.[635] Although national regulation regarding different aspects of the marine environment can be traced back to early Swedish fisheries regulation from the mid-1700s,[636] it was not until the late 1970s that an inclusion of rules targeting air pollution from ships was first discussed in *travaux préparatoires* by the Swedish legislator. The question of air pollutants was then mentioned in relation to the question whether Sweden should become a party to the 1973 MARPOL Convention or not. Simultaneously, a new act, *Lag om åtgärder mot vattenförorening från fartyg* ('Act on Measures to Prevent Water Pollution from Ships'), was proposed.[637]

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632 S*upra* Chapter 3 Section 3.1.5.
633 Para. 3.2.5. of COM(2013) 918 final. See also *supra* Chapter 3 Section 3.1.5.
634 All translations of titles and text from national legal acts are the author's own translations, unless available translations have been found in other sources.
635 Prop. 1995/96:140 p. 41.
636 Westholm (2015) p. 75. Apart from regulating fishing and fishing waters, an act from 1766 also regulated the disposal of herring refuse into the sea after it had been used in the production of herring oil. It was considered that the disposal of herring refuse into the sea injured both fishing resources and navigation, see same source p. 75. See also Kippis (1786) p. 321. As argued in Larsson (1999) pp. 252-253, the control of water pollution (defensive water rights) at this time was mainly an indirect effect of protecting so-called lucrative water rights such as fishing and navigation.
637 Prop. 1979/80:167 p. 1.

At this point however, in 1979, the national legislator considered that the timing was not apt to include gaseous substances in the definition of “harmful substance” in the proposed new *Lag om åtgärder mot vattenförorening från fartyg*. As it was stated, this would be to go further than the then 1973 MARPOL Convention, and it was considered appropriate to await MARPOL developments before regulating air pollutants in the Swedish act.[638]

In 1995, the discussion once again surfaced, although this time in connection to whether Sweden should ratify the United Nations Convention on the Law of the Sea, the LOSC, or not.[639] More specifically, it was proposed that Sweden should ratify the LOSC, and since the convention contained a dedicated article regarding ‘Pollution from or through the atmosphere’,[640] it was also considered justified to include air pollutants from ships under the scope of Swedish law.[641] As a consequence, the then *Lag (1980:424) om åtgärder mot vattenförorening från fartyg*[642] would have to be changed.[643] This was *inter alia* done by changing the title and scope of *Lag (1980:424) om åtgärder mot vattenförorening från fartyg.* The act was renamed as *Lag (1980:424) om åtgärder mot förorening från fartyg* (‘Act (1980:424) on Measures to Prevent Pollution from Ships’) and the scope of ‘harmful substance’ was broadened to also include substances entering the sea from the air.[644]

Although air pollution was now included among the harmful substances in the *Lag om (1980:424) åtgärder mot förorening från fartyg*, specific requirements where not contained in the act itself. The act instead authorised by delegation the issuing of provisions regarding the ‘prohibition of pollution from ships of harmful

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[638] Prop. 1979/80:167 p. 43. See however also the Swedish Maritime Administration’s arguments for an inclusion of air pollution from ships on p. 252, same source.
[639] Prop. 1995/96:140. For further comments about the LOSC, see *infra* Chapter 6 Section 6.1.1.
[640] Art. 212 of the LOSC.
[641] Prop. 1995/96:140 pp. 122-123.
[642] SFS 1980:424 as updated via SFS 1983:463.
[643] Bet. 1995/96:UU17 p. 23.
[644] SFS 1980:424 as updated via SFS 1996:527.

substances other than oil' to the Government of Sweden or any competent authority under the Government.[645] As has been explained, a reason for including only general rules in the act, and instead rely on delegation of specific requirements to be formulated in ordinances and instructions, was and still is that the area of marine pollution in Sweden is governed by international law containing technically complex provisions in constant development.[646] In Sweden, it is fairly common to adopt legal acts of a more general character, that are in turn supplemented by ordinances and instructions containing for example more specific environmental requirements.[647] Furthermore, ordinances and instructions can also many times be changed in a faster process than creating amending acts to the general act.

With reference to the delegation in both the act and order on measures to prevent pollution from ships, the Swedish Maritime Administration was empowered to adopt instructions containing provisions regarding prohibition of pollution from ships of harmful substances other than oil.[648] However, in the instructions from the 1980s and forwards, no specific provisions on air pollution from ships were included.[649] With the exception of partial regulation of marine gas oils in accordance

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[645] Chapter 2 Art. 3 of SFS 1980:424 as updated via SFS 1996:527. See also Chapter 2 Art. 3 of SFS 1980:789 as updated via SFS 1996:528, *Förordning (1980:789) om åtgärder mot förorening från fartyg* ("Order (1980:789) on Measures to Prevent Pollution from Ships").

[646] Prop. 2000/01:139 p. 56.

[647] Larsson (1999) p. 251.

[648] In Chapter 2 Art. 3 of SFS 1980:789 as updated via SFS 1996:528, the order stipulated that Sjöfartsverket (the Swedish Maritime Administration) was the responsible authority for adopting instructions regarding the prohibition of pollution from ships of harmful substances other than oil. See also the reference in Chapter 2 Art. 3 of SFS 1980:424 as updated via SFS 1996:527.

[649] SJÖFS 1985:19. As was somewhat apologetically(?) explained in *travaux préparatoires* from 2000, Prop. 2000/01:139 p. 59: '[The Act (1980:424) on Measures to Prevent Pollution from Ships] also applies to air pollution. However, specific provisions that regulate these pollutants have not been introduced. Nevertheless, the problem with air pollution has been noted [in Sweden] so that ships that use low-sulphur oil have a lower fairway due than other ships. The ships that are installing catalytic converters can apply to receive a part of the fairway due as a refund', author's own translation of original text.

with EC law,[650] it was not until amendments of the instructions in 2005, coinciding with the entry into force of MARPOL 73/78 Annex VI 1997, that specific air pollution provisions, including SO_x emissions, were included in *SJÖFS 2005:8 Sjöfartsverkets föreskrifter och allmänna råd om åtgärder mot förorening från fartyg* ('SJÖFS 2005:8 the Swedish Maritime Administration's instructions on measures for the prevention of pollution from ships').[651] Since 2005, the Swedish Maritime Administration updated these instructions, *inter alia* implementing the requirements of MARPOL 73/78 Annex VI 1997. In 2010, Transportstyrelsen ('the Swedish Transport Agency') took the role as the responsible authority for updating the instructions.[652]

When it comes to the actual requirements, since 2005 the instructions included rules reflecting the original MARPOL 73/78 Annex VI 1997, including the alternatives to using low sulphur fuel.[653] These rules were later on amended and updated, among other things because of amendments to MARPOL 73/78 Annex VI in 2008. Although the original instructions implemented most of the requirements regarding SO_x emissions of the original MARPOL 73/78 Annex VI 1997,[654] as regards marine gas oils, the instructions at the same time referred to a general Swedish order on sulphurous fuel applying both to marine and

[650] *I.e. Förordning (1998:946) om svavelhaltigt bränsle* ('Ordinance (1998:946) on sulphurous fuel') corresponding with Dir. 1999/32/EC, where limits were set for gas oils and marine gas oils used in EU territory, however with some limitations, *supra* Section 4.1.2.

[651] SJÖFS 2005:8 which repealed SJÖFS 1985:19. Author's own translation of the title of SJÖFS 2005:8 to English.

[652] TSFS 2010:96.

[653] Chapter 13 of SJÖFS 2005:8. For specific comments about the original MARPOL 73/78 Annex VI 1997 and the alternatives of using an exhaust gas cleaning system with a specified total emission limit of sulphur oxides, or by application of another technological method for emission reduction that could achieve an equivalent result of the exhaust gas cleaning system, *see supra* Section 4.1.1.2.

[654] Chapter 13, Sections 18-22 of SJÖFS 2005:8. For comments on the requirements of the original MARPOL 73/78 Annex VI 1997, see *supra* Section 4.1.1.2.

terrestrial uses of fuels, *Förordning (1998:946) om svavelhaltigt bränsle* ('Ordinance (1998:946) on sulphurous fuel').[655]

Apart from some provisions regarding matters linking to the main sulphur regulation in the Revised MARPOL 73/78 Annex VI 2008[656] still partly left in the Swedish Transport Agency's instructions,[657] the essential requirements for *all types of marine fuels* defining maximum allowed sulphur content in fuels, including HFOs, were gradually moved to *Förordning (1998:946) om svavelhaltigt bränsle*. This order also contained the specific EU requirements following from Dir. 1999/32/EC with amendments.[658] The latest update of provisions reflecting international and EU law most recently appear in *Svavelförordning (2014:509)* ('the Sulphur Ordinance (2014:509)').[659]

4.2 Conclusions

As was described above, regulating air pollution at sea from ships is related and linked to the regulation of the same emissions from terrestrial sources. In addition, similar impracticalities of relying on classic principles of State responsibility for solving conflicts is present

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[655] SFS 1998:946. The order, with reference to Dir. 1999/32/EC, at this stage (SFS 1998:946 as updated via SFS 2000:372) only partly applied to marine gas oil by stating that the fuel limits in SFS 1998:946 did not apply to fuels contained in the fuel tanks of vessels or aircraft crossing a frontier between a third country and a Member State. For more comments about this particular order in its most recently updated form, see *infra* Chapter 6, Section 6.3.

[656] Art. 14 of the Revised MARPOL Annex VI 2008.

[657] The regulations in TSFS 2010:96 as most recently updated via TSFS 2016:128, with matters linking to the main sulphur regulation, Art. 14 of the Revised MARPOL 73/78 Annex VI 2008, regards so-called equivalents, the International Air Pollution Prevention Certificate (IAPP Certificate), fuel changeover, fuel availability and quality. For further comments about all of these regulations in the Revised MARPOL 73/78 Annex VI 2008 and how they have been implemented in current Swedish law, see *infra* Chapter 6 Section 6.3.

[658] *E.g.* the 'at berth' and the passenger ship requirements, see *supra* Section 4.1.3.1.

[659] SFS 2014:509. For more comments about this particular order, see *infra* Chapter 6 Section 6.3.1. See also reference to the aforementioned sulphur ordinance in Section 34 of TSFS 2010:96, most recently updated via TSFS 2016:128, where it is stated that provisions regarding allowed sulphur content in marine fuels are to be found in the sulphur ordinance.

both in the setting of regulating air pollution from terrestrial and marine sources. Arguably, it could be held that the situation at sea is even more complicated. Not only are the long-range transfrontier effects of emissions to air present, the difficulty to pinpoint the exact emission source coupled with moving vessels operating in shifting jurisdictions, often flying 'flags of convenience' creates a difficult regulatory problem to solve. A general strategy, like in the case of SO_x emissions from terrestrial sources, has therefore been to find solutions that reduce the share of emissions from all ships.

Looking at the history of the regulation of SO_x emissions from ships, a couple of factors regarding the use of HFO on ships in the period post World War II are particularly important to mention. At first glance, it is easy to assume that is was the regulation of SO_x emissions from terrestrial sources, and a diminished market on land for HFO that started the trend of using this kind of fuel at sea, subsequently increasing vessel-source emissions *inter alia* of SO_x. At a closer look however, it appears to have been a combination of at least two other factors than terrestrial regulation causing this trend. Accordingly, the increased use of residual fuels at sea and their later regulation can not only be explained because terrestrial regulation was tightened in the 1980s and forwards, but because it became technically possible already in the 1950s to use HFO on ships. With time, this also became a cheap way to cut ship running costs, which unfortunately increased SO_x emissions to air as a result of the high sulphur content present in the fuel.

On the international level, a core question in connection to regulating SO_x emissions during the years has been whether there should be only a global maximum sulphur cap for ships or if 'special areas' where stricter limits apply should also complement this global limit. As has been described, since the MARPOL 73/78 1997 Protocol and the original version of Annex VI, a combination of a global cap and SECAs/ECAs have lasted. The first Annex VI from 1997 was a disappointment to many States, especially since the global 4,5% sulphur limit was regarded as practically meaningless. This later became one of the reasons for why the entry into force of Annex VI was delayed until May 2005, when arguments were already being raised for a revision of the same annex.

Looking specifically at the history of air emission regulation for ships in the EU, this started relatively late. The heritage of regulating vessel-source air pollution can nevertheless be found in the regulation of liquid fuels used in terrestrial emission sources that started in the mid-1970s. The beginning of the 1980s saw the introduction of EU air quality legislation targeting sulphur and other air pollutants, and several important events for the regulation of air pollution in the EU took place during the 1990s. It was however not until the amendment of directive Dir. 1999/32/EC via Dir. 2005/33/EC that the important heavy fuel oil used in *marine applications* was regulated in Europe. The amendment directive principally introduced parallel requirements in the EU for those limits already applying according to the original MARPOL 73/78 Annex VI 1997, however with some additional EU specific arrangements.

In retrospect, it seems that the amendments via this directive going further than the requirements of the original MARPOL 73/78 Annex VI 1997 marked an official standpoint of the EU ambition to move further in its air pollution abatement from ships. This had more or less started with the consolidation of EU air pollution policy in the mid-1990s and the amendment directive was only *a first step* in an ongoing process to reduce marine emissions, a process that would be reinforced by EU Member States' coordinated positions at IMO.

Finally, in a broader view, EU initiatives have continued to support work with air emissions. For example air quality is still a priority in the 7th EAP, and the relatively recent EU 'Clean Air Quality Package' considers the contribution of shipping to air emissions in the EU. For example, the new strategy document 'A Clean Air Programme for Europe' has taken shipping into consideration in connection to the revision of the directive on national emission ceilings.

From a historical perspective, the Swedish regulation of marine environmental protection has developed partly according to specific national needs, and partly according to the requirements of international agreements that Sweden has joined. National regulation regarding different aspects of the marine environment can be traced back to early Swedish fisheries regulation from the mid-1700s, but air pollutants were not discussed in relation to regulation until the late 1970s. However, it was not until amendments of the relevant instructions in 2005, coinciding with the entry into force of the original MARPOL 73/78 Annex VI 1997, that air pollution provisions were included in the instructions. Since 2005, the Swedish Maritime Administration, and more recently, the Swedish Transport Agency has updated these instructions, *inter alia* implementing the revised requirements of MARPOL 73/78 Annex VI 2008.

Parallel with the requirements regarding SO_x emissions expressed in the mentioned instructions as regards marine gas oils, the instructions have at the same time referred to a general Swedish ordinance on sulphurous fuel applying both to the marine and terrestrial use of fuels. Today this ordinance not only implements the Revised MARPOL 73/78 Annex VI 2008 requirements, but also the specific EU requirements following from Dir. 1999/32/EC with amendments.

‘Ambient air pollution kills about 3 million people annually and is affecting all regions of the world, although Western Pacific and South East Asia are the most affected. About 90 % of people breathe air that does not comply with the WHO Air Quality Guidelines.’[660]

5 Current Regulation of SO_x Emissions from Terrestrial Sources

This chapter discusses current regulation of SO_x emissions from terrestrial sources focusing on current applicable regulation at the international, regional and Swedish scales. The chapter commences with an examination of the 1979 LRTAP Convention and its currently applicable Gothenburg Protocol. The chapter then continues with a presentation of the regional regulatory scale, including currently applicable EU legislation regarding SO_x emissions from stationary and mobile sources, ambient air quality and national emission ceilings. The examination of regional regulation of SO_x emissions from terrestrial sources is followed by a presentation of currently applicable Swedish national regulation of SO_x emissions from terrestrial sources. Finally, the chapter ends with some conclusions.

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[660] WHO (2016) p. 49.

5.1 International Regulation of SO_x Emissions from Terrestrial Sources

5.1.1 The 1979 Convention on Long-range Transboundary Air Pollution

At the international scale, the LRTAP Convention, which to some extent has already been discussed above,[661] stands out as an instrument forming the fundament for international air pollution regulation. Drafted as a framework convention, it contains objectives and general principles for the prevention, reduction and control of air pollution,[662] as well as means for negotiating amendments to the treaty.[663]

As regards SO_x emissions, the LRTAP Convention itself only mentions sulphur,[664] but does not contain any specific provisions about this group of pollutants. However, before looking at the specific undertakings for abating SO_x emissions found in the protocols to the convention, some words ought to be said about how the LRTAP Convention defines air pollution and how it formulates its objectives and general principles for the prevention, reduction and control of air pollution in general.

Starting with definitions, the convention takes a broad approach to air pollution defining it as:

'…the introduction by man, directly or indirectly, of substances or energy into the air resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems and

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661 *Supra* Chapter 3 Sections 3.1.2-3.1.3.

662 Preamble and fundamental principles in Arts. 2-5 of the LRTAP Convention. See also Art. 6.

663 Art. 12 of the LRTAP Convention.

664 Preamble of the LRTAP Convention, mentioning 'the development through international cooperation of an extensive programme for the monitoring and evaluation of long-range transport of air pollutants, *starting with sulphur dioxide* and with possible extension to other pollutants', emphasis added.

material property and impair or interfere with amenities and other legitimate uses of the environment'[665]

This is a common point of departure for other wider encompassing definitions of pollution that today also can be found in treaties protecting the marine environment.[666] As the LRTAP Convention was not drafted to apply to *short-range air pollution even when crossing borders*, it further also defines 'long-range transboundary air pollution' as follows:

'…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'[667]

Like the definition of 'air pollution', this is broadly formulated. The core of the definition relates to the transboundary nature of air pollution and its legal implications. Air pollution can in most cases not be handled effectively under a single jurisdiction. Additionally, when it has travelled long distances it is generally not possible to pinpoint its precise source or group of sources.

A relevant question that has been raised is what kind of long-range transboundary air pollution the definition applies to? One view is that it applies to *all forms* of transboundary air pollution, including nuclear pollution.[668] Another view holds that this is going too far considering the purpose of the negotiations of the LRTAP Convention. The convention was drafted to reduce the kind of air pollutants causing acid rain, especially SO_x and NO_x emissions. Therefore, the definition of air pollution was meant to include these pollutants only, as it was formulated against a specific background.[669] Notwithstanding these

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[665] Art. 1(a) of the LRTAP Convention.
[666] *E.g.* Art. 1(1.)(4) of the LOSC and Art. 2 of the 1992 Convention on the Protection of the Marine Environment of the Baltic Sea Area (1992 Helsinki Convention).
[667] Art. 1(b) the LRTAP Convention.
[668] Lammers (1990) p. 265.
[669] Okowa (2000) pp. 25-26.

different interpretations, it is safe to assume that the definition at least covers SO_x emissions.

The essential provisions of the LRTAP Convention are found among the 'fundamental principles'. In particular, it is held that:

'The Contracting Parties … shall *endeavour to limit* and, as far as possible, *gradually reduce and prevent* air pollution'[670]

Moreover, the contracting parties shall:

'by means of exchanges of information, consultation, research and monitoring, develop without undue delay policies and strategies which shall serve as a means of combating the discharge of air pollutants, taking into account efforts already made at national and international levels'[671]

Additionally, to achieve these objectives the parties shall:

'develop the best policies and strategies including air quality management systems and, as part of them, control measures compatible with *balanced development*, in particular by using the *best available technology* which is *economically feasible* and low- and non-waste technology'[672]

Given these formulations, the contracting parties have been left with a lot of room to decide how the obligations shall be achieved.[673] The parties shall *endeavour* to limit and gradually reduce, and prevent air pollution by developing policies and strategies, however in harmony with a *balanced development* and the *best available technology* which is *economically feasible*.

The convention further contains an article on exchange of information between states, *inter alia* when major changes in policy and industrial

[670] Art. 2 of the LRTAP Convention, emphasis added.
[671] Art. 3 of the LRTAP Convention.
[672] Art. 6 of the LRTAP Convention, emphasis added.
[673] Birnie et al. (2009) p. 345. See also Okowa (2000) pp. 26-27.

development are likely to cause *significant changes* in long-range transboundary air pollution.[674]

Against the background of these loosely held provisions in the LRTAP Convention, it is perhaps no surprise that the legal qualities of the provisions have historically been put into question.[675] Looking at the criticism in present time, some of it must however be viewed in light of the time it was articulated. Possibly, early commentators of the convention would be less critical if they could have glanced into the future to see the results of the convention and its protocols today. Although it can still be held that the LRTAP Convention contains provisions of weak language that may be criticized, there are also several good arguments that counter the critique. For example, suggestions that the open obligations in the convention are no more than a political commitment lacking legally binding effect has been opposed by explanations of among other things the political background at the time of negotiations, scientific uncertainties, and a generally accepted flexibility in formulations when environmental obligations are phrased.[676]

In retrospect, it has been stated that the convention's 'real value is that it has provided a successful framework for cooperation and the development of further measures of pollution control' and that 'the weakness of its obligations is deceptive'.[677] Additionally, with a starting point in the framework of the LRTAP Convention, more extensive commitments are possible.[678] Not only have several

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674 Specifically Art. 8 (b) of the LRTAP Convention.

675 *E.g.* Gündling (1986) pp. 21-23 and 30-31.

676 As Okowa puts it 'The generality of provisions is not so much a lack of intention to create legal relations, but rather the result of an attempt to accommodate the different interests of the states parties who were reluctant to accept more definite commitments', Okowa (2000) p. 28. See also pp. 27-33 same source, for other challenges and counter-arguments.

677 Birnie et al. (2009) p. 345.

678 This approach has proved to be successful also in other cases. An oft-cited example is the 1985 Vienna Convention on Substances that Deplete the Ozone Layer and its 1987 Montreal Protocol. The latter has been described as 'a landmark international environmental agreement', Sands *et al.* (2012) p. 265.

protocols been added despite many difficult negotiation rounds,[679] the convention's Executive Body has also followed up and is still following the contracting parties' implementation of the convention with recurring reviews.[680] Thus, taking this into account and that the protocols have led to concrete air pollution reductions during the last 30 years with international cooperation that still functions well today, it is probably not an overstatement to call the LRTAP Convention 'one of the most successful and highly developed of the older environmental regimes'.[681]

5.1.2 The Gothenburg Protocol and the Revised Gothenburg Protocol 2012

As already described above,[682] after the addition of two protocols to the LRTAP Convention regulating SO_x emissions, the Gothenburg Protocol was added in 1999. This protocol not only ended up covering SO_x emissions and acidification. It further regulated emissions of nitrogen, ammonia and VOCs, affecting eutrophication and the formation of ground-level ozone.

Regarding the substantive content of the Gothenburg Protocol, it can initially by noted that this multi-effect and multi-pollutant approach can be seen in its key provisions. For instance, the protocol states that its objective is to:

'control and reduce emissions of *sulphur*, *nitrogen oxides*, *ammonia* and *volatile organic compounds* that are caused by anthropogenic

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[679] Lidskog, Sundqvist (2007) p. 187.
[680] See Art. 10 of the LRTAP Convention for a description of the Executive Body's functions. A subsidiary body, the Implementation Committee, was created by the Executive Body in 1997. This subsidiary body reviews the contracting parties' reporting obligations periodically. For a list of reviews, see < http://www.unece.org/environmental-policy/conventions/envlrtapwelcome/convention-bodies/implementation-committee.html>.
[681] Birnie et al. (2009) p. 344. In numbers, one report celebrating the 30th anniversary of the LRTAP Convention mentions overall reductions of SO_x emissions in Europe by nearly 70% and about 35% in the United States between the years 1990 and 2004, UNECE (2009) p. 6.
[682] *Supra* Chapter 3 Section 3.1.3 and 3.1.5.

activities and are likely to cause adverse effects on human health, natural ecosystems, materials and crops, due to *acidification*, *eutrophication* or *ground-level ozone* as a result of long-range transboundary atmospheric transport'[683]

Additionally, the same article also states that a stepwise approach is to be taken in order not to exceed critical loads and levels of the specified compounds.

The main obligations of the Gothenburg Protocol are found in Article 3. Among other things, each party is to reduce and maintain annual emission reductions following the emission ceilings and dates for each State specified in Annex II of the protocol.[684] Here, binding national emission ceilings for 2010 with 1990 as a base year are set, *inter alia* for SO_x emissions.[685] These ceilings were revised in 2012, but the revisions, which will be commented on immediately below, have not yet entered into force.

The Gothenburg Protocol also includes obligations specifying emission limit values not only for stationary emission sources, and the sulphur content for fuels (gas oils) used therein.[686] Limit values for fuels (petrol and diesel) in mobile sources are also included.[687] Additionally the Gothenburg Protocol formulates subsidiary process standards as sulphur removal efficiency percentages in certain cases where the emission limit values for stationary sources can not be fulfilled.[688] The protocol furthermore, requires certain process

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683 Art. 2 of the Gothenburg Protocol, emphasis added.
684 Art. 3 (1.) of the Gothenburg Protocol and Annex II of the same protocol.
685 Annex II of the Gothenburg Protocol.
686 *E.g.* emission limit values for boilers given in Table 1., Annex IV of the Gothenburg Protocol. In the same table, sulphur removal efficiency requirements as alternatives to the emission limit values were also given. See also the sulphur limit values for gas oils given in Table 2., Annex IV of the Gothenburg Protocol.
687 Art. 3 (5.) of the Gothenburg Protocol referring to Annex VII and VIII with time and limit value specifications. Among the regulated compounds, sulphur was but one, see the Gothenburg Protocol Annex VIII, Tables 8-11 where specifications for sulphur content in fuels are given.
688 Table 1, Annex IV of the Gothenburg Protocol.

standards in the form of sulphur recovery rates for specific industrial processes.[689]

In 2012, a revised Gothenburg protocol was adopted, but at the time of writing the substantive parts of this protocol, including the revised emission ceilings, have not yet entered into force.[690] This section will all the same provide some comments on the Revised Gothenburg Protocol 2012.

Generally, the revised protocol continues to build on the structure originally laid down in the Gothenburg Protocol as adopted in 1999. As expressed in the Preamble of the revised protocol, the parties are still resolved to take a *multi-effect* and *multi-pollutant* approach to prevent and minimize the exceedances of critical loads and levels of the regulated compounds. The regulated compounds are still sulphur, nitrogen oxides, ammonia and volatile organic compounds, but the Revised Gothenburg Protocol has also been extended to cover particulate matter (PM2.5), including black carbon as a component of PM2.5.[691]

Like in the original Gothenburg Protocol, the multi-effect and multi-pollutant approach is reflected in the key provisions. For instance, the protocol states that its objective is to:

'control and reduce emissions of *sulphur, nitrogen oxides, ammonia, volatile organic compounds* and *particulate matter* that are caused by anthropogenic activities and are likely to cause adverse effects on human health and the environment, natural ecosystems, materials, crops and *the climate in the short and long term*, due to acidification,

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689 Point 11. in Annex IV of the Gothenburg Protocol.

690 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to the Convention on Long-range Transboundary Air Pollution, as amended on 4 May 2012 (Revised Gothenburg Protocol 2012), not yet in force. A revised annex has nevertheless entered into force. However, changing the main commitments require ratifications by two thirds of the Parties, see <http://www.unece.org/env/lrtap/multi_h1.html>.

691 Art. 2 of the Revised Gothenburg Protocol 2012. See also specifically Table 6, Annex II of the Revised Gothenburg Protocol 2012.

eutrophication, particulate matter or ground-level ozone as a result of long-range transboundary atmospheric transport'[692]

Moreover, the same article still states that a stepwise approach is to be taken in order not to exceed critical loads and levels of the regulated compounds as specified in the annexes of the protocol.

The main obligations of the Revised Gothenburg Protocol 2012 are found in Article 3. Among other things, the parties shall reduce and maintain reductions of its annual emissions following the so-called national emission reduction commitments defined in Annex II.[693] Thus, Annex II in its revised state *instead of emission ceilings* now contains emission reduction commitments, which are expressed as percentage reductions for each State to be achieved in 2020 and beyond. These emission reduction commitments are based on the contracting parties' 2005 emissions levels.[694] As before, the set commitments are based on information given from each party, *inter alia* regarding critical loads of sulphur.[695]

What the requirements actually mean in numbers is that for instance SO_x emissions in Sweden have drop by 22% in 2020 and by 59% in the EU altogether.[696] The set emission reductions commitments are the totals for each pollutant and are linked to demands for both stationary and mobile emission sources further defined in the annexes. As regards stationary sources and sulphur emissions, emission limit values (ELVs) are specified for combustion plants. Moreover,

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[692] Art. 2(1.) of the Revised Gothenburg Protocol 2012, emphasis added. It can be noted that the Revised Gothenburg Protocol 2012 has been extended to include particulate matter in its multi-pollutant approach. Furthermore, the link between air pollution and climate change in the long and short term is now also more acknowledged, even though reference to this link has existed in earlier LRTAP protocols, see *e.g.* Preamble of the Second Sulphur Protocol 1994. For more information about air pollution and climate change interactions, see generally Pleijel *et al.* (2009).

[693] Art. 3(1.) of the Revised Gothenburg Protocol 2012. See also Annex II of the same protocol.

[694] For SO_x emission reduction commitments, see Table 2, Annex II of the Revised Gothenburg Protocol 2012.

[695] *E.g.* Annex I, I., Art. A.(1.) of the Revised Gothenburg Protocol 2012.

[696] Table 2, Annex II of the Revised Gothenburg Protocol 2012.

demands for certain sulphur recovery rates for specific industrial processes and sulphur fuel limits for gas oil used in stationary sources are also specified.[697]

Sulphur limits for mobile sources are set via environmental specifications for engine type and the fuels used in these engines. The maximum sulphur content for fuels used in vehicles both with petrol and diesel engines are set at 10 mg/kg or 0,001% sulphur content.[698]

In the Revised Gothenburg Protocol 2012, certain flexibilities have been included in the provisions. One provision allows flexible transitional arrangements that make it possible to extend the times for which the different emission limit values must be met. This provision has been included to facilitate for so-called SEECCA-countries to join the Revised Gothenburg protocol.[699] The flexibilities vary depending on pollutant and type of source, but for SO_x emissions for instance, the timescales for existing stationary sources may be postponed up to fifteen years after the date of entry into force of the protocol for a party, and for fuels, up to five years.[700] Another flexibility included in the protocol is that parties under listed circumstances may make adjustments to their emission reduction commitments or to their base year emission requirement. Adjustments like these are however limited to special cases such as when new emission source categories are identified that were earlier not accounted for or if there are significant or unforeseen changes to emission factors.[701]

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697 Tables 1, 3 and 2, Annex IV of the Revised Gothenburg Protocol 2012. In any gas oil used in stationary sources the maximum allowed sulphur content is < 0,10% sulphur.

698 Tables 13 and 14, Annex VIII of the Revised Gothenburg Protocol 2012.

699 Acid News No. 2 2012 pp. 3 and 5. SEECCA-countries stand for countries in Southern and Eastern Europe, the Caucasus and Central Asia that mainly were previously part of the then Soviet Union.

700 Art. 3 of the Revised Gothenburg Protocol 2012 and Annex VI of the same protocol.

701 Art. 3(2) of the Revised Gothenburg Protocol 2012 and Paras. 4-5, Annex II of the same protocol.

5.2 Regional Regulation of SO_x Emissions from Terrestrial Sources

As mentioned earlier,[702] the LRTAP Convention and its protocols is in a sense a regional treaty arrangement as it covers air mass of the Northern hemispheric region. There are however other examples of air pollution regulation that are regional in a more traditional sense of the word in that they include states that are actually regionally close geographically.

In the following, EU air pollution regulation, which is linked to and co-exists with the LRTAP Convention, will be examined in more detail. However, before delving into EU law, a Nordic treaty instrument partly covering air pollution is also worth mentioning.

5.2.1 The 1974 Nordic Environmental Protection Convention

In 1974, The Nordic Environmental Protection Convention (NEPC) covering Sweden, Denmark, Finland and Norway was signed.[703] The convention takes a broad approach to regulating environmental protection and defines environmentally harmful activities as follows:

'For the purpose of this Convention environmentally harmful activities shall mean the discharge from the soil or from buildings or installations of solid or liquid waste, gas or any other substance into water courses, lakes or the sea and the use of land, the seabed, buildings or installations in any other way which entails or may entail environmental nuisance by water pollution or any other effect on water conditions, sand drift, air pollution, noise, vibration, changes in temperature, ionizing radiation, light etc.'[704]

A harmful activity in the form of gas discharge causing air pollution that is performed either on land or at sea is not further defined than

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[702] *Supra* Chapter 3 Section 3.1.2.
[703] The Nordic Environmental Protection Convention, Stockholm 19 February 1974. For some comments about the convention, see Koivurova (1997). See also Larsson (1999) pp. 339-342 with further references.
[704] Art. 1 of the NEPC.

this in the convention. SO_x emissions as such are not mentioned, and neither are other typical air pollutants. SO_x emissions all the same seem to fit within the definition of environmentally harmful activities of the convention.

A great deal has been said about the NEPC since its adoption and it has *inter alia* been hailed as a model treaty for the protection of the environment and the settlement of environmental disputes between states.[705] Nevertheless, as has also been noted by several legal scholars, the *actual application* of the convention has been rather sparse. Only one case involving the convention, settled outside of court, is cited in literature.[706] Consequently, with only one known case,[707] the practical effect of the convention has been questioned. However, one view in legal literature is that a lack of cases should not necessarily be interpreted as a lack of effect. Rather, the actual existence of the convention can have worked as a disincentive for states to act contrary to the ideas of the convention, and the lack of cases could therefore also be a sign of a well working treaty.[708] Another view is that the content and the possibilities of the convention are so little known that it has not given rise to much case law. Thus, it could further also be argued that the convention has a large unused potential.[709] In conclusion, the NEPC takes a broad approach on environmental protection and regulates environmentally harmful activities, including air pollution. However, as to yet it has not been used in court in an air pollution dispute between the contracting parties, although the possibility exists.

5.2.2 Introduction to EU Air Policy and Legal Acts, and the Legal Basis for EU Environmental Measures

The international control of air pollution spans a large area of legal and other measures. The approach taken by the European union when it comes to regulating air is no exception. On the contrary, the

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[705] *E.g.* Okowa (2000) p. 49 and Koivurova (1997) p. 505.
[706] Larsson (1999) p. 341. See also Birnie *et al.* (2009) p. 307.
[707] Østberg, Ø (1994) for some comments about the case.
[708] Okowa (2000) p. 49.
[709] Larsson (1999) p. 342 with further references.

measures found on the international regulatory scale are both reflected in and connected to the EU regulatory scale.[710] Additionally, the EU's work with air quality since the early 1970s encompasses measures that further expand the mass of regulation concerning air pollution in general and sulphur emissions in particular.[711] A point of departure that has been sketched out in the context of the then EC and now EU air policy and law, is that a number of basic factors strongly affect the policies, strategies and measures created.[712] Even though discussed in the European context in this part, these decisive factors arguably analogously also hold true outside the EU area.

First, the combustion of fuels and varying energy policies among the EU member states is a factor. That is, a predominant part of emissions to air originate from the combustion of fuels. Adding on to this, different states rely on different energy sources like coal, lignite, gas and nuclear power, and this to varying degrees.[713] Second, emissions to air is not a problem that can be isolated from other environmental problems. For instance, relying on a non-combustion energy source like nuclear power to avoid producing air emissions may seem to be a solution on some level, but it is all the same associated with other problems such as nuclear waste handling, risk of accidents, vulnerability to terrorist attacks and acceptance by the population.[714] Third, the output of air emissions are not evenly dispersed across the EU, but varies a lot from one country to another depending *inter alia* on the level of economic development. To take uniform air pollution

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[710] Jans, Vedder (2012) p. 419, where EU legislation on air pollution is introduced against the background of European obligations stemming from international agreements in the area, *inter alia* the LRTAP Convention.

[711] According to the European Commission, air quality is one of the environmental areas in which the EU has been most active, see <http://ec.europa.eu/environment/air/index_en.htm>.

[712] Krämer (2015) pp. 300-301.

[713] Krämer (2015) pp. 300-301.

[714] Krämer (2015) pp. 300-301. Furthermore, Krämer argues that with the exception of France, nuclear energy is not an economically competitive market within the EU. Looking at the EU 27, France's use of nuclear power still significantly stood out in energy statics compared to the other EU countries, see European Commission (2010) p. 64 and Krämer (2015) same pages as above.

abatement measures all across Europe is thus complicated.[715] Finally, it has been argued that there is a lack of genuine will to change lifestyles in Western Europe to more environmentally friendly ones, judging among other things from private passenger transport patterns and the subordinate role of renewable energy sources in the EU.[716]

At a glance, the EU's regulation of air may be divided into the following categories: ambient air quality, stationary source emissions, regulation of volatile organic compounds (VOCs), national emission ceilings and transport and the environment.[717] However, not all of these categories will be dealt with in the following, since the regulation of SO_x emissions is not present in all categories.

Before examining applicable EU air pollution legislation regarding SO_x emissions, some comments about the wider context of EU environmental law ought to be included. In the case of EU environmental law, it is initially worth noting that the EU legal acts presented in the following sections of the current chapter and in Chapter 6, belong to EU secondary law and have a legal base in primary EU law, that is the EU Treaties. For the purposes of this thesis, it is not necessary to elaborate extensively on possible different

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715 Krämer (2015) pp. 300-301. When it comes to national differences in Europe, consider for example the lignite fired power plant Maritsa 2 in Bulgaria. According to 2007 data this plant alone emitted as much SO_2 as ten other European countries, see Acid News No. 4 (2009) p. 3.

716 Krämer (2015) pp. 300-301. Krämer argues that renewable energies only recently has led to more focused efforts in the (then) European Community and that it still plays a limited role by referring to European Commission documents COM(96) 576 final and COM(97) 599 final, both treating renewable sources of energy. Lately, however, some new initiatives have been taken, *e.g.* the renewable energy road map for the 21st century EU in document COM(2006) 848 final and Dir. 2009/28/EC on the promotion of the use of energy from renewable sources. Nevertheless, in a communication from late 2010, the European Commission stated that 'The quality of National Energy Efficiency Action Plans, developed by Member States since 2008, is disappointing, leaving vast potential untapped. *The move towards renewable energy use and greater energy efficiency in transport is happening too slowly.* While we are broadly on track for the 20% target for renewable, we are a long way from achieving the objective set for energy efficiency', COM(2010) 639 final, emphasis added.

717 This is the European Commission's own rough categorization which is further divided into sub-categories, see <http://ec.europa.eu/environment/air/legis.htm>.

legal bases of EU environmental law.[718] Suffice it therefore here to say that most of EU the legal acts commented on below, and in Chapter 6 have a legal base in primary law under the Environment title, Title XX of the Treaty on the Functioning of the European Union (TFEU).[719]

Here, Articles 191-193 TFEU (formerly 174-176) define the environmental objectives and principles, the legislative procedure, and the remaining scope for national autonomy for keeping or introducing environmental measures after the EU has legislated.[720]

Briefly put, Article 191 TFEU states a number of environmental objectives that should be pursued via the EU environmental policy, for example 'preserving, protecting and improving the quality of the environment', 'protecting human health' and 'promoting measures at the international level to deal with regional or worldwide environmental problems…'.[721] Furthermore, Article 191 TFEU elaborates on the importance of several environmental principles, *inter alia* the principle of a high level of protection in EU policy on the environment, the precautionary principle, the preventive principle and the polluter pays principle.[722]

Article 192 TFEU concerns the legislative procedure regarding EU environmental measures. The standard procedure for environmental measures is the 'ordinary legislative procedure' as regulated in Article 289 TFEU.[723] This procedure requires a joint adoption of proposed environmental measures by the European Parliament and the Council. In the procedure, the Council takes decisions by qualified majority, and the procedure also includes the European Parliament in a dual consultation where it has the final rule as to rejecting or adopting a

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[718] See instead generally *e.g.* Jans, Vedder (2012), Krämer (2015) and Lee (2014).
[719] Treaty on the Functioning of the European Union, Consolidated version (2012).
[720] Lee (2014) p. 1.
[721] Art. 191(1.) TFEU.
[722] Art. 191(2.) TFEU. See also Lee (2014) pp. 3-15 and Jans, Vedder (2012) pp. 41-51.
[723] Art. 192(1.) and Jans, Vedder (2012) p. 59. Note however also the special legislative procedure referred to in Art. 192(2.) and discussed by Jans, Vedder (2012) pp. 59-64.

measure.[724] Most of the EU legal acts analysed in this thesis (EU directives) refer to the environmental legal base in Article 192 TFEU, earlier represented by the equivalent Article 175.

Finally, Article 193 TFEU concerns the remaining scope for national autonomy for keeping or introducing environmental measures after the EU has legislated. The environment title provides only for legislation with a level of minimum harmonisation to reach environmental objectives. The EU Member States are therefore allowed to introduce more stringent environmental measures than the EU measures, as long as the measures do not infringe on other rules of the TFEU, including such basic rules as the free movement of goods.[725] Additionally, if a Member State wishes to maintain or introduce more stringent environmental measures, it must notify the Commission.[726]

5.2.3 EU Law - Stationary Source Emissions

As regards stationary emission sources, the earlier IPPC Directive was recast and merged with six waste and emissions directives in 2010 into one industrial emissions directive, the IED. The IED is now the principal legal act for environmental effects of industrial installations.[727] The main idea of the IPPC Directive was however kept; namely to take a holistic or integrated approach to minimising pollution from various industrial sources throughout the European Union.[728] This aim is to be achieved mainly via four components of

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724 Jans, Vedder (2012) p. 59 and Lee (2014) p. 16.

725 Lee (2014) p. 17. See also Jans, Vedder (2012) pp. 113-122.

726 Art. 193 TFEU. For a discussion regarding more stringent environmental measures and the connection to the principle of a high level of protection, see Langlet, Mahmoudi (2016) pp. 49-51.

727 Dir. 2010/75/EU. The directive took effect on 6 January 2011 and had to be transposed into national legislation by EU member states by 7 January 2013. The IED replaced the IPPC Directive (Dir. 2008/1/EC) and five directives (Dir. 78/176/EEC, Dir. 82/883/EEC, Dir. 92/112/EEC, Dir. 1999/13/EC, Dir. 2000/76/EC) as of 7 January 2014, with the exception of the Large Combustion Plants Directive (2001/80/EC) where the final date of replacement was set to the 1 January 2016.

728 Preamble (3) and (2) of Dir. 2010/75/EU. Furthermore, Art. 1 regarding the directive's subject matter reflects a holistic approach by stating that the 'Directive

the directive, namely the permit, emissions limit values, best available techniques, and environmental quality standards.[729]

Industrial operators covered by Annex I of the directive have to apply for integrated permits issued by authorities in their respective EU countries.[730] The integrated permits shall consider the *entire performance* of the industrial installation by accounting for emissions to water, land and *air*, but also other factors such as the generation of waste, the use of raw materials and energy efficiency, all with the aim of providing a high level of protection for the environment as a whole.[731]

When it comes to emission limit values for pollutants to air, water and land in the individual permits, these are specified partly as emission limit values in the annexes of the IED. For SO_x emissions to air, which is one of the substances listed in Annex II, emission limit values must be included in the requirements of a permit.[732] Emission limit values can for instance be found for waste incineration and for installations producing titanium dioxide.[733] Emission limit values in permits are however also dependent on the best available techniques. More specifically, permit conditions regarding emission limit values must be specified based on so-called BAT conclusions for the type of industrial activity in question.[734]

As regards environmental quality standards, the IED may also in some instances require a permit to include emission limit values that are

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lays down rules on integrated prevention and control of pollution arising from industrial activities. It also lays down rules designed to prevent or, where that is not practicable, to reduce emissions into air, water and land and to prevent the generation of waste, in order to achieve a high level of protection of the environment taken as a whole'.

729 Jans, Vedder (2012) p. 365.

730 Art. 5, 10 and Annex I of Dir. 2010/75/EU.

731 Art. 5 and 11 and 1 of Dir. 2010/75/EU.

732 Art. 14(1.)(a) and Annex II, 1. of Dir. 2010/75/EU.

733 Part 3, Annex VI and Part 2, Annex VIII of Dir. 2010/75/EU.

734 Art. 15(3.) of Dir. 2010/75/EU. For a definition of Best Available Technology Conclusions (BAT) conclusions, see Art. 1(12) of Dir. 2010/75/EU. For further details about the relation between BAT, BAT conclusions, and the specification of emission limit values in permits, see Langlet, Mahmoudi (2016) pp. 200-203.

stricter than those values mandated by the best available techniques. This in a situation where an environmental quality standard would not be complied with, even though emission limit values according to BAT have been included in a permit for a specific industry.[735] 'Environmental quality standard' as defined in the IED include those standards specified in Union law, which for example means those defined by the directive on ambient air quality, Dir. 2008/50/EC.[736]

On the 1 January 2016, the IED repealed the directive on large combustion plants (LCP Directive), which regulated SO_x emissions.[737] Currently, the equivalent parts of the IED in Chapter III applies to large combustion plants with a rated thermal input equal to or greater than 50 MW, irrespective of the type of fuel used; solid, liquid or gaseous.[738] Furthermore, the IED applies both to new and existing combustion plants. Plants permitted before 7 January 2013 and put into operation no later than 7 January 2014 have to comply with those emission limit values *inter alia* for SO_x emissions that are specified in Annex V.[739] Those plants that are licensed after 7 January 2014 have to comply with stricter emission limit values also specified in Annex V.[740] Additionally, for the combustion of indigenous solid fuel, the IED specifies minimum rates of desulphurization as an alternative to the emission limit values. These minimum rates of desulphurization apply to plants within both of the mentioned intervals.[741]

As a part of the revision of EU air policy, a new directive on the limitation of emissions of certain pollutants into the air from medium combustion plants (MCPs) has been adopted.[742] The directive aims to fill the gap in EU legislation applying to combustion plants by targeting plants with a rated thermal input from 1 to 50 MW. As regards pollutants, the directive aims at reducing emissions *inter alia*

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735 Art. 14(1.) and 18 of Dir. 2010/75/EU.
736 Art. 3(6) of Dir. 2010/75/EU and Lee (2014) p. 111.
737 Dir. 2001/80/EC.
738 Art. 28 of Dir. 2010/75/EU.
739 Art. 30(2.) and Part 1, Annex V of Dir. 2010/75/EU.
740 Art. 30(3.) and Part 2, Annex V of Dir. 2010/75/EU.
741 Art. 31 and Part 5, Annex V of Dir. 2010/75/EU.
742 Dir. (EU) 2015/2193.

of SO_x emissions to air from MCPs in order to avoid potential risks to human health and the environment from such emissions.[743] The directive has been drafted in a manner not to overlap with the rules already existing for large combustion plants in the IED.[744] Emission limit values for SO_x emissions are set out in an annex to the directive applying to both existing and new MCPs.[745]

Finally, apart from the pollution sources falling within the scope of the IED, some stationary pollution sources have all the same been subject to the type of fuel quality requirements that have been employed for *mobile pollution sources*. In the latter case, the quality of petrol and diesel fuels for vehicles using positive-ignition and compression-ignition engines are separately regulated in Directive 98/70/EC commented on below. However, Directive (EU) 2016/802, a consolidating act replacing the 'sulphur directive', Directive 1999/32/EC with amendments, also contains fuel quality requirements, and regulates the reduction of sulphur content of certain liquid fuels used on land. As the text of the new directive stands today, its purpose is to:

'reduce the emissions of sulphur dioxide resulting from the combustion of certain types of liquid fuels and thereby to reduce the harmful effects of such emissions on man and the environment … [and] … Reductions in emissions of sulphur dioxide resulting from the combustion of certain petroleum-derived liquid fuels shall be achieved by imposing limits on the sulphur content of such fuels as a condition for their use within Member States' territory, territorial seas and exclusive economic zones or pollution control zones'[746]

For the purposes of land applications, the directive's definitions of 'heavy fuel oil' and 'gas oil' are relevant. In both cases, the fuels are defined as 'any petroleum-derived liquid fuel, *excluding marine fuel*' falling within the specified range given in combined nomenclature

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743 Art. 1 of Dir. (EU) 2015/2193.
744 Art. 2 of Dir. (EU) 2015/2193.
745 Annex II of Dir. (EU) 2015/2193. See also Art. 6 of the same directive.
746 Art. 1(1.)-(2.) of Dir. (EU) 2016/802.

codes (CN codes).[747] In practice, what Directive (EU) 2016/802 prescribes when it comes to stationary terrestrial installations is that any liquid sulphur containing fuel used on land, for example for heating and for industrial engines and boilers, has to fulfil the sulphur quality requirements of the directive. According to the directive, currently a maximum of 1,00% or 1000 mg/kg sulphur content in heavy fuel oil,[748] and 0,10% or 100 mg/kg sulphur content for gas oil is allowed.[749]

5.2.4 EU Law - Ambient Air Quality

Apart from directives like the IED, applying to air pollution from industrial installations, legislation that forms a fundamental part of EU air regulation is also found in the area of air quality legislation or air quality standards. In essence, the current directive on ambient air quality and cleaner air for Europe maintains the overarching aim or aims already set in the 1996 air quality framework directive,[750] although with the inclusion of two additional aims. One of these aims is that the measures of the directive now also seeks to 'monitor long-term trends and improvements resulting from national and Community measures' and the other is that 'increased cooperation between the Member States in reducing air pollution' is promoted.[751]

As regards definitions, Directive 2008/50/EC defines 'ambient air' as:

'outdoor air in the troposphere, excluding workplaces as defined by Directive 89/654/EEC … where provisions concerning health and

[747] Art. 2(a)-(b) of Dir. (EU) 2016/802, emphasis added.
[748] Art. 3(1.) of Dir. (EU) 2016/802. See however applicable derogations in relation to heavy fuels used in combustion plants in Art. 3(2.) of the same directive.
[749] 4 of Dir. (EU) 2016/802.
[750] *I.e.* to 'avoid, prevent or reduce harmful effects on human health and the environment as a whole … assess the ambient air quality in Member States on the basis of common methods and criteria … [to make information] available to the public … [and to] maintain ambient air quality where it is good and improve it in other cases', Art. 1 of Dir. 96/62/EC.
[751] Art. 1(3.) and 1(6.) of Dir. 2008/50/EC as most recently amended by Dir. (EU) 2015/1480. See also Art. 1 of Dir. 96/62/EC. In the following, when references are made to Dir. 2008/50/EC, these are references to the directive as most recently amended by Dir. (EU) 2015/1480.

safety at work apply and to which members of the public do not have regular access'[752]

Further, 'pollutant' is defined as '*any substance* present in ambient air and likely to have harmful effects on human health and/or the environment as a whole',[753] which thus aptly applies to typical air pollutants like SO_x emissions.

When it comes to obligations and scope, one of the basic obligations in Directive 2008/50/EC demands that 'Member States shall establish zones and agglomerations throughout their territory', further it is held that 'Air quality assessment and air quality management shall be carried out in all zones and agglomerations'.[754] What is meant by 'territory' is not defined in the directive but 'zone' is defined as 'part of the territory of a Member State, as delimited by that Member State for the purposes of air quality assessment and management' and 'agglomeration' as 'a zone that is a conurbation with a population in excess of 250000 inhabitants or, where the population is 250000 inhabitants or less, with a given population density per km2 to be established by the Member States'.[755]

Other basic obligations of the directive *inter alia* concern the regime, criteria and sampling points for the assessment of air quality for different pollutants.[756] The directive furthermore contains regulations formulating basic requirements for the management of air quality.[757] A dedicated article is also found concerning cooperation between Member States in the case that transboundary air pollution causes exceedances of 'any alert threshold, limit value or target value plus any relevant margin of tolerance or long-term objective'.[758]

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[752] Art. 2(1.) of Dir. 2008/50/EC.
[753] Art. 2(2.) of Dir. 2008/50/EC, emphasis added.
[754] Art. 4 of Dir. 2008/50/EC.
[755] Art. 2(16.) and (17.) of Dir. 2008/50/EC.
[756] Arts. 5-11 of Dir. 2008/50/EC. The more detailed requirements are however laid down in separate annexes, see respective annexes referred to in the articles.
[757] Arts. 12-22 of Dir. 2008/50/EC.
[758] Art. 25 of Dir. 2008/50/EC.

When it comes to SO_x emissions, Directive 2008/50/EC like its predecessor directive, sets requirements for the protection of human health as well as for the protection of vegetation. For human health, average hourly and daily limit values are established.[759] A limit value is defined in the directive as:

'a level fixed on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained within a given period and not to be exceeded once attained'[760]

For human health, there are also so-called alert thresholds for among other pollutants SO_x emissions. An alert threshold is defined as 'a level beyond which there is a risk to human health from brief exposure for the population as a whole and at which immediate steps are to be taken by the Member States'.[761] Should an alert threshold for a specified pollutant be reached 'Member States shall take the necessary steps to inform the public by means of radio, television, newspapers or the Internet'.[762] In the case of protection of vegetation, critical levels *inter alia* for SO_x emissions are set instead of limit values.[763]

[759] Section B, Annex XI of Dir. 2008/50/EC.

[760] Art. 2 (5.) of Dir. 2008/50/EC. As is apparent from the specific limit values formulated in Section B, Annex XI of Dir. 2008/50/EC, there is however also a 'margin of tolerance' for exceedances in amount of sulphur dioxide in air as well as a tolerance given in numbers of maximum permitted exceedances per year of hourly and daily average values.

[761] Art. 2 (10.) of Dir. 2008/50/EC. For the specific values, see Section A, Annex XII of Dir. 2008/50/EC.

[762] Art. 19 of Dir. 2008/50/EC.

[763] Annex XIII of Dir. 2008/50/EC. Critical level is defined as 'a level fixed on the basis of scientific knowledge, above which direct adverse effects may occur on some receptors, such as trees, other plants or natural ecosystems but not on humans', see Art. 2 (6.) Dir. 2008/50/EC.

5.2.5 EU Law - National Emission Ceilings and Reduction of National Emissions of Certain Atmospheric Pollutants

Yet another directive that may also be categorized as containing a type of air quality standards, is the directive on national emission ceilings (NEC Directive).[764] The NEC Directive, which will be repealed by an updated directive with effect from 1 July 2018,[765] fixes national emission ceilings for atmospheric pollutants. The aim of the directive is to improve the protection of European Union environment and human health against adverse effects of acidifying and eutrophying pollutants and ozone precursors. Four air pollutants are targeted within the territory of Member States and their exclusive economic zones (however *not covering* international maritime traffic),[766] namely sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia.[767] Reduction of these compounds was to be achieved stepwise with interim environmental targets that had to be attained in 2010, and the long-term targets are to be attained in 2020.[768]

For the first targets for 2010, the purpose of the national emission ceilings was to meet broadly a set of interim environmental objectives. For example, in the case of acidification the directive states that 'The areas where critical loads are exceeded shall be reduced by at least 50 % … compared with the 1990 situation'.[769] When it comes to the long-term targets, none of the ceilings for the pollutants are to be exceeded after 2010.[770]

The recently adopted directive that will repeal the NEC Directive with effect from 1 July 2018, is the directive on the reduction of national emissions of certain atmospheric pollutants (RNE Directive).[771] The

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[764] Dir. 2001/81/EC and Krämer (2015) p. 306.
[765] The updated directive is commented on immediately below.
[766] Art. 2 of Dir. 2001/81/EC.
[767] Art. 4 of Dir. 2001/81/EC. See also Annex I for the specifically formulated country ceilings, same directive.
[768] Arts. 1 and 4 of Dir. 2001/81/EC.
[769] Art. 5 of Dir. 2001/81/EC.
[770] Art. 1 of Dir. 2001/81/EC.
[771] Art. 21 of Dir. (EU) 2016/2284.

RNE Directive, which also aligns the European emission reductions with the latest revisions of the Gothenburg Protocol 2012 under the LRTAP Convention for several pollutants,[772] establishes so-called *emission reduction commitments* for the Member States' anthropogenic atmospheric emissions, *inter alia* for SO_x emissions.

The main objective of the RNE Directive is to 'move towards achieving levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment'.[773] Five air pollutants will be specifically targeted within the territory of the Member States, their exclusive economic zones, and pollution control zones (however *not covering* international maritime traffic).[774] These pollutants are: sulphur dioxide, nitrogen oxides, non-methane volatile organic compounds, ammonia and fine particulate matter.[775]

The Member States shall *as a minimum*, limit their annual anthropogenic emissions of these compounds according to the formulated emission reduction commitments applicable from 2020.[776] For 2025, intermediate indicative (non-binding) emission levels will be formulated, and finally, yet other emission reduction commitments will be applicable from 2030 and onwards,[777] with some possible flexibilities.[778] Like in the Revised Gothenburg Protocol 2012, the new proposed European emission reduction commitments applying from 2020 and beyond are expressed as emission reductions that have

[772] Preamble (5)-(7) of Dir. (EU) 2016/2284.
[773] Art. 1(1.) of the RNE Directive.
[774] Art. 2 of the RNE Directive.
[775] Art. 4(1.) of the RNE Directive. See also Annex II for the specifically formulated national emission reduction commitments, same directive.
[776] The old NEC Directive emission ceilings from 2010 are kept until 2020, when they will be replaced by the emission reduction commitments, Art. 21 of the RNE Directive.
[777] Arts. 4(1.)-4(2.) of the RNE Directive. See also Annex II of the same directive.
[778] Art. 5 of the RNE Directive, according to which Member States may apply for 'Adjustment of national emission inventories', see also Annex IV Part 4 of the same directive.

'to be delivered in the target calendar year, as a percentage of the total of emissions released during the base year (2005)'.[779]

To implement the RNE Directive, the Member States are among other things required to draw up national programmes, and to report their emission inventories to the European Commission and the European Environment Agency to show progress and to verify compliance.[780]

5.2.6 EU Law - Mobile Source Emissions

Generally considered, the regulation of transport and the environment has developed into two discernable main categories today: legislation of road vehicles, and legislation regarding automotive fuel quality. The legislation of road vehicles is extensive and encompasses a large overlapping body of legal acts establishing among other things common emissions standards and standards for type approval of technical qualities of different vehicles.[781] Since the 1990s, measures to abate air emissions from cars have been drafted in the Commission's Auto/Oil Programme.[782] For road vehicles, the standards go by the name of 'EURO' standards followed by Hindu-Arabic and Roman numerals depending on type of vehicle.[783] The

[779] Art. 3(10.) of the RNE Directive. See also Annex II of the same directive. See also Table 2, Annex II of the Revised Gothenburg Protocol 2012.

[780] Arts. 6 and 10 of the RNE Directive.

[781] This large body of legal acts has been described as difficult to penetrate for other than experts insofar as 'numerous overlapping directives and proposals which use numerous acronyms, contain extensive technical details, measurements, control and test rules which all constantly change among themselves, as well as the lack of consolidating texts have led to a situation in which the legal provisions lack transparency and cannot really be checked by people other than specialist experts—which are in industry', Krämer (2015) p. 311. Other wheeled vehicles for non-road use, *i.e.* tractors for agricultural and forestry use, have been regulated separately, see Dir. 2000/25/EC as most recently amended via Dir. 2014/43/EU. Polluting emissions from railway transport and other non-road mobile machinery are also regulated separately, see Dir. 97/68/EC as most recently amended and repealed by Reg. (EU) 2016/1628.

[782] Krämer (2015) pp. 310-311. Auto/Oil II started in 1997 and called for adoption or implementation of different emission standards until 2010, COM(2000) 626 final.

[783] Hindu-Arabic numerals are used for light vehicles (e.g. EURO 1 for passenger cars and light commercial vehicles) and Roman numerals are used for heavy vehicles (e.g.

emission standards for road vehicles in the EURO 1-6 (or EURO I-VI) however only concern the four major pollutants of carbon monoxide (CO), NO_x, particles, and hydrocarbons, but *not SO_x emissions*.[784] SO_x emissions from road and other vehicles are instead regulated in legislation regarding automotive fuel quality which is commented on in the following.

Directive 98/70/EC is the main legal act regulating vehicle fuel quality by setting specifications for petrol and diesel.[785] Moreover, the directive regulates monitoring and reporting of greenhouse gas intensity of fuel and energy and sustainability criteria for biofuels.[786] As is stated in the preamble, the directive was created both with market and environmental considerations in mind.[787] The directive not only aims to reduce SO_x emissions, but it additionally aims to abate pollutants like NO_x, unburnt hydrocarbons, particulate matter, and carbon monoxide, that typically are dealt with through motor requirements.[788]

When it comes to SO_x emissions, the directive initially states that 'the significant reduction in aromatics, olefins, benzene and *sulphur* can permit better fuel quality to be obtained from an air quality standpoint'.[789] The scope of the directive encompasses the setting of:

'(a) technical specifications on health and environmental grounds for fuels to be used with positive ignition and compression-ignition engines, taking account of the technical requirements of those engines; and

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EURO I for lorries and buses). For further details, an extensive archive of reference documents in the form of directives and regulation of road vehicles can be accessed via <https://ec.europa.eu/growth/sectors/automotive/legislation/motor-vehicles-trailers_en>.

784 See <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:l28165> with further references.

785 In the following, when references are made to Dir. 98/70/EC, these are references to Dir. 98/70/EC as most recently amended by Dir. (EU) 2015/1513.

786 Art. 7a and 7b and Annex IV of Dir. 98/70/EC.

787 Preamble (1)-(3) of Dir. 98/70/EC.

788 Preamble (3) of Dir. 98/70/EC.

789 Preamble (12) of Dir. 98/70/EC, emphasis added.

(b) a target for the reduction of life cycle greenhouse gas emissions.'[790]

What the directive practically means today, is that the fuel marketed for vehicles with positive-ignition engines (gasoline engines) and compression ignition engines (diesel engines) can have a maximum sulphur content of 10 mg/kg or 0,001%, although with possibility of derogation in some cases.[791]

5.3 The National Regulation of SO_x Emissions from Terrestrial Sources - Sweden[792]

The following sections give an overview of the current Swedish regulation of SO_x emissions from terrestrial sources. As will become apparent, the structure of Swedish regulation of SO_x emissions from terrestrial sources in many cases broadly reflects the structure found in EU legislation as a consequence of Member State obligations to implement directives, and in some instances, it also simultaneously implements LRTAP requirements as a consequence of treaty obligations. This is for example the case for mobile and stationary emission sources and ambient air quality. All the same, Sweden does not solely implement EU acts or its international obligations, but also complements implementing acts with for example soft law measures like in the case of some of the Swedish environmental objectives that are linked to national emission ceilings. Like the historical examination of Swedish regulation of SO_x emissions above in Chapter 3, the examined regulation in the sections below are structured according to themes.

5.3.1 Stationary Source Emissions

As regards SO_x emissions from stationary sources, Sweden has since the 1990s used an approach based on the European framework for

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[790] Art. 1 of Dir. 98/70/EC.
[791] Arts. 3 and 4 and Annex I and II of Dir. 98/70/EC.
[792] Like in the national historical section *supra* Chapter 3 Section 3.1.6, all translations of titles and text from national legal acts are the author's own translations, unless available translations have been found in other sources.

regulating sulphur and other pollutants. As mentioned above,[793] this framework *inter alia* builds on integrated pollution prevention control. Current Swedish regulation regarding stationary source emissions therefore aims to implement the IED partly via the Swedish Environmental Code,[794] which spells out the basic rules for integrated permit application together with the specifications in *Miljöprövningsförordning* (the 'Ordinance on Environmental Assessment').[795] Additionally, *Industriutsläppsförordning* (the 'Ordinance on industrial emissions') aims to implement the IED as regards BAT-requirements connected to the directive.[796] In *Industriutsläppsförordning,* the BAT-requirements are referred to in the form of separate commission implementing decisions, establishing the best available techniques conclusions for different industrial activities under the IED, including references to SO_x emission limits.[797]

Further, like on the EU level, requirements for land installations also occur in fuel quality regulation. *Svavelförordning* (2014:509) (the 'Sulphur Ordinance (2014:509)')[798] currently regulates fuel quality and applies, with some exceptions, to *all fuels* containing sulphur.[799] Practically, this means that *Svavelförordning* as a point of departure applies to all terrestrial uses of fuels containing sulphur. Additionally,

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793 *Supra* Section 5.2.3.

794 Chapter 9 of SFS 1998:808. See also references in the bibliographic information of act SFS 2012:907 amending SFS 1998:808 and its Chapter 9. Here, OJ L334/2010 p. 17 or Dir. 2010/75/EU is *inter alia* listed as *travaux préparatoires.*

795 SFS 2013:251. In the bibliographic information, OJ L334/2010 p. 17 or Dir. 2010/75/EU is *inter alia* listed as *travaux préparatoires.*

796 SFS 2013:250. The *travaux préparatoires* listed in the bibliographic information for this legal act is *inter alia* OJ L334/2010 p. 17, which is Dir. 2010/75/EU. See also the *travaux préparatoires* to SFS 2013:250, given in document Fm 2013:1. Here, SFS 2013:250 is further elaborated and explained.

797 As regards BAT conclusion references to SO_x emission limits under normal operations, see *e.g.* the limits given for emissions for the manufacture of glass and emissions limits for the production of cement, lime and magnesium oxide in Decisions 2012/134/EU and 2013/163/EU respectively.

798 SFS 2014:509. See also *infra* Section 5.3.4 for more comments about current regulation of sulphur content in liquid fuels.

799 Section 11 of SFS 2014:509.

in *Svavelförordning,* the requirements of the aforementioned Dir. 1999/32/EC are simultaneously aimed to be implemented.[800] For instance, in the ordinance, it is prescribed that gas oils for terrestrial uses can be sold, transferred or used *only* if the sulphur content does not exceed 0,10% sulphur content.[801] This is in line with what Dir. 1999/32/EC stipulates.[802] However, when it comes to the burning of heavy fuel oil for terrestrial use, the ordinance goes further and sets a maximum limit at 0,80% sulphur content.[803] This should be compared to the maximum of 1,00% sulphur content prescribed by Dir. 1999/32/EC.[804]

A separate section in the ordinance is dedicated to the combustion of sulphurous fuels used in industrial installations or installations for energy production. In these cases, the release of sulphur compounds to air can amount to a maximum of 0,10 grams of sulphur per megajoule of fuel, or if the total amount of emissions per year surpasses 400 tons of sulphur, 0,05 grams of sulphur per megajoule of fuel, all measured in yearly mean value.[805] Additionally, a separate article for coal fired combustion installations prescribes that coal can not be used if its combustion results in the release of sulphur compounds to air surpassing 0,05 grams of sulphur per megajoule of fuel, measured in yearly mean value.[806]

A related piece of legislation to *Svavelförordning*, also applying to stationary emission sources' release of SO_x emissions, is *Förordning*

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[800] The *travaux préparatoires* listed in the bibliographic information for this legal act is *inter alia* OJ L121/1999 p. 13, which is Dir. 1999/32/EC. At the time of writing, no changes have been made in the ordinance as an effect of the consolidating Dir. (EU) 2016/802 replacing Dir. 1999/32/EC. The changes are however, as with consolidating acts oriented to clarify, and not to change the actual content, which is why the Swedish ordinance arguably all the same is in conformity also with the new directive as regards content.
[801] Section 13 of SFS 2014:509.
[802] Art. 4 of Dir. 1999/32/EC. See also Art. 4 of Dir. (EU) 2016/802.
[803] Section 14 of SFS 2014:509. Additional criteria also apply to the combustion results of sulphur compounds emitted to air from burning heavy fuel according to the section.
[804] Art. 3 of Dir. 1999/32/EC. See also Art. 3 of Dir. (EU) 2016/802.
[805] Section 15 of SFS 2014:509.
[806] Section 16 of SFS 2014:509.

(2013:252) om stora förbränningsanläggningar (the 'Ordinance (2013:252) on large combustion plants').[807] This ordinance aims to implement the IED as regards large combustion plants[808] into Swedish legislation and it *inter alia* aims to limit the amount of SO_x emissions from large combustion plants with a rated thermal input of 50 MW or more.[809] In the ordinance, a combustion plant is defined as 'technical equipment in which one or more fuels are oxidised in order to use the released energy'.[810] Further, specific SO_x emission limit values apply to both new and existing combustion plants.[811] These emission limit values are given in milligram per cubic meters for released sulphur dioxides and differ depending on type of fuel used, for example biomass, peat or liquid fuel.[812] Yet another ordinance, which applies to waste incineration, is Förordning (2013:253) om förbränning av avfall (the 'Ordinance (2013:253) on incineration of waste'). This ordinance aims to implement the IED as regards incineration of waste,[813] and among other things specifies SO_x emission limits to air from waste incinerators.[814]

5.3.2 Ambient Air Quality

When it comes to national regulation of ambient air quality, *Luftkvalitetsförordning* (the 'air quality ordinance') is the main act aiming to implement the EU directive on ambient air quality.[815] Additionally, *Naturvårdsverkets föreskrifter om kontroll av*

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[807] SFS 2013:252.
[808] The directive on medium combustion plants has at the time of writing not yet been transposed into Swedish law. According to the directive, the date for transposition is at latest 19 December 2017, Art. 17 of Dir. (EU) 2015/2193.
[809] The *travaux préparatoires* listed in the bibliographic information for this legal act is *inter alia* OJ L 334/2010 p. 17, which is Dir. 2010/75/EU (the IED). See also Sections 1 and 6 of SFS 2013:252.
[810] Section 5 of SFS 2013:252. *Cf.* Art. 1(25) of the IED.
[811] Sections 8-11 of SFS 2013:252.
[812] Sections 44-54 of SFS 2013:252. Cf. Annex V, Part 1 and 2 of the IED.
[813] The *travaux préparatoires* listed in the bibliographic information for SFS 2013:253 is *inter alia* OJ L 334/2010 p. 17, which is Dir. 2010/75/EU (the IED).
[814] Section 57 of SFS 2013:253.
[815] SFS 2010:477. The *travaux préparatoires* listed in the bibliographic information for SFS 2010:477 is *inter alia* OJ L152/2008 p. 1, which is Dir. 2008/50/EC.

luftkvalitet ('The Environmental Protection Agency's instructions on control of air quality') works as a supplementary act, also aiming to implement the EU directive on ambient air quality as regards measurement methods.[816]

Initially, the *Luftkvalitetsförordning* clearly states that it has been enacted on the basis of the general rules on environmental quality standards laid down in *Miljöbalk*, the Swedish Environmental Code. To this end, the environmental quality standards formulated in *Luftkvalitetsförordning* specify the levels of pollution that must be complied with according to *Miljöbalk*.[817] With respect to allowed levels of SO_x emissions in air to protect human health, *Luftkvalitetsförordning* sets slightly stricter levels than Dir. 2008/50/EC. For an average period of one hour, a limit value is set at 200 μg/m^3 compared to 350 μg/m^3 in the directive and for a daily average of one day, a limit value is set at 100 μg/m^3 compared to 125 μg/m^3 in the directive.[818] However, the levels of allowed exceedances are at the same time more generous in the *Luftkvalitetsförordning* than in Dir. 2008/50/EC. The hourly limit value may be exceeded up to 175 times a calendar year compared to 24 times a calendar year in the directive and the daily average may be exceeded up to 7 times a calendar year compared to 3 times a calendar year in the directive, all as long as the exceedances never pass the maximum allowed exceedance limits *specified in the directive*.[819] For the protection of vegetation from SO_x emissions, the *Luftkvalitetsförordning* sets the same critical levels given in the directive.[820]

More details on the regulation of control of air quality is not given in *Luftkvalitetsförordning*, but as initially mentioned in an instruction that supplements the ordinance, *Naturvårdsverkets föreskrifter om*

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816 The *travaux préparatoires* listed in the bibliographic information for NFS 2016:9 is *inter alia* OJ L152/2008 p. 1, which is Dir. 2008/50/EC.

817 Sections 8 and 9 of SFS 2010:477. See also Section 2, Chapter 5 of SFS 1998:808.

818 Section 12 of SFS 2010:477 and Section B, Annex XI of Dir. 2008/50/EC.

819 Section 12 of SFS 2010:477. See also Section B, Annex XI of Dir. 2008/50/EC.

820 *I.e.* a critical level of 20 μg/m^3 sulphur dioxide in air, in an averaging period of a calendar year and in winter (1 October to 31 March), see Section 13 of SFS 2010:477. See also Annex XIII of Dir. 2008/50/EC.

kontroll av luftkvalitet.[821] Here, the specifics are given concerning measurements, modelling techniques, common assessment criteria and reporting of results of air quality assessment for outdoor air. The instruction addresses all responsible counties in Sweden.[822]

5.3.3 National Emission Ceilings

As mentioned above, the NEC Directive and the recently adopted RNE Directive fixes national emission ceilings and national emission reductions for atmospheric pollutants. Its aim is to improve the protection of European Union environment and human health against adverse effects of acidifying and eutrophying pollutants and ozone precursors. To implement the directive, the Member States are required to draw up national programmes.

In Sweden, *Förordning om nationella utsläppstak för luftföroreningar* (the 'Ordinance on national emission ceilings for air pollutants')[823] is aimed as one part of the implementation of Dir. 2001/81/EC.[824] The ordinance establishes a primary responsibility for the Swedish Environmental Protection Agency to compile a foundation for the formulation of national programmes. In this responsibility lies also a task to collect basic data from other authorities needed for the formulation of the same programmes.[825] The ordinance does not contain any specific limits itself, however it refers back to Dir. 2001/81/EC.[826]

Another part aiming to implement Dir. 2001/81/EC is performed via Sweden's environmental objectives.[827] Briefly explained, the Swedish parliament has adopted 16 environmental quality objectives. Their purpose is to describe what state and quality of the Swedish

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[821] NFS 2016:9.
[822] Section 1 of NFS 2016:9.
[823] SFS 2003:65.
[824] The *travaux préparatoires* listed in the bibliographic information for SFS 2003:65 is OJ L309/2001 p. 22, which is Dir. 2001/81/EC.
[825] Section 1 of SFS 2003:65.
[826] Sections 1-2 of SFS 2003:65.
[827] Naturvårdsverket (2006) p. 1.

environment is sustainable in the long term.[828] Beside the ordinance just mentioned, the implementation of Dir. 2001/81/EC has been realized in three of Sweden's environmental objectives, namely 'clean air', 'natural acidification only' and 'zero eutrophication'.[829] All of these environmental objectives are nationally based, and to a large extent follow up on land-sourced pollution activities. Nevertheless, shipping is also relevant and acknowledged as an emission factor.[830] Generally, in the case of SO_x emissions to air, the objectives 'clean air' and 'natural acidification' are of main interest.[831]

Each of the 16 environmental objectives are specified with milestone targets that may contain more concrete values like for example in the case of 'clean air', which *inter alia* specifies that 'The level of 5 micrograms/m³ for sulphur dioxide as an annual average must be attained in all municipalities in 2005'.[832] Likewise for the objective 'natural acidification only' it is stipulated that 'In 2010, emissions in Sweden of sulphur dioxide into the air shall have been reduced to 50 000 tonnes'.[833] On a county level, it is allowed to establish tailored

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[828] Swedish Environmental Protection Agency (2011) p. 2. These 16 environmental objectives are in turn subordinate to the 'generation target', which is guiding Swedish environmental policy. It states that 'The overall goal of environmental policy is to hand over to the next generation a society in which the major environmental problems are solved, without causing increased environmental and health problems outside of Sweden', Prop. 2009/10:155 p. 21, own translation. See also p. 17 same source.

[829] Naturvårdsverket (2006) p. 1. English translation of environmental objectives taken from Swedish Environmental Protection Agency (2011).

[830] See *e.g.* the discussion about shipping relating to the environmental objective 'zero eutrophication' at < http://www.miljomal.se/Miljomalen/Alla-indikatorer/Indikatorsida/Fordjupning/?iid=91&pl=1&t=Land&l=SE>.

[831] The target 'zero eutrophication' focuses specifically on nitrogen oxides and nutrient outlets and not on emissions of sulphur oxides, Naturvårdsverket (2011) p. 87. See also the discussion about shipping relating to the environmental objectives 'natural acidification only' and 'clean air' at: <http://www.miljomal.se/Miljomalen/Alla-indikatorer/Indikatorsida/Fordjupning/?iid=126&pl=1&t=Land&l=SE> and < http://www.miljomal.se/Miljomalen/Alla-indikatorer/Indikatorsida/Fordjupning/?iid=125&pl=1&t=Land&l=SE>.

[832] Naturvårdsverket (2006) p. 28, own translation.

[833] Naturvårdsverket (2006) p. 29, own translation. See also Swedish Environmental Protection Agency (2011) p. 2.

regional targets that specify the national environmental objectives and their respective milestone targets.[834] These regional targets could potentially be transformed into binding and enforceable environmental quality standards guided by what is needed in each county. However, no examples of this exist in Sweden as to yet according to the author's knowledge.[835]

5.3.4 Mobile Source Emissions

The Swedish legislation on emissions to air from mobile sources basically follow the same separation pattern of different air pollutants found in the EU legal acts. For instance, the regulation of NO_x emissions is handled via rules regarding type approval and technical qualities of vehicles in *Avgasreningslag* (the 'exhaust emission control act')[836] and *Avgasreningsförordning* (the 'exhaust emission control ordinance').[837] Moreover, these legal acts refer to the relevant EU-acts connected to the different EURO vehicle emission standards.[838]

However, like in the case of EU legislation, SO_x emissions from road and other vehicles[839] in Sweden are regulated in legislation regarding *automotive fuel quality*. *Drivmedelslag* (the 'fuel act')[840] and *Drivmedelsförordning* (the 'fuel ordinance')[841] regulate vehicle fuel

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[834] See *e.g.* Länsstyrelsen Västra Götalands län Beslut 2008-03-17 (2008) p. 5, which stipulates a county objective that 'In 2010 the emissions of sulphur dioxide in the county of Västra Götaland have been reduced to 4200 tonnes or less', own translation. This is a specification of the national milestone target stating that 'In 2010, emissions in Sweden of sulphur dioxide into the air shall have been reduced to 50 000 tonnes', see p. 5 same source.
[835] See however Dahlhammar (2008) p. 86 for some comments about the possibilities to strengthen Sweden's environmental objectives by transforming milestone targets into binding environmental quality standards.
[836] SFS 2011:318.
[837] SFS 2011:345.
[838] Article 2 of SFS 2011:318.
[839] SFS 1998:1707, *Lag om åtgärder mot buller och avgaser från mobila maskiner* (the 'act on measures against noise and exhaust emissions from mobile machinery') covers other vehicles such as tractors and terrain vehicles.
[840] SFS 2011:319.
[841] SFS 2011:346.

quality, *inter alia* by setting specifications for petrol and diesel. With an aim 'to prevent that fuels for engine operation injures or causes harm to health or the environment',[842] the *Drivmedelslag* applies not only to petrol and diesel but also to biofuels.[843] When it comes to sulphur limits, *Drivmedelslag* specifies the limits which are based on and reflects the limits set in the main EU directive on automotive fuel quality, Dir. 98/70/EC.[844] What this means in practice is that irrespective of automotive fuel type, if sulphur occurs in the fuel composition, it can at a maximum have a 10,0 mg/kg or 0,001% sulphur content.[845] Thus, *Drivmedelslag* prescribes the same sulphur limits as the current Dir. 98/70/EC, which is a maximum of fuel sulphur content of 10,0 mg/kg or 0,001% sulphur.[846]

5.4 Conclusions

Current international regulation of SO_x emissions from terrestrial sources can be found within the framework of the LRTAP Convention. A revised version of the 1999 Gothenburg Protocol was adopted in 2012 with new emission reduction commitments for 2020 and beyond. Although not yet in force, the Revised Gothenburg Protocol 2012 continues to build on the multi-effect and multi-pollutant approach of the 1999 Gothenburg Protocol to prevent and minimize the exceedances of critical loads and levels of the regulated compounds, including sulphur. Like before, a stepwise approach is to be taken to reduce emissions. The new emission reduction commitments are set based on information given from each party, *inter alia* regarding critical loads of sulphur. These commitments are the totals for each pollutant and are linked to emission limits for both stationary and mobile emission sources further defined in the annexes. A difference from the earlier 1999 Gothenburg Protocol is that the

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842 Section 1 SFS 2011:319.
843 Section 2 of SFS 2011:319.
844 The *travaux préparatoires* listed in the bibliographic information for this legal act is *inter alia* OJ L350/1998 p. 58, which is Dir. 98/70/EC.
845 See Arts. 4 (10.), 5 (8.), 6 (10.), 8 (7.) and 12 (12.) setting sulphur limits for different fuels as well as different classes of fuels.
846 Arts. 3 and 4 and Annex I and II of Dir. 98/70/EC.

Revised Gothenburg Protocol 2012 does not set emission ceilings for each pollutant. Instead, it specifies emission reduction commitments for 2020 and beyond in terms of percentage reductions counted from the base year 2005.

As regards regional instruments regulating terrestrial air pollutant emissions from the perspective of this thesis, the 1974 Nordic Environmental Protection Convention should initially be mentioned. The convention takes a broad approach in regulating environmental protection and environmentally harmful activities such as gas discharges causing air pollution. Typical air pollutants are not mentioned in the convention, but SO_x emissions all the same seem to fit within the definition of environmentally harmful activities of the convention. As to yet, the actual application of the convention is rather sparse, although the possibility of using it in disputes between contracting parties remains.

When it comes to EU air pollution legislation, several categories that cover air pollution from terrestrial sources can be identified. Starting with stationary emission sources, the main act for industrial emissions is the industrial emissions directive, the IED. The IED aims to take a holistic or integrated approach to minimising pollution from various industrial sources throughout the European Union. The structure of the directive rests on the four basic components the permit, emissions limit values, best available techniques, and environmental quality standards. Industrial operators covered by Annex I of the IED have to apply for integrated permits issued by authorities in their respective EU countries. These permits shall consider the entire performance of the industrial installation *inter alia* by accounting for emissions to water, land and air. The IED specifies both minimum emission limit values and also connects permits to emission limits based on the best available technique conclusions for specific industries, for example for sulphur emissions. In some instances, where an environmental quality standard would not be complied with, the IED may require a permit to include emission limit values that are stricter than those values mandated by the best available techniques.

The IED also regulates large combustion plants with a rated thermal input of 50 MW and more with emission limits values, both applying to existing and new plants. As a part of the revision of EU air policy, a new directive on the limitation of emissions of certain pollutants into the air from medium combustion plants, MCPs, has been adopted. The new directive targets plants with a rated thermal input from 1 to 50 MW.

The reduction of sulphur content of certain liquid fuels used on land is currently regulated in Dir. (EU) 2016/802, which recently replaced the old 'sulphur directive', Dir. 1999/32/EC. For the purposes of terrestrial applications, a maximum of 1,00% or 1000 mg/kg sulphur in heavy fuel oil, and 0,10% or 100 mg/kg sulphur for gas oil is allowed.

As regards ambient air quality, the EU legislation aims at avoiding, preventing or reducing harmful effects on human health and the environment as a whole. Furthermore, its aims include assessment of ambient air quality in member states on the basis of common methods and criteria as well as maintaining ambient air quality where it is good and improving it in other cases. The latest air quality directive, Dir. 2008/50/EC, bundles a number of previous directives on air quality, and like in the case of the older directives it sets limit and threshold values among other things for sulphur dioxides that are to be respected in zones and agglomerations.

As regards national emission ceilings, the NEC Directive currently fixes national emission ceilings for atmospheric pollutants. Its aim is to improve the protection of European Union environment and human health against adverse effects of acidifying and eutrophying pollutants and ozone precursors. Among other things, the pollutant sulphur dioxide is targeted within the territory of member states and their exclusive economic zones. With goals to be attained at specific dates, the NEC Directive stipulates reduction of specified compounds in a stepwise manner. A revision of the NEC Directive linked to the LRTAP's Revised Gothenburg protocol 2012 has recently led to the adoption of a new directive that will repeal the NEC Directive with effect from 1 July 2018. This new directive is a directive regulating the reduction of national emissions of certain atmospheric pollutants, the RNE Directive. The RNE Directive, establishes so-called emission reduction commitments for the Member States' anthropogenic atmospheric emissions, *inter alia* for SO_x emissions. The main objective of the RNE Directive is to 'move towards achieving levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment'.[847] Five air pollutants, including SO_x emissions, will be specifically targeted within the territory of the Member States, their exclusive economic zones, and pollution control zones (however not covering international maritime traffic).

The Member States shall as a minimum, limit their annual anthropogenic emissions of these compounds according to the formulated emission reduction commitments applicable from 2020, 2025 (intermediate non-binding emission levels), and from 2030 and onwards.

As regards mobile source emissions and the EU, Directive 98/70/EC is the main legal act regulating vehicle fuel quality by setting specifications for petrol and diesel. When it comes to sulphur, the directive sets out rules for fuel marketed for vehicles with positive-ignition engines (gasoline engines) and compression ignition engines (diesel engines) at a maximum sulphur content of 10,0 mg/kg or 0,001%, although with possibility of derogation in some cases.

When it comes to current Swedish regulation of terrestrial sulphur emissions, its structure broadly reflects the structure found in EU legislation as a consequence of Member State obligations to implement directives, and in some cases also simultaneously implementing Swedish LRTAP requirements. For stationary source emissions, Sweden has aimed to implement the European framework regulating SO_x emissions. This has partly been done in *Industriutsläppsförordning* implementing the IED. Fuel quality requirements for sulphurous fuels when burnt on land are formulated in *Svavelförordning.* Additional emission limit values for large combustion plants are formulated in *Förordning (2013:252) om stora förbränningsanläggningar*.

[847] Art. 1(1.) of the RNE Directive.

For ambient air quality, Sweden has mainly aimed to implement Dir. 2008/50/EC in two separate legal acts. With some minor differences, the *Luftkvalitetsförordning* basically reflects the EU directive. In *Naturvårdsverkets föreskrifter om kontroll av luftkvalitet*, specific requirements are set concerning measurements, modelling techniques, common assessment criteria and reporting of results of air quality assessment for outdoor air.

As regards national emission ceilings, Sweden has aimed to implement the NEC Directive, partly by creating an ordinance, *Förordning om nationella utsläppstak för luftföroreningar*, pointing out the Swedish Environmental Protection Agency as having the primary responsibility for information gathering and the establishment of national programmes according to the directive. Partly, the implementation of the NEC Directive is however also performed by linking Sweden's (non-binding) environmental objectives to the requirements of the directive. These objectives cover the national level as well as regional parts of Sweden.

Finally, when it comes to SO_x emissions from mobile terrestrial sources, road and other vehicles in Sweden are regulated in legislation regarding automotive fuel quality. The main acts are *Drivmedelslag* and *Drivmedelsförordning* that regulate vehicle fuel quality, *inter alia* by setting specifications for petrol and diesel. When it comes to sulphur limits, *Drivmedelslag* specifies the limits which are based on and reflects the limits set in the main EU directive on automotive fuel quality, Dir. 98/70/EC.

'The reductions in sulphur oxide
emissions resulting from the lower
global sulphur limit are expected
to have a significant beneficial
impact on the environment and on
human health, particularly that of
people living in port cities and
coastal communities, beyond the
existing emission control areas'[848]

6 Current Regulation of SO_x Emissions from Marine Sources

Following Chapter 5 presenting current regulation of SO_x emissions from terrestrial sources, the present chapter describes current regulation of SO_x emissions from marine sources. This chapter is at the same time the last of four chapters, Chapters 3-6, of Part II - BRIDGE, where the historical and current regulation of SO_x emissions from both terrestrial and marine sources is presented with a view to provide a fundament for the coming analysis in Chapter 7.

As regards content, this chapter commences by examining the regulation of SO_x emissions from marine sources at the international scale by presenting the Law of the Sea Convention, the LOSC, and MARPOL 73/78. Furthermore, the specific air pollution annex, Annex VI of MARPOL 73/78 is presented with a focus on provisions regarding SO_x emissions. The chapter then continues with a presentation of the regional regulatory scale, including currently

[848] IMO Secretary-General Kitack Lim as quoted in IMO Briefing 27, 28 October (2016).

applicable EU legislation regarding SO_x emissions marine sources. This examination is followed by a presentation of currently applicable Swedish national regulation of SO_x emissions from marine sources. Finally, the chapter ends with some conclusions.

6.1 International Regulation of SO_x Emissions from Marine Sources

6.1.1 The United Nations Convention on the Law of the Sea

At the international scale, the United Nations Convention on the Law of the Sea, the LOSC, with its ‘constitutional’ nature lays out the fundamental legal framework for the most basic matters of the law of the sea, including protection and preservation of the environment.

As regards SO_x emissions, the LOSC does not contain specific provisions, but as will be elaborated in the following, the more explicit sulphur regulation in other instruments at the international level builds on the legal foundations laid out in the LOSC. Looking at the regulation of air pollution at sea from the perspective of the LOSC first requires a look at the core provisions for protecting and preserving the marine environment, since these articles form a base for other more specific articles. Although references to marine environmental protection are found in the preamble and in several articles spread across the LOSC, the core provisions in this area are found in the dedicated Part XII, entitled ‘Protection and Preservation of the Marine Environment’. The current section will focus on the LOSC articles relevant to describing the general principles underpinning States’ duties to protect and preserve the marine environment.

At the outset, it can be mentioned that the duty to protect the marine environment predates the expression it is given in the LOSC. Rather, it is part of an obligation resting also on regional treaties and other multilateral instruments that have been created since 1954.[849] Given

[849] Birnie *et al.* (2009) p. 387.

this historical and legal instrument backdrop, it has been suggested that the articles on marine environmental protection in the LOSC could be considered as agreed codifications of principles of customary international law. This, firstly because various international instruments preceding the LOSC, like the 1972/1996 London Dumping Convention and MARPOL 73/78, enjoyed a high level of acceptance in their regulation of marine environmental protection. And secondly, because there was a strong acceptance surrounding the importance of marine environmental provisions when this part of the LOSC was formulated.[850]

Looking more closely at the articles of Part XII of the LOSC, the first section lays out the general provisions, Articles 192-196, and sets a framework for the rest of the provisions on the protection and preservation of the marine environment.[851] These articles are often considered and referred to as a package that elaborates principles regarding the protection of the marine environment.[852] As has been noted though, this first part 'formulates a series of legal principles … without imposing specific obligations or conferring quantifiable rights on States'.[853]

Article 192 starts by expressing that 'States have the obligation to protect and preserve the marine environment'.[854] It is addressed to States generally and not only to 'States parties'. This formulation has been described as a proclamation 'in general and universal terms what is regarded as the right or the duty of every State as a general principle of international law'.[855] The extent of this fundamental and general obligation is further developed in Article 193.

In Article 193 it is held that 'States have the sovereign right to exploit their natural resources…' however, this right must be exercised 'pursuant to their environmental policies and in accordance with their

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[850] Birnie *et al.* (2009) p. 387. See also Nordquist *et al.* (1991) p. 3.
[851] Nordquist *et al.* (1991) p. 36.
[852] *E.g.* Churchill, Lowe (1999) p. 338, Birnie *et al.* (2009) p. 387. and Rothwell, Stephens (2016) pp. 370-371.
[853] Nordquist *et al.* (1991) p. 36.
[854] Art. 192 of the LOSC.
[855] Nordquist *et al.* (1991) p. 39.

duty to protect and preserve the marine environment'.[856] Read together, the two articles thus imply that the sovereign right of States to exploit their natural resources is subordinate to their duty to protect and preserve the marine environment.[857] Additionally, the basic obligation to protect and preserve the environment expressed in Article 192 has a broad extent in application. The duty concerns the *whole of the marine environment*, which becomes clearer when the article is read in the light of Article 194.

In Article 194 it is firstly provided that:

'States shall take, individually or jointly as appropriate, all measures consistent with this Convention that are necessary to prevent, reduce and control pollution of the marine environment from any source, using for this purpose the best practicable means at their disposal and in accordance with their capabilities, and they shall endeavour to harmonize their policies in this connection'[858]

This is an expression of the concept or principle of due diligence.[859]

Moreover, Article 194 requires that:

'States shall take all measures necessary to ensure that activities *under their jurisdiction or control* are so conducted as not to cause damage by pollution *to other States and their environment*, and that pollution arising from incidents or activities under their jurisdiction or control *does not spread beyond the areas where they exercise sovereign rights*'[860]

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[856] Art. 193 of the LOSC.
[857] Rothwell, Stephens (2016) p. 370. See also Birnie *et al.* (2009) p. 387.
[858] Art. 194(1.) of the LOSC.
[859] According to Birnie *et al.*, this particular formulation is a bit more flexible and with slightly more discretion than usual formulations as a result of interests of developing countries in the formulation of the LOSC. The reference to 'take all measures necessary', which is a usual expression of the principle, is specifically formulated in the LOSC since the requirement is coupled with the phrase that States shall use the 'best practicable means *at their disposal* and *in accordance with their capabilities*' where the marine environment in general is in risk of damage, Birnie *et al.* (2009) p. 389.
[860] Art. 194(2) of the LOSC, emphasis added.

This passage, together with Article 193, elaborates on the original *Trail Smelter* doctrine and incorporates what is stated in Principle 21 of the Stockholm Declaration, and Principle 2 of the Rio Declaration. The obligation not only includes the prevention of serious harm by pollution to another State's territory. It also extends the duty to prevent damage to areas beyond national jurisdiction, like the global common area of the high seas.[861] An important related note here is also what is actually protected according to this duty. Birnie *et al.* argues that States' duty to protect the environment does not only concern 'economic interests, private property or the human use of the sea', as implied by the LOSC definition of 'pollution'.[862] The duty additionally extends to the protection of 'rare and fragile ecosystems as well as the habitat depleted, threatened, or endangered species and other forms of marine life'.[863]

Article 195 lays down that States 'shall act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another'.[864] This article regards States' obligation to secure that pollution is not transferred from one part of the sea to another or that pollution is not taken care of simply by transforming it from one kind of pollution to another.[865] Finally, the last of the general provisions, Article 196, regulates States' obligation to take necessary measures preventing, reducing and controlling pollution of the marine environment associated with the use of technologies and introduction of alien or new species.[866]

Even though not situated among the general provisions, another article, which is principally important to the protection of the marine environment, shall lastly also be mentioned. This is Article 197, stipulating a duty among States to cooperate:

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[861] Birnie *et al.* (2009) p. 387 and Rothwell, Stephens (2016) p. 371.
[862] Birnie *et al.* (2009) p. 388. See also Art. 1(1.)(4) of the LOSC.
[863] Art. 194(5) of the LOSC.
[864] Art. 195 of the LOSC.
[865] Nordquist *et al.* (1991) p. 70.
[866] Art. 196 of the LOSC.

‘on a global basis and, as appropriate, on a regional basis, directly or through competent international organizations, in formulating and elaborating international rules, standards and recommended practices and procedures consistent with this Convention, for the protection and preservation of the marine environment, taking into account characteristic regional features’[867]

State cooperation is a necessary condition for successful protection of the marine environment, since vessels move between jurisdictions and pollution, from vessels or from terrestrial areas, can easily transcend national boundaries.[868] This position has also been affirmed in case law of the International Tribunal for the Law of the Sea (ITLOS).[869]

Having commented on the more general provisions on the protection of the marine environment in the LOSC, another section is worth specific attention. This is the fifth section of Part XII, entitled ‘International Rules and National Legislation to Prevent, Reduce and Control Pollution of the Marine Environment’. The articles in Section 5, Articles 207-212 of the LOSC, are linked to the basic Article 194 in that they ‘indicate the relationship that is to be maintained between international rules and national legislation in respect of the various sources of marine pollution’.[870] That is to say, these articles point out what States shall legislate about at the national level regarding marine pollution, for example if it occurs via emissions to air. At the same time, the articles open up for incorporation by reference of present and future instruments regarding pollution.[871]

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[867] Art. 197 of LOSC.
[868] Tanaka (2015) p. 277.
[869] *The MOX Plant Case (Ireland v. United Kingdom)* para. 82 where the tribunal stated that ’the duty to cooperate is a fundamental principle in the prevention of pollution of the marine environment under Part XII of the Convention and general international law’. See also *Case Concerning Land Reclamation by Singapore in and Around the Straits of Johor (Malaysia v. Singapore)* para. 92, *Dispute Concerning Delimitation of the Maritime Boundary Between Ghana and Côte d'Ivoire in the Atlantic Ocean (Ghana/ Côte d'Ivoire)* para. 73, and Rothwell, Stephens (2016) p. 371.
[870] Nordquist *et al.* (1991) p. 127.
[871] The LOSC intentionally links to other existing conventions and even to future possible not yet drafted legal instruments via the so-called ‘rules of reference’. This is

In Section 5 of Part XII, six more precise kinds of marine pollution are recognized in the articles. These are: pollution form land-based sources, pollution from seabed activities subject to national jurisdiction, pollution from activities in the Area, pollution by dumping, pollution from vessels, and pollution from or through the atmosphere.[872] Two of these articles, Article 211 and 212, will be specifically commented on in the following since they bear relevance to pollution from vessels in general, and to the topic of air pollution in particular.[873] It should however also be recalled that the general provision defining 'pollution of the marine environment' is found in Article 1(1.)(4) of the LOSC, a broad and flexible provision that applies to various kinds of pollution, including air pollution in from marine sources.[874]

Article 211 is the more specific legal basis addressing vessel-source pollution. The article completes the basic obligation of States formulated in Article 194 (3.)(b), which in its more general manner *inter alia* requires States to take measures 'designed to minimize to the fullest possible extent … pollution from vessels'.[875] Broadly speaking, the extensive Article 211 has been described as having two main functions.

Firstly, it demands that States 'acting through *the competent international organization* … shall establish international rules and standards to prevent, reduce and control pollution of the marine environment from vessels'.[876] In this case, it is clear that the competent international organization is IMO, although this is not always the case when similar reference phrases are used in the

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a dynamic feature of the LOSC that gives the convention better possibilities to stand the test of time. Environmental standards change over time, but by referring to other instruments, the LOSC itself can avoid the risk of being outdated quickly when environmental standards change, Harrison (2011) p. 171.

872 Arts. 207-212 of the LOSC.

873 For further comments about the other articles in Section 5, see Nordquist *et al.* (1991) pp. 125-213.

874 Art. 1 1.(4) of the LOSC. See also Nordquist *et al.* (1991) pp. 41-42.

875 Nordquist *et al.* (1991) p. 180. See also Art. 193(3.)(b) of the LOSC.

876 Art. 211(1.) of the LOSC, emphasis added. See also Rothwell, Stephens (2016) pp. 376-377.

LOSC.[877] In the language of Article 211, regulation for *flag States* shall '*at least have the same effect* as that of *generally accepted international rules and standards* established through the competent international organization',[878] which is an obligation of result at a minimum regulation level. Secondly, Article 211 lays down a jurisdictional framework that allows for these standards to be used, not only by flag States, but also by coastal and port States.[879] However, here the standards are the 'maximum level for regulation by coastal states who wish to protect their coasts and coastal waters'.[880]

Article 212 regards pollution from or through the atmosphere of the marine environment. The article completes the basic obligation of States formulated in Article 194(3.)(a), to take measures designed to minimize to the fullest possible extent 'the release of toxic, harmful or noxious substances, especially those which are persistent, from land-based sources, from or through the atmosphere or by dumping'.[881] Even though Article 211 of the LOSC applies to vessel-source pollution in general, Article 212 is the suitable legal basis for

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[877] LEG/MISC/8 (2014) p. 123. In the commentary to Art. 211 it is stated that 'IMO is *the* competent international organization' as opposed to commentaries to other articles where it is stated that 'IMO is *a* competent international organization', emphasis added.

[878] Art. 211(2.) of the LOSC, emphasis added. See also Tan (2006) p. 179. As regards the meaning and content of 'generally accepted international rules and standards' ('GAIRS'), some short comments should be added. A common view in scholarly publications is that GAIRS should be interpreted as including the rules and standards of those legal instruments that enjoy a high level of State acceptance, Tan (2006) pp. 195-196. Here, the first two mandatory annexes of MARPOL 73/78 with its wide acceptance has been mentioned as an example. Another view as regards GAIRS holds that the central factor deciding its content is related to whether the rules and standards have reached a status of customary international law, Harrison (2011) p. 172 and 174. In any event, the exact meaning and content of GAIRS remains uncertain.

[879] Rothwell, Stephens (2016) p. 376.

[880] Ringbom (1999) p. 22 and Tan (2006) p. 180. See also Art. 211(5.) and Art. 211(6.) of the LOSC.

[881] Nordquist *et al.* (1991) p. 208. See also Art. 194(3.)(a) of the LOSC.

regulation regarding air pollution from ships rather than Article 211.[882]

In the wording of Article 212(1) 'States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment *from or through the atmosphere*, applicable to the air space under their sovereignty and to *vessels flying their flag* or *vessels* or aircraft *of their registry*, taking into account *internationally agreed rules*, *standards and recommended practices and procedures* and the safety of air navigation'.[883] This statement *inter alia* indicates that legislation on the national level regarding vessels' pollution from or through the atmosphere must take into account internationally agreed regulations.[884] In the case of air pollution,[885] these are IMO instruments like the subsequently created regulations added through the MARPOL 73/78 1997 Protocol.[886] IMO's mandate to regulate air pollution for ships is more particularly based on Article 212(3) of the LOSC. According to Article 212(3),

'States, acting especially through competent international organizations or diplomatic conference, shall endeavour to establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control [pollution of the marine environment from or through the atmosphere]'[887]

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[882] As Ringbom points out, Art. 212 explicitly applies to ships, and the article does so under the specifying article heading of 'Pollution from or through the atmosphere', Ringbom (2008) p. 431.
[883] Art. 212 of the LOSC, emphasis added.
[884] Article 212, like Article 211, thus also contains a rule of reference. However, in the case of Article 212, this phrase includes a weaker undertaking since it holds that States shall adopt laws and regulations '*taking into account* internationally agreed rules, standards and recommended practices and procedures …'.
[885] Art. 212(1) and 212(3) have also been linked to instruments and work of IMO relating to climate change, for example Resolution A.963(23), see LEG/MISC.8 p. 126.
[886] LEG/MISC.8 p. 126.
[887] Art. 212(3) of the LOSC. See also *e.g.* Preamble of Res. A.926(22) referring to the legal base of Art. 212 of the LOSC in relation to developing legally binding measures for the reduction of air pollution from ships.

A relevant question to pose in the air pollution context is whether Article 212 of the LOSC can be linked via its reference to 'rules, standards and recommended practices and procedures' to other instruments regarding air pollution, like the LRTAP Convention regulating emissions from land-based sources?

Looking again at the wording of Article 212, 'States shall adopt laws and regulations to prevent, reduce and control pollution of the marine environment from or through the atmosphere, applicable to the *air space under their sovereignty* …'.[888] This in more precise terms includes 'the airspace over its land territory, its internal waters and its territorial seas' *but not* the airspace above the exclusive economic zone.[889] Compared to the LRTAP Convention, which also regulates airspace, Article 212 of the LOSC specifically regulates *pollution of the marine environment from or through the atmosphere*, while the LRTAP Convention concerns pollution *of the atmosphere as such*.[890] It has been proposed that Article 237 of the LOSC, regarding 'Obligations under other conventions on the protection and preservation of the marine environment', 'provides an opening for linking … [Article 212(3)] with other aspects of environmental control of the atmosphere'.[891] Furthermore, there are other articles in the LOSC suggesting that 'the atmosphere itself can be regarded as a component of the marine environment, at least to the extent that there is a direct link between the atmosphere in superjacent airspace and the natural qualities of the subjacent ocean space'.[892]

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[888] Art. 212(1) of the LOSC, emphasis added.
[889] This is derived from Arts. 2 and 49 (in the case of an archipelagic State) read together with Arts. 58 and 78 of the LOSC. See also Nordquist *et al.* (1991) pp. 208-209.
[890] Nordquist *et al.* (1991) p. 212.
[891] Art. 237 of the LOSC and Nordquist *et al.* (1991) p. 213.
[892] Nordquist *et al.* (1991) p. 67, mentioning for example that Art. 56(1)(a) of the LOSC *inter alia* provides a coastal State with sovereign rights that can be exercised for the production of energy from winds. It is also noted that 'Article 194, paragraph 3(a), together with articles 212 and 222, thus also constitutes a link between the law relating to the marine environment, and the law relating to the atmosphere as such, whether or not over the oceans', see same source p. 67. Relating this to Article 222 of the LOSC and its reference to States' implementation of 'applicable international

6.1.2 MARPOL 73/78 and the Revised MARPOL 73/78 Annex VI 2008

While the LOSC can be described as the highest-level instrument providing a broadly accepted 'constitutional' frame for protecting the oceans, MARPOL 73/78 is the highest-level instrument for the prevention of pollution originating from *ships*, both when this pollution is operational and accidental.[893]

Before commenting on the regulation of SO_x emissions under MARPOL 73/78, some comments about the general articles are necessary. Regarding articles of MARPOL 73/78, and the general framework regarding vessel-source pollution, it should first be recalled that Article 211(1) of the LOSC is the foundation on which a general obligation for States is based, to establish international rules and standards regarding vessel-source pollution, and to re-examine them from time to time, as necessary. This is to be done through the competent international organization, in this case IMO, or through a general diplomatic conference.[894] In this regard, MARPOL 73/78 is considered to be the main linked instrument specifying in closer detail the generally formulated environmental requirements for ships in the LOSC, especially those of Article 211 of the LOSC commented on

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rules and standards established through competent international organizations or diplomatic conference to prevent, reduce and control pollution of the marine environment from or through the atmosphere …' it has finally also been suggested that these rules and standards could include the LRTAP Convention. Nordquist et al. (1991) p. 319 mentions that 'Article 222 does not envisage any single international organization as being competent' but then also mentions the Economic Commission for Europe and its creation of the LRTAP Convention in 1979 as an example. In summary, it therefore seems that there is some support for linking Article 212 to other instruments surrounding air pollution, although in conjunction with other articles of the LOSC and with the aid of some interpretation.

[893] Preamble of MARPOL 73, stating that the convention desires to achieve 'the complete elimination of intentional pollution of the marine environment by oil and other harmful substances and the minimization of accidental discharge of such substances', and Art. 2(3) of MARPOL 73 stating that '"Discharge" in relation to harmful substances or effluents containing such substances, *means any release howsoever caused from a ship* and includes any escape, disposal, spilling, leaking, pumping, emitting or emptying', emphasis added. See also LEG/MISC.8 pp. 58-59.

[894] Art. 211(1) of the LOSC.

above.[895] In the drafting of the LOSC, links to MARPOL 73/78 where furthermore established via the LOSC's rules of reference and compatibility criteria,[896] links that were intentionally planned so as to avoid conflicts with already established instruments, like MARPOL 73/78.[897]

In Article 2(2) of MARPOL 73, a definition of 'harmful substance' can be found. Here it is stated that a 'harmful substance' means 'any substance which, if introduced into the sea, is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea, and includes any substance subject to control by the present Convention'. Further, in Article 2(3) of MARPOL 73 'discharge' is defined. It is stated that 'in relation to harmful substances or effluents containing such substances, [discharge] means any release howsoever caused from a ship and includes any escape, disposal, spilling, leaking, pumping, emitting or emptying'. Read together, these provisions can be compared with the general definition of 'pollution of the marine environment' in Article 1 (1.)(4) of the LOSC. MARPOL 73's definition of 'harmful substances' is compatible with the LOSC definition of pollution, since it also applies to 'actual or potential harm to living resources and marine life, hazards to human health,

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[895] LEG/MISC.8 p. 58. As stated in LEG/MISC.8, other IMO instruments also exist that 'exclusively relate to the prevention of marine pollution, irrespective of whether the introduction of polluting substances into the sea is the result of an accident involving a ship or derives from ship-related operational discharges', p. 56 same source. These instruments are among others the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990, as amended and the International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001. For the full list, see LEG/MISC.8 p. 56-57.

[896] An example of links between MARPOL 73/78 and the LOSC is Art. 211(2) and its reference to 'generally accepted international rules and standards established through the competent international organization', in this case MARPOL 73/78. Since Art. 211 is a provision in PART XII of the LOSC, the special compatibility clause in Art. 237 of the LOSC is applicable to how other international instruments should be applied in relation to the LOSC. See also the general compatibility clause in Art. 311 of the LOSC and the comments in LEG/MISC.8 pp. 57-58 and p. 138.

[897] LEG/MISC.8 p. 11.

hindrance to legitimate uses of the sea, and reduction of amenities'.[898] However, regarding *how* the harm is done, the LOSC definition of 'pollution of the marine environment' has a wider application. Two differences can be noted here. Firstly, the LOSC definition covers substances or *energy*, while MARPOL 73 only covers 'harmful substances'. Secondly, MARPOL 73 only applies to 'discharges' *when occurring from ships*,[899] while the LOSC definition applies to *all sources* of marine pollution introduced by man.[900]

Even though MARPOL 73/78 applies to both operational and accidental discharge of substances in the different annexes, its provisions mainly regulate the limits of allowed intentional operational pollution.[901] The technical annexes of MARPOL 73/78 lay down the substantive content of the convention, and regulate discharges of harmful substances organised under six categories: the prevention of pollution by oil (Annex I), noxious liquid substances in bulk (Annex II), harmful substances carried by sea in packaged forms (Annex III), sewage from ships (Annex IV), garbage (Annex V), and air pollution from ships (Annex VI). The last annex, which is of special interest for the present section, was also extended to cover GHGs in 2011 via the addition of a chapter regulating mandatory

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[898] LEG/MISC.8 p. 58.

[899] More specifically, as is stated in Art. 3(1) of MARPOL 73, the convention applies to '(a) ships entitled to fly the flag of a Party to the Convention; and (b) ships not entitled to fly the flag of a Party but which operate under the authority of a Party'. It can nevertheless be noted that this does not apply to warships, naval auxiliary or other ships owned or operated by a State and used only on government non-commercial service, see Art. 3(3) of MARPOL 73.

[900] LEG/MISC.8 p. 58. *Cf.* Art. 1 1.(4) of the LOSC and Art. 2(2) and 2(3) of MARPOL 73.

[901] de la Rue, Anderson (2009) pp. 821-823. As the authors state, the predecessor to MARPOL 73, the 1954 International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL 1954) was primarily created to reduce intentional oil pollution associated with practices such as tank cleaning and deballasting. MARPOL 73 was drafted with the intention to update OILPOL 1954 to how practices at sea had changed.

energy efficiency measures for international shipping.[902] The first five annexes will not be further commented in the following.[903]

Focusing on Annex VI, the original content was added to MARPOL 73/78 in 1997 via a protocol.[904] As stated above,[905] shortly after the entry into force of this protocol in 2005, a revision process of Annex VI was initiated. This resulted in a revised MARPOL Annex VI adopted via a resolution by the MEPC in 2008.[906] Subsequent amendments of MARPOL Annex VI were, as mentioned, made in 2011 to include energy efficiency measures for ships to control GHGs.[907] Thus, looking at the Revised MARPOL 73/78 Annex VI 2008 today, it is not only an annex that limits traditional air pollutants like SO_x and NO_x from ships, but it also includes climate influencing GHGs. Thus, in practice, the current Annex VI today covers *air emissions*, which terminologically encompasses both air pollutants and GHGs.[908]

Looking at the substantive content of the Revised MARPOL 73/78 Annex VI 2008, it is firstly relevant for this thesis to examine some of the general provisions before moving on to the provisions that deal specifically with SO_x emissions. In Chapter 1 of the annex, under the heading 'General' it is firstly stated in Regulation 1 that 'The provisions of this Annex shall apply to *all ships*', which in this

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902 Res. MEPC.203(62).
903 See instead generally de la Rue, Anderson (2009) pp. 824-847 and Gold (2006) pp. 201-240.
904 MARPOL 73/78 1997 Protocol.
905 *Supra* Chapter 4 Section 4.1.3.2.
906 Revised MARPOL 73/78 Annex VI 2008.
907 Res. MEPC.203(62) adding a new chapter 4 to Revised MARPOL Annex VI 2008. See also the recent Res. MEPC.280(70), changing the final dates of the globally applicable sulphur limits in Reg. 14 of the Revised MARPOL 73/78 Annex VI 2008.
908 For some comments about historical distinctions between air pollutants and GHGs in natural science and policy, and the decision to regulate GHGs in Revised MARPOL 73/78 Annex VI 2008, see Linné (2012). In this context it can be noted that Annex VI further contains provisions regulating ozone depleting substances in Reg. 12 and prohibition of shipboard incineration of certain products in Reg. 16 of the Revised MARPOL 73/78 Annex VI 2008.

context means all ships regardless of flag.[909] In the same regulation, a list is however included of provisions where expressly provided exceptions in application can be found. These exceptions *inter alia* concern emissions connected to emergency situations,[910] specific conditions for surveys and the issuing of certificates,[911] specifics for some emissions and shipboard incineration,[912] fuel availability and quality,[913] and particular procedures regarding the Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP).[914]

Among the definitions found in Regulation 2, Regulations 2.7-9 are of particular interest. In Regulation 2.7 'emission' in the sense of Annex VI is defined as 'any release of substances … from ships into the atmosphere or sea'.[915] Further, an 'emission control area', or ECA, is defined in Regulation 2.8 as:

'an area where the adoption of special mandatory measures for emissions from ships is required to prevent, reduce and control air pollution from NO_x or SO_x and particulate matter or all three types of emissions and their attendant adverse impacts on human health and the environment. Emission Control Areas shall include those listed in, or designated under, regulations 13 and 14 of this Annex'

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909 The definition of 'ship' is found in Art. 2(4) of MARPOL 73, where it is stated that '"Ship" means a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft and fixed or floating platforms'. The notion 'all ships' does however still not include warships, naval auxiliary or other ships owned or operated by a State and used only on government non-commercial service, *cf.* Art. 3(3) of MARPOL 73.
910 Reg. 3 of the Revised MARPOL 73/78 Annex VI 2008.
911 Regs. 5 and 6 of the Revised MARPOL 73/78 Annex VI 2008.
912 Regs. 13, 15 and 16 of the Revised MARPOL 73/78 Annex VI 2008.
913 Reg. 18 of the Revised MARPOL 73/78 Annex VI 2008.
914 Regs. 19-23 of the Revised MARPOL 73/78 Annex VI 2008.
915 *Cf.* 'harmful substance' as defined in Art. 2(2) of MARPOL 73, 'any substance which, if introduced into the sea, is liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea, and includes any substance subject to control by the present Convention'.

Basically, ECAs are thus areas in which stricter limits are set on emissions of NO_x and SO_x emissions, and on particulate matter. Compliance with these limits is directly connected to which fuel a ship uses and/or cleaning technology, as well as what kind of engine a ship is equipped with. In the particular case of SO_x emissions, it is exactly the fuels and their sulphur content, their price and availability, and the possibilities to comply with stricter sulphur limits that lately have caused a lot of debate among nations, organizations, cargo owners and shippers alike.[916]

As can be seen in the definition of ECAs cited above, the 'attendant adverse impacts on human health and the environment' are mentioned. These impacts are among other things important factors to be taken into account in the formulation and submission of proposals for the designation of ECAs.[917] Finally, among the definitions, 'fuel oil' should be noted. This is defined in Regulation 2.9 as 'any fuel delivered to and intended for combustion purposes for propulsion or operation on board a ship, including distillate and residual fuels'.[918] Once again, this definition points to the core of the problem with vessel-source air pollution, which to a large extent is affected by what kind of fuel is used for ship propulsion,[919] in this context, a reminder

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[916] *Supra* Chapter 1 Section 1.1.

[917] APPENDIX III of the Revised MARPOL 73/78 Annex VI 2008, in particular Para. 1.1.2 and 3.3.1.3 of the mentioned appendix. See also *infra*, current section, more discussion about ECAs and their relation to the dedicated sulphur provision, Reg. 14. of the Revised MARPOL 73/78 Annex VI 2008.

[918] As mentioned *supra* in Chapter 4 Section 4.1.1.2, MARPOL 73/78 Annex VI 1997 did not contain any definitions of 'fuel oil'. Nor did it make any distinctions between marine gas oils (MGOs) and marine diesel oils (MDOs) that can be found in European SO_x emissions regulation. This definition of fuel oil mentioning distillate and residual fuels was thus new.

[919] *I.e.* fuels used for ship propulsion cause the most significant amount of air emissions from ships in general and SO_x emissions in particular. However, as Reg. 2.9 is formulated, it does not only apply to fuels used in main and auxiliary engines, it also covers emissions from other combustion equipment and devices onboard such as boilers and inert gas generators: 'any fuel delivered to and intended for *combustion purposes* for *propulsion or operation* on board a ship, including distillate and residual fuels', emphasis added.

of the choice between different fuels such as residual or distillate fuels.

Leaving the basic definitions, Regulation 4 leaves some room for flexibility for fulfilling the requirements of the Revised MARPOL 73/78 Annex VI 2008. Under the heading of 'Equivalents', this regulation states that:

'The Administration of a Party may allow any fitting, material, appliance or apparatus to be fitted in a ship or other procedures, alternative fuel oils, or compliance methods used as an alternative to that required by this Annex if such fitting, material, appliance or apparatus or other procedures, alternative fuel oils, or compliance methods are *at least as effective* in terms of emissions reductions as that required by this Annex, including any of the standards set forth in regulations 13 and 14'[920]

Upon communication with IMO, it is therefore possible for States to allow equivalent ways of complying with the demands of the Revised MARPOL 73/78 Annex VI 2008, as long as these are at least as effective in terms of emissions reductions.[921] This flexibility provision may be compared to how many provisions regarding BAT are usually constructed. They set some kind of requirement and state that BAT is to be used, but they do not necessarily prescribe the exact technology, thus intentionally leaving some room for innovation if the same results can be achieved by other measures.

Under the heading of 'Survey, Certification and Means of Control', Chapter 2 of the Revised MARPOL 73/78 Annex VI 2008 spells out the specific conditions for surveys, the issuing of certificates and controls related to air emissions. Firstly, under Regulation 5 regarding surveys, it is stated that:

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[920] Reg. 4 of Revised MARPOL 73/78 Annex VI 2008, emphasis added. 'Administration' is defined in Art. 2(5) of MARPOL 73 as 'the Government of the State under whose authority the ship is operating. With respect to a ship entitled to fly a flag of any State, the Administration is the Government of that State … '.

[921] For relevant guidelines regarding equivalents, see Res. MEPC.259(68).

‘Every ship of *400 gross tonnage and above* and every fixed and floating drilling rig and other platforms shall to ensure compliance with chapter 3 be subject to the surveys specified below’[922]

The basic qualification for surveys is thus that a ship’s volume is at least of 400 gross tonnage. Five types of related surveys are specified in Regulation 5.1,[923] but generally they serve two main purposes. The first purpose is to ensure a ship’s compliance in terms of equipment, systems, fittings, and other technical requirements stipulated in Chapter 3 of the Revised MARPOL 73/78 Annex VI 2008 regarding the different air emissions. The second purpose is that the surveys are a decision basis for the issuing of certificates under Regulation 6.[924] Principally, the survey procedures in Regulation 5 prescribe surveys at regular intervals, to be performed each year during five-year periods, five years being the time span for which a valid International Air Pollution Prevention Certificate (IAPP Certificate) can be issued.[925]

An IAPP Certificate must be on board all ships of ‘400 gross tonnage and above engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties’, that is ships engaged in *international voyages* when they are put into service after 19 May 2005,[926] the entry into force date of the original MARPOL 73/78 Annex VI 1997. For ships constructed before 19 May 2005 a grace period is given for ships until their first dry-docking, but this period may not stretch further than three years after MARPOL 73/78 Annex VI has entered

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922 Reg. 5.1 of the Revised MARPOL 73/78 Annex VI 2008, emphasis added.

923 These are: ’initial survey’ (Reg. 5.1.1), ’renewal survey’ (Reg. 5.1.2), ’intermediate survey’ (Reg. 5.1.3), ’annual survey’ (Reg. 5.1.4) and ’additional survey’ (Reg. 5.1.5), all found in the Revised MARPOL 73/78 Annex VI 2008.

924 Reg. 5 and Reg. 6.1 of the Revised MARPOL 73/78 Annex VI 2008.

925 Reg. 5.1.2 of the Revised MARPOL 73/78 Annex VI 2008, *cf.* Reg. 5.1.4, Reg. 6 and Reg. 9 of the Revised MARPOL 73/78 Annex VI 2008. Reg. 5.4 further also contains instructions for surveys connected to energy efficiency for ships and links to the issuing of an International Energy Efficiency Certificate according to the requirements of Regulation 6.4 and Chapter 4 of the Revised MARPOL 73/78 Annex VI 2008. This will not be further commented in the below.

926 Reg. 6.1 of the Revised MARPOL 73/78 Annex VI 2008. *Cf.* Res. MEPC.181(59) Chapter 1 Para. 1.2.1.

into force for a particular ship's Administration.[927] It is to be noted that depending on emission, different time scales apply to what is controlled and noted in the IAPP Certificate, this since for example the NO_x and SO_x requirements are contingent on different factors. The former on engine performance, and the latter on *fuel type*.[928] Finally, as a point of departure, ships *under* the volume of 400 gross tonnage must still comply with the Revised MARPOL 73/78 Annex VI 2008 generally, but Regulation 5.2 delegates the specifics for these ships to 'the Administration' of each State to 'establish appropriate measures in order to ensure that the applicable provisions of [Annex VI] are complied with'.[929]

The conditions for control of Annex VI requirements are elaborated in Regulations 10 and 11. Regulation 10 lays out the details regarding port State control of operational requirements stating that 'A ship, when in port … under the jurisdiction of another Party, is subject to inspection by officers duly authorized by such Party concerning operational requirements under [Annex VI], where there are *clear grounds* for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of air pollution from ships'.[930] Further, when such a situation is at hand, 'the

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[927] In the normal case, for countries that signed and ratified the original MARPOL 73/78 Annex VI 1997, this would be three years after the entry into force of the original MARPOL 73/78 Annex VI 1997: 19 May 2008. However, countries that have signed and ratified MARPOL 73/78 Annex VI at later dates can have time limits stretching further than 19 May 2008, Reg. 6.2 of the Revised MARPOL 73/78 Annex VI 2008.

[928] See the applicable time limits in Reg. 13 of the Revised MARPOL 73/78 Annex VI 2008 and *cf.* Reg. 14 of the Revised MARPOL 73/78 Annex VI 2008. See also the details for SO_x in the IAPP Certificate in Para. 2.3 'Sulphur oxides (SOx) and particulate matter (regulation 14)' of Appendix I of the Revised MARPOL 73/78 Annex VI 2008.

[929] *E.g.* the Swedish instructions TSFS 2010:96 *Transportstyrelsens föreskrifter och allmänna råd om åtgärder mot förorening från fartyg* ('The Transport Agency's instructions and general guidelines on the prevention of pollution from ships'), Chapter 13 (Air pollution), implementing the Revised MARPOL 73/78 Annex VI 2008, commented on *infra* Section 6.3.

[930] Reg. 10.1 of the Revised MARPOL 73/78 Annex VI 2008, emphasis added. For some examples of 'clear grounds', see Chapter 2, Section 2.4.2 of Res. A.1052(27),

Party shall take such steps as to ensure that the ship shall not sail until the situation has been brought to order in accordance with the requirements of [Annex VI].[931] If an inspection of a ship indicates a violation of the Revised MARPOL 73/78 Annex VI 2008, the Administration of the State where the ship is flagged is to be notified and reported to according to Regulation 11.[932]

In Chapter 3 of the Revised MARPOL 73/78 Annex VI 2008, the substantive provisions regulating various vessels-source air emissions are found. When it comes to the specific emissions of *SO_x emissions* and related particulate matter emissions, Regulation 14 is the dedicated provision. Basically, the provision regulates SO_x emissions by setting limit values for the sulphur content in fuels, but it also contains instructions for how to comply with the regulation. A part regarding review of the provision itself is also included.

Looking firstly at how the fuel sulphur limits in the regulation are set, Regulation 14 builds on defining limits contingent on ship operations *outside* ECAs and *inside* ECAs. Further, these limits are gradually made stricter according to a time schedule. The limits themselves are defined in Regulation 14.1 (fuel sulphur limits outside ECAs/global application), and in Regulation 14.4 (fuel sulphur limits inside ECAs/regional application), and are set in sulphur weight content per unit of fuel (% sulphur m/m). As explained earlier in this section, ECAs are areas where stricter limits of NO_x, SO_x and PM can be set. The defined limits, whether outside or inside ECAs, apply to all fuel oils 'intended for combustion purposes for propulsion or operation on board a ship',[933] that is not only when fuel oils are used in main and auxiliary engines, but also in boilers and inert gas generators. As to yet, four ECAs have been designated under MARPOL 73/78 Annex VI.[934] In these four ECAs, noted in Regulation 14.3.1-3, specific

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regarding applicable procedures for port State control. In the specific case of the Revised MARPOL 73/78 Annex VI 2008, see also Res. MEPC.181(59).

[931] Reg. 10.2 of the Revised MARPOL 73/78 Annex VI 2008.

[932] Regs. 11.2-4 of the Revised MARPOL 73/78 Annex VI 2008.

[933] Reg. 2.9 of the Revised MARPOL 73/78 Annex VI 2008.

[934] These are the Baltic Sea ECA (SO_x) in effect from 19 May 2006 (formerly known as a sulphur emission control area), the North Sea ECA (SO_x) in effect from 22 Nov

sulphur fuel oil content limits apply.[935] Interestingly, when it comes to ECAs, there are clear connections to terrestrial control of SO_x emissions among the criteria for designating new ECAs. A proposal for a new ECA shall *inter alia* include:

‘a description of the control measures taken by the proposing Party or Parties addressing *land-based sources* of NOx, SOx and particulate matter emissions affecting the human populations and environmental areas at risk that are in place and operating concurrent with the consideration of measures to be adopted in relation to provisions of regulations 13 and 14 of Annex VI …’ and ‘the relative costs of reducing emissions from ships when compared with *land-based controls*’[936]

Graphically, the fuel oil sulphur limits applying in a given year interval, outside and inside an ECA may be presented in the following manner:[937]

2007 (formerly known as a SECA), the North American ECA (SO_x, and NO_x and PM) in effect from 1 Aug 2012, and the United States Caribbean Sea ECA (SO_x, NO_x and PM) in effect from 1 Jan 2014, Reg. 14(3)(a) MARPOL 73/78 Annex VI 1997, Res. MEPC.132(53), Res. MEPC.190(60) and Res. MEPC.202(62) respectively.

[935] For the specific limits applicable to ECAs in the case of SO_x and PM, see Regulation 14.4 of the Revised MARPOL 73/78 Annex VI 2008.

[936] Paras. 3.3.1.7-8 in APPENDIX III of the Revised MARPOL 73/78 Annex VI 2008, emphasis added.

[937] Sulphur limits as stated in Reg. 14.1 and Reg. 14.4 of the Revised MARPOL 73/78 Annex VI 2008.

Outside an ECA established to limit SOx and particulate matter emissions	Inside an ECA established to limit SOx and particulate matter emissions
4.50% m/m prior to 1 January 2012	1.50% m/m prior to 1 July 2010
3.50% m/m on and after 1 January 2012	1.00% m/m on and after 1 July 2010
0.50% m/m on and after 1 January 2020	0.10% m/m on and after 1 January 2015

Table 6.1 Final fuel oil sulphur limits according to Regulation 14 of the Revised MARPOL 73/78 Annex VI 2008 as decided by Res. MEPC.280(70). Source: Adaptation of graphics from www.imo.org

Among the general requirements, where the limits for sulphur content in fuel oils outside ECAs are defined, a paragraph about sulphur monitoring is also found in Regulation 14.2. The purpose of this paragraph is to keep track of worldwide average sulphur levels in fuel oil supplied for on board use by means of regular monitoring. This monitoring shall be performed taking into account relevant guidelines. Originally, these guidelines, like Regulation 14.2, only covered the monitoring of residual fuels but has now been revised to include the monitoring of distillates as well.[938] This seems sensible since the Revised MARPOL 73/78 Annex VI 2008 addresses *all marine fuels*, including distillate fuels.[939] The monitoring of worldwide average sulphur content in fuels gives an indication of global sulphur content

[938] The original guidelines were stated in Res. MEPC.82(43). *Cf.* Reg. 14.2 of the Revised MARPOL 73/78 Annex VI 2008, and the latest revised guidelines for sulphur monitoring in Res. MEPC.192(61). As is stated in Res. MEPC.192(61), 'The primary objective of the Guidelines is to establish an agreed method to monitor the average sulphur content of fuel oils supplied for use on board ships taking into account the different sulphur limits as required by regulation 14 of the revised MARPOL Annex VI'.

[939] The definition of 'Fuel oil' in Reg. 2.9 mentions both residual and distillate fuels. The original MARPOL 73/78 Annex VI 1997 did not contain a definition of fuel oil and did not mention distillates.

in fuels and may be seen as a status check for how the sulphur content limits in Regulation 14 are working.[940]

As regards the instructions for how to comply with Regulation 14, these are found in paragraphs 14.6-7. Regulation 14.6 lays out the proper procedures for fuel changes when ships using separate fuels enter or leave an emission control area. Regulation 14.7 stipulates a ‘grace period’ of 12 months from the date of the entry into force of an amendment designating a new emission control area, in which ships operating in the area are exempt from the requirements applying to ECAs. Finally, instructions for a review of Regulation 14.1.3 are included in 14.8-10. The purpose of the review was until it was recently done, to determine the availability of lower sulphur fuels at latest by 2018, to provide a decision basis for determining if going from a global limit of 3.50% m/m sulphur content in fuel to 0.50% m/m sulphur content is feasible in 2020.[941] The effective date for the global sulphur limit has now been set to 1 January 2020, when a 0.50% sulphur limit will apply according to Regulation 14.[942]

A last regulation in Annex VI to be commented, concerning both quality and availability of fuel is Regulation 18. At the outset, it should be noted that Regulation 18 to a large part is *not directed to ships*, but to the suppliers of fuel oil and their control by authorities apt to make such controls. Many of the paragraphs of Regulation 18 therefore ‘should be seen as supportive of Regulation 14 in respect of those aspects which are outside the control of the ship owner’.[943] As

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[940] Both a monitoring and calculation of yearly and three-year rolling averages are prescribed in the guidelines. These averages are based on testing of supplied fuels performed by independent companies. In figures, these companies currently analyse over 100,000 fuel samples annually, which corresponds to between 25% and 35% of all fuel deliveries, see Annex 1 Para. 3 of Res. MEPC 192(61). An example of yearly sulphur monitoring, in this case for 2014, can be found in MEPC 68/3/2.

[941] Reg. 14.8 of the Revised MARPOL 73/78 Annex VI 2008.

[942] Res. MEPC.280(70) and Reg. 14.1.3 of the Revised MARPOL 73/78 Annex VI 2008.

[943] IMO’s online comments regarding ’Fuel oil availability and quality – Regulation 18’, available via < http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Pages/F

has been stated ‘Regulations 18.9 together with regulations 18.1, 18.3, 18.4 and 18.5 in the first instance refer to the *local control of fuel oil suppliers* while regulations 18.7, 18.8.2 – and hence appendix VI - and 18.10 refer to the *application of port State controls*’.[944] All of these paragraphs will not be commented in detail in the below.

As an example of local control of fuel oil suppliers, paragraph 1 of Regulation 18 under the heading of ‘Fuel oil availability’ starts by requiring parties to Annex VI to ‘take all reasonable steps to promote the availability of fuel oils that comply with … [Annex VI] and inform the Organization of the availability of compliant fuel oils in its ports and terminals’.[945] Paragraph 3 of Regulation 18 under the heading of ‘Fuel oil quality’ further mandates that ‘Fuel oil for combustion purposes delivered to and used on board ships to which this Annex applies shall … [*inter alia*] … be free from inorganic acid; and … shall not include any added substance or chemical waste that: … jeopardizes the safety of ships or adversely affects the performance of the machinery, or … is harmful to personnel, or … contributes overall to additional pollution’.[946] A paragraph of Regulation 18 that however focuses on ships is Paragraph 2. This is a ‘fuel oil availability clause’ for situations when compliant fuels according to the sulphur limits in Regulation 14 are not locally available. If a ship owner, despite best efforts, has not been able to obtain compliant fuels locally, this can be taken into account in an inspection situation given

uel-oil-quality-%E2%80%93-Regulation-18.aspx>. *Cf.* Reg. 14.5 of the Revised MARPOL Annex VI 2008.

[944] IMO’s online comments regarding ’Fuel oil availability and quality – Regulation 18’, available via < http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Fuel-oil-quality-%E2%80%93-Regulation-18.aspx>.

[945] Reg. 18.1 of the Revised MARPOL 73/78 Annex VI 2008.

[946] Reg. 18.3.1 of the Revised MARPOL 73/78 Annex VI 2008. See also Reg. 18.3.2 for requirements regarding fuel oils ’derived by methods other than petroleum refining’. It should be noted that the quality requirements in Reg. 18 does not apply to ’coal in its solid form or nuclear fuels’, Reg. 18.3.4 of the same annex.

that the ship owner can show that actions have been taken to achieve fuel compliance and that evidence for this exists.[947]

For the actual control of fuel oil quality via inspections, two aspects are especially relevant. The first aspect is that the bunker delivery note shall be subject to the scrutiny of 'the competent authority of a Party' at inspection, and the 'note shall be kept on board the ship in such a place as to be readily available for inspection at all reasonable times'.[948] The second aspect at inspection for securing compliance with fuel quality is that the 'bunker delivery note shall be accompanied by a representative sample of the fuel oil delivered', the so-called 'MARPOL sample'.[949] The MARPOL sample shall be delivered taking into account guidelines for fuel sampling,[950] and can be used for follow up in an inspection situation, together with the bunker delivery note, in order to verify whether the fuel used on a ship meets the requirements of the Revised MARPOL 73/78 Annex VI 2008.[951]

6.2 Regional Regulation of SO_x Emission from Marine Sources

When it comes to regulating the marine environment on the regional scale, there are clear connections upwards between regulatory scales to international undertakings, such as the LOSC, which basically permits regional variations in marine environment protection and

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947 Reg. 18.2 of the Revised MARPOL 73/78 Annex VI 2008. See also IMO's online comments regarding 'Fuel oil availability and quality – Regulation 18', available via < http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Fuel-oil-quality-%E2%80%93-Regulation-18.aspx>.

948 Regs. 18.7 and 18.6 of the Revised MARPOL 73/78 Annex VI 2008.

949 Reg. 18.8.1 of the Revised MARPOL 73/78 Annex VI 2008 and paragraph 1.1.1 in Appendix VI of the Revised MARPOL 73/78 Annex VI 2008.

950 For guidelines on fuel sampling, see MEPC.182(59). See also MEPC.1/Circ.508.

951 Reg. 18.8.2 of the Revised MARPOL 73/78 Annex VI 2008. *Cf.* the verification procedure described in Appendix VI of the Revised MARPOL 73/78 Annex VI 2008.

preservation, so long as they do not infringe on the general principles and objectives of the convention.[952]

Nevertheless, regulation at the regional scale is not a mere reflection and implementation of commitments at the international scale, but constitutes a scale with its own regulatory traits. Regional treaty arrangements falling both inside and outside of the United Nations Environment Programme's (UNEP's) regional seas programme[953] are tools shaped on the level at which they are to be used. That is to say, a protected region is many times 'defined by the context in which the issue arises'.[954] From an ecological point of view, this is sensible, since variations in ecology and sensitivity will mean different needs in different parts of the world. For the protection and preservation to be as effective as possible, taking into account both specific ecology but for instance also cooperation between States in a region in situations of pollution emergencies, regional solutions make sense. These may be the primary reasons for regulation taking specific regional shapes.[955] Nevertheless, there are also other reasons, for example political ones, for creating regional regulation as well as other benefits of maintaining it.[956]

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[952] Arts. 122 and 123 of the LOSC defining 'enclosed or semi-enclosed areas', and regional cooperation in these areas. In Art. 123 it is *inter alia* stated that 'States bordering an enclosed or semi-enclosed sea should cooperate with each other in the exercise of their rights and in the performance of their duties under this Convention. To this end they shall endeavour, directly or through an appropriate regional organization: (a) to coordinate the management, *conservation*, exploration and exploitation of the living resources of the sea; (b) to coordinate the implementation of their rights and duties with respect to *the protection and preservation of the marine environment*', emphasis added. See also Art. 237 of the same convention, allowing for states to make further agreements on regional marine protection and preservation and Birnie et al. (2009) pp. 390-393.

[953] <http://web.unep.org/regionalseas/>. See also Birnie *et al.* (2009) pp. 393-398.

[954] Birnie *et al.* (2009) p. 391.

[955] Birnie *et al.* (2009) p. 392.

[956] As Birnie *et al.* notes, a protected region can besides ecology be created for example due to political factors, mutual interests, or simply geographical closeness. Another argument for regional arrangements is that regional cooperation may help formulate stronger environmental standards and create better means for control. This is equally noted by Frank (2007), who argues that 'regional agreements between

As has been mentioned before, the particularities of other regulatory arrangements on the regional scale, appearing as EU regulation, is likewise a proof that regional regulation not only mimics international conventions and processes occurring at the international regulatory scale. The EU regulatory layer on the regional scale contains its own legal reasoning, regulatory packages and may *in itself* be a driving force for what happens both on higher and lower regulatory scales.[957]

What will be presented in the below is thus both regional treaty arrangements taking a more classic international agreement shape, as well as legal acts originating from regional arrangements with special constitutional features represented by the EU legal system. In the latter case, the field of EU marine environmental regulation spans everything from broadly formulated policy and framework documents to legal acts regulating sulphur in marine fuels in detail. The historical development of European marine environmental regulation has already been discussed above.[958] The following sections discuss the current applicable regulation regarding marine environment protection and conservation, and specifically, SO_x emissions from marine sources.

6.2.1 The 1992 Convention on the Protection of the Marine Environment of the Baltic Sea Area

On the regional scale, in 1992 the Convention on the Protection of the Marine Environment of the Baltic Sea Area (1992 Helsinki Convention)[959] replaced an already existing framework established by

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states sharing similar interests normally result in a lower level of compromise, stronger commitments and higher environmental standards compared to global instruments'. Further, regional treaties can be viewed as voicing broader framework commitments like the LOSC. Yet another feature of regional cooperation is that it better fits as a scale for integrated ecosystem and coastal zone management, see Birnie *et al.* (2009) pp. 391-393 and Frank (2007) p. 31.

[957] *Supra* Chapter 1 Section 1.3 and Chapter 2 Section 2.2.6.

[958] *Supra* Chapter 4 Section 4.1.2.

[959] The 1992 Helsinki Convention also has important implications for terrestrial pollution sources. However, the bulk of relevant comments regarding the convention for this thesis have a maritime focus. It is thus justified to comment on the instrument in the present chapter and not in Chapter 5.

its predecessor treaty, the 1974 Convention on the Protection of the Marine Environment of the Baltic Sea Area. However, the convention of 1992 introduced a new set of legal principles and concepts as well as new ambitions for international cooperation in the Baltic Sea area.[960] Before the 1992 Helsinki Convention is examined in more detail, some comments about institutional arrangements surrounding the convention ought to be mentioned. Arguably, the convention cannot be discussed in a meaningful manner without mentioning its governing body, the Helsinki Commission (HELCOM).[961] Formed in 1974,[962] HELCOM has integral functions for the 1992 Helsinki Convention. By this token, the convention's provisions do not merely address convention parties, but also concern the work to be performed by HELCOM.[963]

Regarding the 1992 Helsinki Convention, on a general level, the convention has two main functions: namely to lay down provisions for the protection of the marine environment in the Baltic Sea area, and further to define 'the competence of the international institution with respect to future cooperation and international norm-making', in this case HELCOM.[964] As a governing body, the listed formal duties of HELCOM are to continuously observe the implementation of the convention,[965] to draft recommendations on measures relevant for the purposes spelled out in the convention,[966] to review the contents of the

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[960] The 1974 Convention on the Protection of the Marine Environment of the Baltic Sea Area, and Ebbesson (2000) p. 38. Further, as Birnie *et al.* notes about the predecessor convention, 'The 1974 Helsinki Convention for the Protection of the Marine Environment of the Baltic Sea Area was the first regional-seas treaty to cover control of marine pollution from all sources. It had an important influence on the formulation of the marine pollution provisions of the 1982 UNCLOS, and of UNEP's regional-seas treaties', Birnie *et al.* (2009) p. 395.
[961] About HELCOM, see <http://www.helcom.fi/about-us>.
[962] Art. 12 of the 1974 Helsinki Convention for the Protection of the Marine Environment of the Baltic Sea Area.
[963] Regarding the position of HELCOM, referred to in the 1992 Helsinki Convention as 'the Commission', see Arts. 19-24 of the 1992 Helsinki Convention. See also further Arts. 30-32 of the same convention.
[964] Ebbesson (2000) p. 40.
[965] Art. 20(1.)(a). of the 1992 Helsinki Convention.
[966] Art. 20(1.)(b) of the 1992 Helsinki Convention.

convention and the substances it regulates and to define control criteria and objectives for reduction of pollution and measures.[967] Further, HELCOM is to promote, in close cooperation with appropriate governmental bodies, additional measures to protect the marine environment in the Baltic Sea area *inter alia* by using scientific and technological information and working with regional and international organizations that perform research in these and other relevant areas.[968] Finally, there is also a flexible mandate for HELCOM stating that the 'Commission may assume such other functions as it deems appropriate to further the purposes of this Convention'.[969]

Among the formal duties mentioned above, the function of HELCOM as a drafter of recommendations deserves further scrutiny. Firstly, as one author puts it, the HELCOM recommendations 'provide the formal means for developing environmental cooperation and furthering the mutual expectation of the parties on measures to be taken in order to approach the objectives of the Convention'.[970] Secondly, these recommendations, which now amount to some 260 since the 1980s,[971] shed light on the convention by providing potential legal arguments for its interpretation. In so doing, the recommendations can have specifying functions, but may even potentially develop and further the obligations of the convention.[972] Practically, the character and the normative effects and expectations

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967 Art. 20(1.)(c)-(d) of the 1992 Helsinki Convention.
968 Art. 20(1.)(e)-(f) of the 1992 Helsinki Convention.
969 Art. 20(2.) of the 1992 Helsinki Convention.
970 Ebbesson (2000) pp. 40-41.
971 <http://www.helcom.fi/helcom-at-work/recommendations/>.
972 Ebbesson (2000) p. 41. As Ebbesson argues, the recommendations 'In conjunction with the treaty text and the context of the regime' can provide interpretation arguments, leading back to Art. 31(3) of the 1969 VLCC. Here it is stated that account shall be taken to subsequent practice of the parties of a convention. The recommendations arguably constitute such practice, Ebbesson (2000) p. 41. Furthermore, the recommendations, although not formally binding could also be said to represent a fair degree of *opinio iuris* of the HELCOM parties, since the recommendations are adopted unanimously, same source p. 40.

on the recommendations differ, which is contingent on how the actual issue to be dealt with is regulated in the convention.[973]

Getting to the substantive content of the 1992 Helsinki Convention, among the general provisions, a geographical definition of the 'Convention Area' is firstly to be found. According to this definition, the convention applies to the 'Baltic Sea Area' determined as 'the Baltic Sea Area and the entrance to the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57° 44.43'N'.[974] The geographical coverage of the convention not only extends seawards, it equally applies to the internal waters of the contracting parties.[975]

The definition of crucial convention terminology follows in Article 2. At the outset, pollution is defined as:

'[the] introduction by man, directly or indirectly, of substances or energy into the sea, including estuaries, which are liable to create hazards to human health, to harm living resources and marine ecosystems, to cause hindrance to legitimate uses of the sea including fishing, to impair the quality for use of sea water, and to lead to a reduction of amenities'[976]

With minor differences, this definition of pollution is basically the same as the definition of 'pollution of the marine environment' found

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973 Ebbesson notes three different situations here. The first is where the provisions of the 1992 Helsinki Convention are clear enough for pointing out the obligations of the parties. Here the recommendations take on a specifying role for these obligations. A second situation is where the convention states that the parties shall 'develop and apply uniform requirements' for the provisions of certain installations, *e.g.* Art. 8(1) of the 1992 Helsinki Convention. The parties could also be obligated to take appropriate measures 'individually and jointly'. In this second situation the recommendations spell out such uniform requirements or appropriate measures. In a third situation, the provisions of the convention are more open ended and become a platform for further measures by HELCOM, however without specifying what kind of measures that should be taken. This gives room, not merely for specification, but also for developing and furthering the obligations of the convention, Ebbesson (2000) p. 41.

974 Para. 1 of Art. 1 of the 1992 Helsinki Convention.

975 Para. 1 of Art. 1 of the 1992 Helsinki Convention.

976 Art. 2(1.) of the 1992 Helsinki Convention.

in the LOSC.[977] The basic definition of pollution in the 1992 Helsinki Convention is then supplemented by a dedicated definition of 'Pollution from land-based sources' formulated as:

'pollution of the sea by point or diffuse inputs from all sources on land reaching the sea waterborne, *airborne* or directly from the coast. It includes pollution from any deliberate disposal under the seabed with access from land by tunnel, pipeline or other means'[978]

This complementary provision thus applies to pollution, both from point and diffuse source inputs, from all sources on land reaching the Baltic Sea Area, including air emissions in the form of SO_x. Closely tied to the definitions of 'pollution' and 'pollution from land-based sources' is the definition of 'harmful substance' spelled out as 'any substance, which, if introduced into the sea, is liable to cause pollution'.[979]

Finally, among the definitions, it can be noted that 'ship' is defined as 'a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft and fixed or floating platforms',[980] however with applicable limitations like in the case of MARPOL 73.[981]

In Article 3, the fundamental principles and obligations of the 1992 Helsinki Convention are set out. As is firstly expressed:

'The Contracting Parties shall individually or jointly take all appropriate legislative, administrative or other relevant measures *to prevent and eliminate pollution in order to promote the ecological*

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977 Art. 1(1.)(4) of the LOSC.
978 Art. 2(2.) of the 1992 Helsinki Convention, emphasis added.
979 Art. 2(7.) of the 1992 Helsinki Convention. See also further comments immediately below.
980 Art. 2(3.) of the 1992 Helsinki Convention.
981 A 'vessel of any type whatsoever' does *not include* 'any warship, naval auxiliary, military aircraft or other ship and aircraft owned or operated by a state and used, for the time being, only on government non-commercial service', Art. 4(3.) of the 1992 Helsinki Convention. *Cf.* Arts. 2(4) and 3(3) of MARPOL 73. In the cases of both conventions, the parties shall however still ensure 'that such ships and aircraft act in a manner consistent, so far as is reasonable and practicable' with the respective convention.

restoration of the Baltic Sea Area and the preservation of its ecological balance'[982]

A general direction or aim of the individual or joint measures is thus formulated at the outset. This is a broad aim covering both the obligation to take measures against pollution and to conserve nature and biological diversity by protection and preservation. All the same, as has been noted, the objective 'to promote the ecological restoration of the Baltic Sea Area and the preservation of its ecological balance' is 'couched in ambiguous terms'.[983] It is not an easy task to decide what exactly is needed to preserve the ecological balance of the Baltic Sea Area, or even what ecological balance really means. Moreover, to 'eliminate pollution' altogether is an objective worth of praise, but is it practically possible?[984]

In the same article, references in the context of the convention to some well-known legal principles and concepts of environmental law are also to be found. These include the precautionary principle, the polluter-pays principle,[985] as well as the concepts of best available technology and best environmental practice.[986]

The definition of 'harmful substance' and its connection to pollution is already stated in Article 2 of the convention. Nevertheless, a dedicated provision on harmful substances is also included in Article 5. Here it is stated that

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[982] Art. 3(1.) of the 1992 Helsinki Convention, emphasis added.
[983] Ebbesson (2000) p. 43.
[984] Ebbesson (2000) p. 43. As Ebbesson argues, to completely eliminate pollution would only be possible if 'the uses and/or production of the concerned substances are completely prohibited', which is rather unlikely. The convention as such further only prohibits a restricted number of substances completely, see Part 2 on banned substances in Annex I of the 1992 Helsinki Convention.
[985] Arts. 3(2.) and 3(4.) of the 1992 Helsinki Convention. These principles will not be discussed further here, see instead Ebbesson (2000) pp. 43-46 for some comments about these principles in the context of the 1992 Helsinki Convention.
[986] Art. 3(3.) of the 1992 Helsinki Convention and Annex II of the same convention setting 'Criteria for the use of Best Environmental Practice and Best Available Technology'. These concepts will not be elaborated further here, see instead Ebbesson (2000) pp. 46-49 for some comments about these concepts in the context of the 1992 Helsinki Convention.

‘The Contracting Parties undertake to prevent and eliminate pollution of the marine environment of the Baltic Sea Area caused by harmful substances from all sources, according to the provisions of this Convention and, to this end, to implement the procedures and measures of Annex I’[987]

The closer meaning of ‘harmful substances’ is elaborated in the devoted Annex I on harmful substances.[988] The purpose of the annex on harmful substances is to give the contracting parties a procedure for ‘identifying and evaluating harmful substances, as defined in Article 2, paragraph 7’ so as to fulfil the requirements of the convention.[989] A harmful substance shall according to the annex be identified and evaluated based on its inherent properties. These properties are a substance’s persistency, its toxicity or other noxious properties and its tendency to bio-accumulate.[990] Moreover, the identification and evaluation of substances shall be based on ‘characteristics liable to cause pollution’, *inter alia* ‘the ratio between observed concentrations and concentrations having no observed effect’, ‘transboundary or long-range significance’ and ‘distribution pattern (i.e. quantities involved, use pattern and liability to reach the marine environment)’.[991] Among these intrinsic properties and characteristics liable to cause pollution, the toxicity of SO_x emissions (both from land and sea-based sources) and their transboundary or long-range significance is well known. Furthermore, SO_x emissions are liable to reach the marine environment.[992]

Moving on to the specific articles of the convention, the ecosystemic ambition of the 1992 Helsinki Convention naturally means that various activities and pollution sources are regulated. These among others include industry, agriculture, sewage treatment, dumping and ships. In the following, only those articles that have a bearing on air pollution will be commented.

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[987] Art. 5 of the 1992 Helsinki Convention.
[988] Annex I of the 1992 Helsinki Convention.
[989] Part 1.0, Annex I of the 1992 Helsinki Convention.
[990] Part 1.1, Annex I of the 1992 Helsinki Convention.
[991] Part 1.1, Annex I of the 1992 Helsinki Convention.
[992] *E.g.* Corbett *et al.* (2007)

Article 6 of the 1992 Helsinki Convention stipulates 'Principles and obligations concerning pollution from land-based sources'. As regards land-based sources,

'The Contracting Parties undertake to prevent and eliminate pollution of the Baltic Sea Area from land-based sources by using, inter alia, Best Environmental Practice for all sources and Best Available Technology for point sources'[993]

The convention parties shall also among other things

'co-operate in the development and adoption of specific programmes, guidelines, standards or regulations concerning emissions and inputs to water and *air*, environmental quality, and products containing harmful substances and materials and the use thereof'[994]

Further details on procedures and measures for land-based sources are set out in Annex III to the convention. When it comes to air pollutants in particular, specific requirements for the prevention of pollution from industry and municipalities mandate that 'Limit values for emissions containing harmful substances to water and air shall be stated in special permits'.[995] Limits for SO_x emissions to air could thus be set in such limit values.

Article 8 of the 1992 Helsinki Convention is the dedicated provision for the prevention of pollution from ships.[996] As is promptly stated in the article, 'In order to protect the Baltic Sea Area from pollution from ships, the Contracting Parties shall take measures as set out in Annex IV'.[997] Looking at the substantive content in Annex IV elaborating Article 8, the contracting parties firstly are obliged to co-operate regarding the protection of the Baltic Sea Area from pollution

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[993] Art. 6(1.) of the 1992 Helsinki Convention.
[994] Art. 6(2.) of the 1992 Helsinki Convention, emphasis added.
[995] Reg. 2(5.) Part I, Annex III of the 1992 Helsinki Convention.
[996] See however also Art. 9 of the 1992 Helsinki Convention regarding measures to abate harmful effects of pleasure craft on the marine environment of the Baltic Sea Area. As it is stated the 'measures shall, inter alia, deal with air pollution, noise and hydrodynamic effects as well as with adequate reception facilities for wastes from pleasure craft'.
[997] Art. 8(1.) of the 1992 Helsinki Convention.

from ships. This co-operation shall take place within IMO, 'in particular in promoting the development of international rules' and 'in the effective and harmonized implementation of rules adopted by the International Maritime Organization'.[998] With this ambition, it is natural that Annex IV makes reference to the central instrument regulating pollution from ships, MARPOL 73/78. In the annex, it is stated that 'The Contracting Parties shall apply the provisions of Annexes I-V of MARPOL 73/78'.[999] From an air emission point of view it should therefore be noted that the air pollution annex of MARPOL 73/78, Annex VI, is not referred to explicitly in the convention itself.

Still, the undertaking of the parties 'to prevent and eliminate pollution of the marine environment of the Baltic Sea Area caused by harmful substances *from all sources*, according to the provisions of this Convention' arguably covers emissions of SO_x emissions from ships as a point of departure. Moreover, supplementing recommendations adopted according to the convention that focuses on SO_x emissions from ships exists. Two of these recommendations were adopted under the earlier 1974 Helsinki Convention; the first in 1990 'to promote early and effective global measures for minimizing air pollution from ships'.[1000] The second recommendation supplemented the first one in 1992 *inter alia* by taking into consideration IMO Assembly Resolution A.719(17) on prevention of air pollution from ships, which was the call for IMO MEPC to prepare a new draft annex; Annex VI to MARPOL 73/78.[1001] In the same recommendation it is stated that

'early special interim measures should be taken by the Baltic Sea States in order to protect the marine environment of the Baltic Sea Area, the environment in the Baltic Sea States, as well as to contribute to the global reduction of air pollution from ships'[1002]

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[998] Reg. 1(a) and (b) Annex IV of the 1992 Helsinki Convention.
[999] Reg. 5(1.) Annex IV of the 1992 Helsinki Convention.
[1000] HELCOM Recommendation 11/12.
[1001] HELCOM Recommendation 13/15.
[1002] HELCOM Recommendation 13/15.

Already in this recommendation from 1992, five years before the adoption of the original MARPOL 73/78 Annex VI 1997, the parties to the Helsinki Convention were recommended to take appropriate action to:

'Encourage both the oil industries to supply and the shipowners to use marine fuel oils with a sulphur content as low as possible, but not exceeding 1,5% by weight' and to 'Conclude bilateral agreements for ships trading in the Baltic Sea in regular traffic between the two countries involved to use only marine fuel oils with a sulphur content not exceeding 1,5% by weight, not later than 1 January 1995'[1003]

In yet another recommendation from 2007, the parties of the convention are, in the context of the revision of the original MARPOL 73/78 Annex VI 1997, introduced to economic incentives that

'can serve as complements to regulatory measures and thereby may lead to a larger reduction of pollution compared to that achieved by traditional regulations and can stimulate technological improvements and innovations as well as achievement of environmental results at lower costs'[1004]

Further, the adoption of this recommendation was linked to a joint initiative that was put forth as the HELCOM Baltic Sea Action Plan (BSAP).[1005] In this plan, as regards air pollution from ships, the HELCOM contracting states among other things agreed

'to support efforts within IMO under the ongoing review process of Annex VI of MARPOL 73/78 to tighten sulphur content in fuel oil at the global level, by having a joint submission to IMO'[1006]

[1003] 1.) and 2.) of HELCOM Recommendation 13/15.

[1004] HELCOM Recommendation 28E/13. By this token, the contracting parties are then recommended to 'investigate and, when appropriate, introduce feasible and effective economic instruments as a possible complement to existing regulations to further reduce air pollution from shipping'.

[1005] BSAP (2007).

[1006] BSAP (2007) p. 27. This mentioned joint submission was later on presented to the MEPC in 2008, before the revision of MARPOL Annex VI as document MEPC 57/4/20.

All in all, SO_x emissions from ships are not as explicitly regulated in the 1992 Helsinki Convention as other emissions. However, in supplementary documents the question of SO_x emissions from ships lingers and is acknowledged as a problem. Further, the HELCOM contracting parties have historically worked together to negotiate joint submissions to IMO, which has *inter alia* led to the adoption of the Baltic Sea SECA.[1007] Additionally, the contracting states have shown joint initiative in the BSAP supporting the revision process of MARPOL 73/78 Annex VI, and the tightening of sulphur limits for fuels used by ships. Thus, although the regulation of SO_x emissions from ships is not presently clearly stipulated in 'hard law' in relating to the 1992 Helsinki Convention, the HELCOM platform is still important and potentially open for the regulation of such emissions.

6.2.2 EU Law - The Marine Strategy Framework Directive

Adopted in 2008, the EU's Marine Strategy Framework Directive (MSFD),[1008] provides a common European framework and objectives for the protection and conservation of the marine environment.[1009] The common objectives of the directive are to be pursued via Member State evaluation of the requirements of marine areas for which they are responsible. Upon such evaluation, marine strategies shall be created for each region, in cooperation with other Member States and third countries, and their application shall then be monitored.

As regards the provisions, the 'Subject matter' of the directive is described in Article 1. Here it is stated that 'This Directive establishes a framework within which Member States shall take the necessary measures to *achieve* or *maintain good environmental status* in the

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[1007] <http://www.helcom.fi/action-areas/shipping/airborne-emissions>

[1008] Dir. 2008/56/EC.

[1009] As is noted in para. (3) Preamble of Dir. 2008/56/EC, the directive 'should, inter alia, promote the integration of environmental considerations into all relevant policy areas and *deliver the environmental pillar of the future maritime policy for the European Union*', emphasis added. The directive is also linked to the EU's 6th environment action programme, see para. (4) Preamble of the same directive.

marine environment by the year 2020 at the latest'.[1010] In Article 3, the meaning of 'good environmental status' is explained as:

'the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations…'[1011]

The closer meaning of this is that:

'the structure, functions and processes of the constituent marine ecosystems, together with the associated physiographic, geographic, geological and climatic factors, allow those ecosystems to function fully and to maintain their resilience to human-induced environmental change. Marine species and habitats are protected, human-induced decline of biodiversity is prevented and diverse biological components function in balance'

and it is further held that:

'hydro-morphological, physical and chemical properties of the ecosystems, including those properties which result from human activities in the area concerned, support the ecosystems as described above. Anthropogenic inputs of substances and energy, including noise, into the marine environment do not cause pollution effects'[1012]

[1010] Art. 1(1.) of Dir. 2008/56/EC, emphasis added. *Cf.* Art. 14 of the same directive for a list of exceptions under which a Member States may identify instances where the environmental targets or good environmental status cannot be achieved in every aspect through measures pursuant to the directive's ambitions.
[1011] Art. 3(5.) of Dir. 2008/56/EC. See also the definition of 'environmental status' in Art. 3(4.) of Dir. 2008/56/EC, stating that it is 'the overall state of the environment in marine waters, taking into account the structure, function and processes of the constituent marine ecosystems together with natural physiographic, geographic, biological, geological and climatic factors, as well as physical, acoustic and chemical conditions, including those resulting from human activities inside or outside the area concerned'.
[1012] Art. 3(5.)(a)-(b) of Dir. 2008/56/EC.

What is considered to be ‘good environmental status’ is to be determined depending on the scales of marine region or subregion, based on qualitative criteria given in the directive.[1013] Moreover, adaptive management based on the ecosystem approach is to be applied in order to aim for attaining good environmental status.[1014] As a point of departure, the directive divides European seas into four main marine regions with possible subregions. The main regions are the Baltic Sea, the North-East Atlantic, the Mediterranean and the Black Sea.[1015] In these regions (and their subregions) Member States must coordinate their work with each other and with the third countries involved, and where practicable and appropriate via already existing regional cooperation structures.[1016]

Returning again to the subject matter in Article 1, it is moreover stated that for the purpose of achieving or maintaining good environmental status, marine strategies are to be developed and implemented to:

‘protect and preserve the marine environment, prevent its deterioration or, where practicable, restore marine ecosystems in areas where they have been adversely affected … [and to] prevent and reduce inputs in the marine environment, with a view to phasing out pollution as defined in Article 3(8), so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate uses of the sea’[1017]

The marine strategies should thus protect and preserve the marine environment as well as prevent its deterioration, *inter alia* by

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[1013] For a definition of marine region or subregion, see Art. 4 of Dir. 2008/56/EC. See also Annex I of the same directive for ’Qualitative descriptors for determining good environmental status’.
[1014] Art. 3(5.) para. 4 of Dir. 2008/56/EC. See also Art. 1(3.) of Dir. 2008/56/EC and paras. (8) and (44) Preamble of the same directive.
[1015] Art. 4(1.) of Dir. 2008/56/EC. For subregions, see Art. 4(2.) of the same directive.
[1016] Art. 6 of Dir. 2008/56/EC. See also para. (19) Preamble of Dir. 2008/56/EC, referring *inter alia* to regional conventions such as the 1992 Helsinki Convention. See also para. 24 Preamble of the same directive.
[1017] Art. 1(2.)(a)-(b) of Dir. 2008/56/EC, emphasis added. See also para. (43) Preamble of the same directive.

preventing and reducing the inputs in the marine environment. In the directive, 'pollution' is defined as:

'the direct or indirect introduction into the marine environment, as a result of human activity, of substances or energy, including human-induced marine underwater noise, which results or is likely to result in deleterious effects such as harm to living resources and marine ecosystems, including loss of biodiversity, hazards to human health, the hindering of marine activities, including fishing, tourism and recreation and other legitimate uses of the sea, impairment of the quality for use of sea water and reduction of amenities or, in general, impairment of the sustainable use of marine goods and services'[1018]

With some minor differences, this corresponds to the LOSC definition of 'pollution of the marine environment',[1019] and thus covers atmospheric inputs into the marine environment, for example in the form of SO_x emissions from ships.

The scope of the directive is formulated in Article 2. Here it is stated that the directive as a point of departure applies to:

'all marine waters as defined in Article 3(1), and shall take account of the transboundary effects on the quality of the marine environment of third States in the same marine region or subregion'[1020]

The term 'marine waters' is in turn defined as:

'waters, the seabed and subsoil on the seaward side of the baseline from which the extent of territorial waters is measured extending to the outmost reach of the area where a Member State has and/or

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[1018] Art. 3(8.) of Dir. 2008/56/EC.

[1019] Art. 1(1.)(4) of the LOSC. See also the open reference to the LOSC obligations of EU Member States in para. (17) Preamble of Dir. 2008/56/EC, where it is stated that 'The obligations of the Community and its Member States under those agreements [UNCLOS and the agreement relating to the implementation of Part XI] should … be taken fully into account in this Directive'.

[1020] Art. 2(1.) of Dir. 2008/56/EC. Exception is made for activities with 'the sole purpose of which is defence or national security'. However Member States shall still 'endeavour to ensure that such activities are conducted in a manner that is compatible, so far as reasonable and practicable, with the objectives of this Directive', Art. 2(2.) of Dir. 2008/56/EC.

exercises jurisdictional rights, in accordance with the Unclos, with the exception of waters adjacent to the countries and territories mentioned in Annex II to the Treaty and the French Overseas Departments and Collectivities; and … coastal waters as defined by Directive 2000/60/EC, their seabed and their subsoil, in so far as particular aspects of the environmental status of the marine environment are not already addressed through that Directive or other Community legislation'[1021]

When it comes to the strategies themselves, Member States shall firstly do an initial assessment analysing the essential characteristics of their waters, among other things physical and chemical features, habitat types and animal and plant populations. An analysis shall also be performed regarding the predominant impacts and pressures, as a result of human activities, which affect the features of these waters, for instance the introduction of toxic substances,[1022] the level of eutrophication, smothering or sealing of habitats by construction work, introduction of non-indigenous species and physical damage caused by ship anchors. Finally, an economic and social analysis of the waters and the cost of degradation of the marine environment should be performed.[1023]

After the initial assessment has been made, the Member States shall use this assessment as a basis for establishing what is 'good environmental status' together with the more specific environmental indicators and criteria elaborated in the directive's Annexes.[1024] Further, environmental targets shall be established, in order to guide

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[1021] Art. 3(1.) of Dir. 2008/56/EC.

[1022] Specifically Art. 8(1.)(b)(i) of Dir. 2008/56/EC. See further Table 2 of Annex III which particularly mentions the 'introduction of non-synthetic substances and compounds (e.g. heavy metals, hydrocarbons, resulting, for example, *from pollution by ships* and oil, gas and mineral exploration and exploitation, *atmospheric deposition*, riverine inputs) under the heading of 'Contamination by hazardous substances', emphasis added. This indicative list reasonably also covers inputs of SO_x emissions into the marine environment.

[1023] Arts. 5 and 8(1.) of Dir. 2008/56/EC. See also Table 1 and 2 of Annex III of the same directive.

[1024] Art. 9 of Dir. 2008/56/EC. See also Annex I and Table 1 and 2 of Annex III of the same directive.

the progress towards reaching good environmental status in the marine environment.[1025] These targets shall *inter alia* be used as reference in the monitoring which the Member States shall perform.[1026]

All in all, the MSFD's requirements on EU Member States to take the necessary measures to achieve or maintain 'good environmental status' in the marine environment by 2020 could include various measures to protect and preserve the marine environment, including strategies to control air pollution. In the case of SO_x emissions and the MSFD, it has been acknowledged that such emissions are already regulated through the directive setting requirements for the sulphur content in fuels.[1027] Nevertheless, the regulation of related air pollutants in the form of NO_x has been proposed in the context of the MSFD's requirements.[1028]

6.2.3 EU Law - The Water Framework Directive

Among the overarching legal acts on the EU level, another directive should lastly also be mentioned. This is the water framework directive, adopted in 2000.[1029] However, this directive only partly covers coastal waters, besides covering inland surface waters, transitional waters and groundwater.[1030] Therefore it will only be

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[1025] Art. 10 of Dir. 2008/56/EC. See also Table 2 of Annex III and Annex IV of the same directive.

[1026] Art. 11 of Dir. 2008/56/EC. See also Annex III and Annex V of the same directive.

[1027] COM(2016) 617 final p. 4. See also further comments about this directive *infra* Section 6.2.4.

[1028] COM(2016) 617 final p. 4.

[1029] Dir. 2000/60/EC, most recently updated via Directive 2014/101/EU. In the following, any references to the former directive are references to it in its most recently amended form.

[1030] Art. 1 of Dir. 2000/60/EC. An overlap with the MSFD is acknowledged in para. (12) Preamble of Dir. 2008/56/EC. Here it is stated that 'Coastal waters, including their seabed and subsoil, are an integral part of the marine environment, and as such should also be covered by this Directive, *in so far as particular aspects of the environmental status of the marine environment are not already addressed through Directive 2000/60/EC* … so as to ensure complementarity while avoiding unnecessary overlaps', emphasis added.

shortly commented on here.[1031] Briefly expressed, the water framework directive creates a framework for water protection and management. Its purpose is *inter alia* to establish a framework that 'prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems'.[1032] Additionally, its purpose is also to promote sustainable water usage, to improve aquatic ecosystems and to mitigate the effects of floods and droughts.[1033] Among its several objectives,[1034] one is to achieve 'good surface water chemical status' for all Community waters by 2015.[1035] Practically, all Member States shall initially identify and analyse European waters, based on the divisions of individual river basins and districts.[1036] The Member States shall then adopt management plans and programmes of measures that are adapted to each body of water.[1037]

In the protection of further deterioration of waters, combatting pollution caused by various substances is included. There is a list of 'priority substances',[1038] which does not include sulphur in particular, nevertheless, the definitions of 'pollutant' and 'pollution' are sufficiently broad to cover the negative effects of sulphur in the waters protected by the directive.[1039] Thus, the directive is at least applicable in principle also to SO_x emissions.

[1031] For more comments about the water framework directive, see instead Jans, Vedder (2012) pp. 392-400.
[1032] Art. 1(a) of Dir. 2000/60/EC.
[1033] Art. 1 of Dir. 2000/60/EC.
[1034] Art. 4 of Dir. 2000/60/EC.
[1035] Art. 4(1.)(a)(ii) of Dir. 2000/60/EC. For a definition of 'good surface water chemical status', see Art. 2(20.) of the same directive.
[1036] Arts. 4 and 5 of Dir. 2000/60/EC.
[1037] Arts. 11 and 13 of Dir. 2000/60/EC.
[1038] Art. 2(30.) and Annex X of Dir. 2000/60/EC.
[1039] Art. 2(31.) and 2(32.) of Dir. 2000/60/EC. In the former paragraph, 'pollutant' is defined as 'any substance liable to cause pollution, in particular those listed in Annex VIII' and in the latter paragraph 'pollution is defined as 'the direct or indirect introduction, as a result of human activity, of substances or heat into the air, water or land which may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems, which result in

6.2.4 EU Law - Marine Applications of Directive (EU) 2016/802

Getting to the more specific EU acts regulating SO_x emissions, the current main act is Dir. (EU) 2016/802 relating to the reduction in the sulphur content of certain liquid fuels. This directive sets maximum sulphur limits for fuels both in the form of gas oils and HFO when used in land-based applications as well as for marine fuels.[1040] Since its creation, the directive regulating the sulphur content of certain liquid fuels has become the legal vehicle where the sulphur provisions of MARPOL 73/78 Annex VI 1997 and 2008 have been implemented in EU law via several amendment directives.[1041] As the directive presently stands, amendments have thus aligned it with the Revised MARPOL 73/78 Annex VI 2008.[1042] Nevertheless, the amended and now consolidated sulphur directive also goes further than what is mandated by the Revised MARPOL 73/78 Annex VI 2008 regarding some aspects.[1043]

Starting from the beginning of the directive, its purpose is to:

'reduce the emissions of sulphur dioxide resulting from the combustion of certain types of liquid fuels and thereby to reduce the

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damage to material property, or which impair or interfere with amenities and other legitimate uses of the environment'. See also para. (45) Preamble of Dir. 2000/60/EC.

[1040] For some comments about terrestrial applications of Dir. (EU) 2016/802, see *supra* Chapter 5 Section 5.2.3.

[1041] See in particular Dir. 2005/33/EC and Dir. 2012/33/EU. The former directive was partly a result of 'A European Union strategy to reduce atmospheric emissions from seagoing ships' adopted in 2002, which *inter alia* took into account the new sulphur regulation for ships in the original MARPOL 73/78 Annex VI of 1997, see para. 2.2 of COM(2002) 595 final.

[1042] See particularly the amendments of Dir. 1999/33/EC via Dir. 2012/33/EU.

[1043] The fact that the directive goes further than its international counterpart in the form of MARPOL 73/78 Annex VI 2008 is not something new. This was also the case earlier when Dir. 2005/33/EC mandated an earlier entry into force of the then North Sea SECA than was prescribed by MARPOL 73/78 Annex VI 1997. Further, the special provisions for passenger ships had no equivalent in MARPOL 73/78 Annex VI 1997, which is still the case compared to the 2008 revision of Annex VI. For some comments about Dir. 2005/33/EC going further than international law, see Ringbom (2008) pp. 264-266 and 427-438.

harmful effects of such emissions on man and the environment … [and] … Reductions in emissions of sulphur dioxide resulting from the combustion of certain petroleum-derived liquid fuels shall be achieved by imposing limits on the sulphur content of such fuels as a condition for their use within Member States' territory, territorial seas and exclusive economic zones or pollution control zones'[1044]

The scope of the directive's limitations on the sulphur content of certain petroleum-derived liquid fuels is further defined in a list of where the directive is not applicable.[1045] Moreover, in the same article there is a provision that has the same function as Regulation 4 in Revised MARPOL 73/78 Annex VI 2008, the provision on equivalents.[1046] In the directive's provision, it is thus stated that the limitations on the sulphur content shall not apply, 'without prejudice to Article 5, [to] fuels used on board vessels employing emission abatement methods in accordance with Articles 8 and 10'.[1047] Article 5 is the provision about maximum sulphur content in marine fuels, and Articles 8 and 10 regard emission abatement methods and trials of new emission abatement methods, which can be applied as an alternative to using low sulphur marine fuels, subject to the conditions given in the articles.[1048]

For the purposes of marine applications, the definitions of 'marine fuel', 'marine diesel oil' and 'marine gas oil' are relevant. In the case of 'marine fuel', this is defined as 'any petroleum-derived liquid fuel intended for use or in use on board a vessel, including those fuels

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[1044] Art. 1(1.)-(2.) of Dir. (EU) 2016/802.

[1045] The directive *inter alia* does not apply to 'fuels intended for the purposes of research and testing … fuels intended for processing prior to final combustion [and] … fuels to be processed in the refining industry', Art. 1(2.)(a)-(c) of Dir. (EU) 2016/802. For the full list of applicable exceptions, see Art. 1(2.)(a)-(h) of the same directive.

[1046] See also comments *supra*, Section 6.1.2 about the equivalents provision in the Revised MARPOL 73/78 Annex VI 2008.

[1047] Art. 1(2.)(h) of Dir. (EU) 2016/802.

[1048] Art. 1(2.)(h) and Art. 2(o) of Dir. (EU) 2016/802. It can be noted that Art. 2(o) of the said directive is almost literally the same as Reg. 4.1 of Revised MARPOL 73/78 Annex VI 2008.

defined in ISO 8217'.[1049] In the case of both 'marine diesel oil' and 'marine gas oil', reference is made to ISO 8217 for fuel characteristics such as viscosity, density and flashpoint.[1050] However, in both cases exceptions are made for 'the reference to the sulphur content' in the ISO-standard.[1051] This, since Dir. (EU) 2016/802 requires lower maximum sulphur content than the ISO 8217 fuel standard. This also has an effect for what fuel quality that is allowed to be sold in the EU according to the directive. Marine diesel oils placed on the market in the EU must not exceed 1.50% sulphur content and marine gas oils placed on the market must not exceed 0.10% in sulphur content.[1052]

Starting on land and moving seawards, when it comes to the details of maximum sulphur content limits for ships, the 'at berth' provision in Dir. (EU) 2016/802 mandates a maximum limit of 0,10% sulphur content in fuel for ships at berth in union ports.[1053] This provision has no equivalent in the Revised MARPOL 73/78 Annex VI 2008.

When it comes to ECAs, the provisions of Dir. (EU) 2016/802 are parallel with the Revised MARPOL 73/78 Annex VI 2008 requirements. That is, a maximum sulphur content of 0,10% in marine fuels has applied since 1 January 2015 in EU Member States, 'in the areas of their territorial seas, exclusive economic zones and pollution control zones falling within SOx Emission Control Areas'.[1054] As is stated, the 'paragraph shall apply to all vessels of all flags, including vessels whose journey began outside the Union'.[1055] The requirements

[1049] Art. 2(c) of Dir. (EU) 2016/802. For ISO 8217 fuel specifications, see e.g. < https://www.iso.org/standard/64247.html>.
[1050] Art. 2(d)-(e) of Dir. (EU) 2016/802.
[1051] Art. 2(d) and (e) of Dir. (EU) 2016/802.
[1052] Art. 6(10.) and Art. 7(3.) of Dir. (EU) 2016/802.
[1053] Art. 7 of Dir. (EU) 2016/802. Exceptions from the main rule apply 'whenever, according to published timetables, ships are due to be at berth for less than two hours… [and] … to ships which switch off all engines and use shore-side electricity while at berth in ports', see Art. 7(2.) of the same directive. See also Art. 2(l) of Dir. (EU) 2016/802. for a definition of 'ships at berth'.
[1054] Art. 6(2.)(b) and (b) of Dir. (EU) 2016/802.
[1055] Art. 6(2.) of Dir. (EU) 2016/802.

are thus set to apply in principle to all vessels of all flags, even when they only pass through the coastal zones of EU Member States.[1056]

A special provision for passenger ships with no equivalent in the Revised MARPOL 73/78 Annex VI 2008 links to the lower sulphur limit in ECAs at the EU level. This is a lower maximum limit of sulphur content that applies to marine fuels used in Member States'

'territorial seas, exclusive economic zones and pollution control zones falling outside SOx Emission Control Areas by passenger ships operating on regular services to or from any Union port if the sulphur content of those fuels exceeds 1,50 % by mass until 1 January 2020'[1057]

Originally, this special limit for passenger ships was created with the motivation that passenger ships stood for a significant share in total air emissions from ships in Europe, and that the ambitions of European air policy justified a lower sulphur limit for this class of ships, even when sailing outside SECAs.[1058] During the last revision of Dir. 1999/32/EC it was suggested that passenger ships should still be linked to the lower ECA limit, which would be 0,10% sulphur in fuel from 1 January 2015. Nevertheless, a compromise in the revision process connected to the last amendment directive of Dir. 1999/32/EC allowed passenger ships to stay at the 1,50% sulphur limit until 2020 when a new global limit will apply (at the time depending on the 2018 feasibility review).[1059]

Getting to the sulphur limits outside ECAs for ships that are not passenger ships, the limit in the EU for marine fuels Member States' territorial seas, exclusive economic zones and pollution control zones has been 3,50 % as from 18 June 2014, and will then drop to 0,50 % as from 1 January 2020, applying to 'all vessels of all flags, including

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1056 For a discussion of the possibilities to actually enforce these standards in the context of international law, see Ringbom (2008) pp. 436-437.

1057 Art. 6(5.) of Dir. (EU) 2016/802. See also Art. 2(i) and (j) for definitions of 'passenger ships' and 'regular services'.

1058 COM(2002) 595 final Volume I discussed *supra* Chapter 4 Section 4.1.3.1.

1059 COM(2011) 439 final p. 4. See also Art. 4a(4.) of Dir. 1999/32/EC.

vessels whose journey began outside of the Union'.[1060] Finally, a general limit for sulphur content in marine fuels is set to 3,50% used within Member State territory 'except for fuels supplied to ships using emission abatement methods subject to Article 8 operating in closed mode'.[1061]

6.3 The National Regulation of SO_x Emission from Marine Sources - Sweden[1062]

The following section gives an overview of the current regulation of marine sulphur emission sources in Sweden. The structure of Swedish regulation of SO_x emissions from marine sources broadly reflects the structure found in international agreements and in EU legislation as a consequence of the implementation of accompanying obligations.

6.3.1 The Main Acts[1063] Regulating Marine Sulphur Emissions

Apart from some provisions still partly left in the Swedish Transport Agency's instructions *Transportstyrelsens föreskrifter och allmänna råd om åtgärder mot förorening från fartyg* (the 'Transport Agency's instructions on measures for the prevention of pollution from ships'),[1064] the essential requirements for *all types of marine fuels* defining maximum allowed sulphur content in fuels, including HFOs,

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1060 Art. 6(1.) of Dir. (EU) 2016/802.

1061 Art. 5 of Dir. (EU) 2016/802. For more details about emission abatement methods with so-called closed loops, see *e.g.* Wilewska-Bien *et al.* (2016) p. 376.

1062 Like previously, all translations of titles and text from national legal acts are the author's own translations, unless available translations have been found in other sources.

1063 Some acts on the regional scale commented above that Sweden is bound to, which are applicable in principle to SO_x emissions, but have not yet resulted in concrete national regulation for such emissions, will not be further commented in the following section, *.i.e.* the 1992 Helsinki Convention, the MSFD and the Water Framework Directive. See instead comments *supra* Section 6.2.

1064 TSFS 2010:96 as most recently updated via TSFS 2016:128. In the following, when references are made to TSFS 2010:96, these are references to TSFS 2010:96 as most recently updated via TSFS 2016:128.

most recently appear in *Svavelförordning (2014:509)* (the 'Sulphur Ordinance (2014:509)').[1065]

Starting with some sections in the instructions, some matters linking to the main sulphur regulation in the Revised MARPOL 73/78 Annex VI 2008 are requirements regarding equivalents,[1066] the International Air Pollution Prevention Certificate (IAPP Certificate),[1067] fuel changeover,[1068] and fuel quality.[1069] All of these sections aim to implement the respective requirements of the Revised MARPOL 73/78 Annex VI 2008 regarding the same matters, and openly refer to exactly which regulation in Annex VI they intend to implement. The sections are more or less literal translations of the requirements of the Revised MARPOL 73/8 Annex VI 2008. Finally, as stated in the instructions, the specific rules about limits for sulphur in marine fuels are however contained in *Svavelförordning (2014:509)*.[1070]

For marine fuels, this order aims to implement the requirements of the Revised MARPOL 73/78 Annex VI 2008, and the requirements of the EU sulphur directive, Directive (EU) 2016/802.[1071] The relevant sections in *Svavelförordning* are found under a dedicated heading concerning 'Marketing, transfer and use of marine fuels'.[1072] Here, it is stated that marine gas oil may be sold or transferred *only* if the sulphur content of the oil does not exceed 0,10 % in sulphur content.[1073] Moreover, marine diesel oil may be sold or transferred *only* if the sulphur content of the oil does not exceed 1,50 % sulphur by weight.[1074] These limits match the EU limits for sulphur in marine fuels.[1075]

[1065] SFS 2014:509.
[1066] Section 2, Chapter 13 of TSFS 2010:96.
[1067] Section 3, Chapter 2 of TSFS 2010:96.
[1068] Section 35, Chapter 13 of TSFS 2010:96.
[1069] Sections 46-47, Chapter 13 of TSFS 2010:96.
[1070] Section 34, Chapter 13 of TSFS 2010:96.
[1071] The travaux préparatoires listed in the bibliographic information for this legal act is inter alia the earlier sulphur directive, Dir. 1999/32/EC.
[1072] Sections 17-23 of SFS 2014:509.
[1073] Section 17 of SFS 2014:509.
[1074] Section 18 of SFS 2014:509.
[1075] Art. 6(10.) and Art. 7(3.) of Dir. (EU) 2016/802.

The EU 'at berth provision' is reflected in a section stating that the sulphur content in fuels used in ports may not exceed 0,10 % sulphur content, mirroring the EU provisions.[1076]

Another article states that the sulphur content in marine fuels may not exceed 0.10 % when the fuel is used in Swedish inner waters, the Baltic Sea area, the North Sea area, and the 'North American regions'.[1077] This provision basically mirrors the content of the EU provision regulating the maximum allowed sulphur content in ECAs, however without explicitly referring to emission control areas.[1078]

An equivalent of the passenger ship provision in the EU sulphur directive is also found in the *Svavelförordning*. The given maximum allowed 1,50% sulphur in fuel for passenger ships operating on regular services to or from an EU port applies until the 31 December 2019.[1079] Furthermore, the same date applies to other vessels than passenger ships with the limitation that such ships may use marine fuels with up to 3,50% sulphur content.[1080] From the 1 January 2020 a limit of 0,50% applies sulphur content applies to all ships.[1081] These requirements correspond with the EU requirements in Dir. (EU) 2016/802.[1082] Additionally, the general requirement of a maximum of 3,50% sulphur content in marine fuel applies, like in the EU directive, with the exception for fuels used together with emission abatement methods in closed mode.[1083]

[1076] *I.e* sufficient time shall be allowed for the crew to complete any necessary fuel-changeover operation as soon as possible after arrival at berth and as late as possible before departure, and fuel-changeovers are to be recorded in a ships' logbook. A ship may also use another fuel if according to published timetables, ships are due to be at berth for less than two hours, Section 21 of SFS 2014:509. See also Art. 7 of Dir. (EU) 2016/802.

[1077] Section 20 of SFS 2014:509. Definition of all of these areas are found in Sections 7-9 of the same ordinance.

[1078] Art. 6(2.) of Dir. (EU) 2016/802. References to emission control areas can however be found in TSFS 2010:96.

[1079] Section 23(1.)(a) of SFS 2014:509.

[1080] Section 23(1.)(b) of SFS 2014:509.

[1081] Section 23(2.) of SFS 2014:509.

[1082] Art. 6(1.) of Dir. (EU) 2016/802.

[1083] Section 24 of SFS 2014:509 and Art. 5 of Dir. (EU) 2016/802.

For the actual control of fuel oil quality and delivery, *Svavelförordning*, like the EU sulphur directive, applies the procedure mandated by Regulation 18 of the Revised MARPOL 73/78 Annex VI 2008: a control via bunker delivery note and a sealed representative oil sample.[1084]

Finally, *Svavelförordning* also contains a fuel availability clause, where compliant fuel has not been available, despite best efforts.[1085] This clause reflects the fuel availability requirements both found in the Revised MARPOL 73/78 Annex VI 2008, and Dir. (EU) 2016/802.[1086]

6.4 Conclusions

At the international scale, the legal base for the current framework regulating SO_x emissions from marine sources is principally found in international treaties. Here, the United Nations Convention on the Law of the Sea, the LOSC, establishes the fundamental legal framework for States' activities at sea, including protection and preservation of the environment from air pollution. There are no specific provisions on SO_x emissions in the LOSC itself, but the core provisions under the environment title in Part XII provides some important principles underpinning States' duties to protect and preserve the environment.

When it comes to the more specific obligations regarding air pollution from ships, MARPOL 73/78 is the primary instrument, and particularly the provisions found in the Revised MARPOL 73/78 Annex VI 2008. Today, this annex covers air emissions, which terminologically encompasses both air pollutants like SO_x and NO_x, and GHGs. Regarding SO_x emissions, Regulation 14 of the Revised MARPOL 73/78 Annex VI 2008 is the dedicated provision. Regulation 14 builds on defining fuel sulphur limits contingent on

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[1084] Sections 19 and 34 of SFS 2014:509, Art. 6(9.)(b) of Dir. (EU) 2016/802, and Reg. 18 of the Revised MARPOL 73/78 Annex VI 2008.

[1085] Section 29 of SFS 2014:509.

[1086] Reg. 18 of the Revised MARPOL 73/78 Annex VI 2008 and Art. 6(8.) of Dir. (EU) 2016/802.

ship operations outside and inside ECAs. These limits have gradually become stricter according to a time schedule. The fuel sulphur limits outside ECAs that have global application and the limits inside ECAs that have regional application are both set in sulphur weight content per unit of fuel (% sulphur m/m). The defined limits, whether outside or inside ECAs, apply to all fuel oils. The set limits for sulphur in fuel oil apply in a given year interval, outside and inside an ECAs.[1087]

As regards the regional regulatory scale and the regulation of SO_x emissions from marine sources, the framework of the LOSC basically permits regional variations in marine environment protection and preservation so long as they do not infringe on the general principles and objectives of the convention. Regulation at the regional scale is however not a mere reflection and implementation of commitments at the international scale, but also constitutes a scale with its own regulatory features.

Although the 1992 Helsinki Convention has the ambition to 'to prevent and eliminate pollution in order to promote the ecological restoration of the Baltic Sea Area and the preservation of its ecological balance',[1088] the specific regulation of SO_x emissions from ships is not among the central issues dealt with in the convention. SO_x emissions are covered in principle by the definition of 'pollution' and 'harmful substance' in the convention, but the convention neither specifically mentions sulphur, nor includes a reference to MARPOL 73/78 Annex VI. Links to MARPOL 73/78 Annex VI can however be found in supplementary documents to the convention.

The EU regulatory layer on the regional scale contains more specific rules regarding the regulation of sulphur emissions from marine sources. These rules are to be found in Dir. (EU) 2016/802 relating to a reduction in the sulphur content of certain liquid fuels. The directive sets maximum sulphur limits for fuels both in the form of gas oils and HFO when used in land-based applications as well as for marine purposes. After revision, this directive has become the main legal vehicle where the sulphur provisions of MARPOL 73/78 Annex VI

[1087] For a graphical presentation of these limits, see *supra* Section 6.1.2.
[1088] Art. 3(1.) of the 1992 Helsinki Convention, emphasis added.

have been incorporated via amendment directives. As the directive presently stands, the amendments have aligned it with the requirements of the Revised MARPOL 73/78 Annex VI 2008. However, Dir. (EU) 2016/802 still goes further than what is mandated by IMO regulation regarding some aspects. The 'at berth' provision in Dir. (EU) 2016/802 mandates a maximum limit of 0,10% sulphur content in fuel for ships at berth in union ports without an equivalent in the Revised MARPOL 73/78 Annex VI 2008. Likewise, the special EU passenger ship provision with no equivalent in the Revised MARPOL 73/78 Annex VI 2008, originally linked to the lower sulphur limits in ECAs, demands passenger ships to use fuel oil with a maximum 1,50% sulphur limit even outside ECAs until 2020, when a new global limit of 0,50% will apply.

When it comes to the national scale and regulation of SO_x emissions from ships, some provisions are found in the Swedish Transport Agency's instructions *Transportstyrelsens föreskrifter och allmänna råd om åtgärder mot förorening från fartyg*. Here, provisions regarding equivalents, the International Air Pollution Prevention Certificate (IAPP Certificate), fuel changeover, and fuel quality are spelled out. All of the sections regarding such matters in the instructions aim to implement the respective requirements of the Revised MARPOL 73/78 Annex VI 2008. However, the essential requirements for *all types of marine fuels* defining maximum allowed sulphur content in fuels, including HFOs, most recently appear in *Svavelförordning*. For marine fuels, this order basically aims to implement the fuel sulphur requirements of the Revised MARPOL 73/78 Annex VI 2008, and simultaneously the requirements of the basic EU sulphur directive just mentioned, including the EU specific provisions.

PART III - CLOSURE

‘sometimes at night the deep waters of the
sea have grown clear and phosphorescent,
to grant me glimpses of the ways beneath.
And these glimpses have been as often of the
ways that were and the ways that might be,
as of the ways that are; for ocean is more
ancient than the mountains, and freighted
with the memories and the dreams of Time.’[1089]

7 Standard-Setting in the Regulation of SO_x Emissions from Terrestrial and Marine Sources – An Analysis

7.1 Introduction

It will be recalled that the purpose of this study is to identify and examine differences between standard-setting in the regulation of SO_x emissions from terrestrial sources and the regulation of SO_x emissions from marine sources with the intention of identifying the underlying rationales for the key differences in standard-setting, their effect, and the possibilities of improvement of SO_x emissions regulation in the marine setting. In other words, the point of this thesis is to examine what can be learned for standard-setting in the regulation of SO_x emissions from marine sources from standard-setting in the regulation of SO_x emissions from terrestrial sources.

Previous chapters have discussed at length the development and content of SO_x regulations in both the terrestrial and the marine contexts and across the international, regional (mainly EU) and

[1089] Lovecraft, H.P. (1919) The White Ship as appearing on <http://www.hplovecraft.com/writings/texts/fiction/ws.aspx>.

national (Swedish) regulatory scales. From the examination of the predominant form of regulation for the control of SO_x emissions from terrestrial and marine sources, CAC regulation, it has been shown that the regulation of such emissions has undergone various regulatory phases in the respective setting. These phases have among other things been influenced by factors such as type of emission source, scientific and technological advances, political developments and economic considerations. Within the context of CAC regulation, one of the central components is that of standard-setting. Importantly, as has been stated above,[1090] the chosen type of standard, and how this is concretely articulated often provides 'the most tangible and precise expressions of the judgements that underlie environmental policies'.[1091] Moreover, the choice of regulatory standard decides a number of crucial aspects of regulation.

With a point of departure in what has been presented above in Chapters 3-6, the function of the current chapter is to develop the main analysis of standard-setting in the regulation of SO_x emissions from terrestrial and marine sources. In so doing, this chapter answers the core research questions of this study, which require a closer analysis of regulation via the study of standard-setting.[1092]

Furthermore, this chapter aims to answer such matters as whether standard-setting in regulation is expressed in an instrumental or goal-oriented fashion and what effects this may have, for instance for how the abatement of SO_x emissions may proceed given a certain standard, and what the choice of standard can reveal about the regulations' accuracy in so doing. Finally, this chapter is expected to reveal whether the regulation of marine SO_x emissions could be improved regarding standard-setting against the background of the largely successful terrestrial regulation of SO_x emissions, and in extension, potentially lead to overall better regulation.

In terms of structure, this chapter begins with a demonstration of the method used for analysis of standard setting in environmental CAC

[1090] *Supra* Chapter 1 Section 1.2.
[1091] RCEP (1998) p. 3.
[1092] *Supra* Chapter 1 Section 1.2.1.

regulation. Next, two graphical matrices of historical and currently applicable standards in the regulation of SO_x emissions from terrestrial and marine sources are presented. Using these matrices as a starting point for discussion, the research questions regarding standard-setting in SO_x emissions regulation are then answered one by one under dedicated subsections, including separate conclusions for each question.

7.2 A Demonstration of the Method Used for Analysis of Standard-Setting in Environmental CAC Regulation

The present section exemplifies an application in practice of the main method used for analysis of standard-setting in CAC regulation for the control of SO_x emissions from terrestrial and marine sources. As was explained in Chapter 2, the use of methods in this study can be described as a process of three methodological steps, where the method for analysis of standard-setting is only one part of the chain.[1093] Thus, this part of the chain rests both on a ground of theoretical concepts and methods previously presented in Chapter 2.

As a matter of recapitulation, the three methodological steps described in Chapter 2 were (1) identifying, (2) analysing, and (3) systematising. The current section focuses on explaining the application of the method in step (2) analysing, where the suitable legal and other material has thus already been identified in the first step, that is, in Chapters 3-6. The second analytical part in turn paves the way for the third step, (3) systematising, which is also commented on to some extent at the end of the current section. It should be noted that going through the different methodological steps is not done in a closed linear and finite order, like described above for pedagogical purposes.[1094] That is, in practice, analysis can be followed by a systematisation, which in turn serves to provide yet more 'identified' material for analysis in a sort of feedback loop. A good example of

[1093] *Supra* Chapter 2 Section 2.2.1.
[1094] *Supra* Chapter 2 Section 2.2.1.

this is how the current chapter progresses. It initially presents graphical matrices of the identified and examined material in Chapters 3-6. These matrices aid both the analysis and systematisation of the information from these chapters. At the same time, the chapter progresses with an analysis of the newly identified information in order to explain why the different types of regulatory standards have been plotted in the matrices as belonging to certain standards, and then continues with further analysis of what can be concluded from the matrices in relation to the research questions.

Returning to the actual application in practice of the method for standard-setting analysis, it may be recalled that the analysis in step two has dual purposes: first, to consider whether the regulation of SO_x emissions from terrestrial and marine sources in the identified legal material could indeed be categorized as CAC regulation? And second, to consider which type of standard-setting is used in the identified CAC regulation?[1095]

Bearing in mind these two purposes, an example of the kind of analysis of SO_x emissions regulation performed later in section 7.4 will now be demonstrated. Choosing from one of the three regulatory scales (international, regional, and national), and the two settings (terrestrial and marine), the application in practice of the method for analysing standard-setting in SO_x emissions regulation will be performed in this section on a legal instrument from the international scale in the historical marine regulatory setting. The example below does however not illustrate when the method is used for excluding material from analysis. Suffice it to say here that in relation to exclusion, the method is used according to the principle that every methodological step must be fulfilled. Should one of the methodological steps not be applicable, this will lead to the exclusion of a certain legal instrument from further examination, for instance in the case where a piece of legislation is not categorized as CAC regulation.[1096]

[1095] *Supra* Chapter 2 Section 2.2.1.
[1096] See also the positions taken regarding scope and delimitations, *supra* Chapter 1 Section 1.3.

Regarding the first purpose of verifying that CAC regulation has indeed been located, the following can be stated. Initially, it should be known that this verification has already been done before the current chapter, after the identification of relevant legal material in step one.[1097] However, for pedagogical purposes, the demonstration of the method for analysis of standard-setting also includes an explanation of this step, since the identification of CAC regulation is a prerequisite for a later analysis of *standard-setting* in CAC regulation. As an example, the historical regulation of SO_x emissions from marine sources at the international scale found in MARPOL 73/78 Annex VI 1997 can be used. For the sake of order and consequence, another preceding step will however firstly also be accounted for: namely, the step of verifying whether this international convention can pass as regulation at all according to the definition of regulation presented in Chapter 2?[1098] Put differently, does this international instrument include the basic functions of regulation as expressed by the generic trio of regulation?

Since MARPOL 73/78 Annex VI 1997 contains provisions with requirements *inter alia* for SO_x emissions (standard-setting),[1099] provisions for a system for surveys, certification, inspection and means of control (information-gathering),[1100] and finally, provisions for procedures of detection of violations and enforcement (behaviour-modification),[1101] this legal instrument passes the fundamental test for being labelled as regulation according to the generic trio presented in Chapter 2.

Then, what about the test whether the instrument can also pass as CAC regulation? Again, considering the definitions of CAC

[1097] *I.e.* since this thesis is limited to analysing CAC regulation, the test as to whether a certain piece of regulation belongs to this category has been done before it is commented on in this chapter when the material to be included in Chapters 3-6 was sifted through.
[1098] *Supra* Chapter 1 Section 2.2.4.
[1099] Reg. 14 of MARPOL 73/78 Annex VI 1997.
[1100] Regs. 5-10 of MARPOL 73/78 Annex VI 1997.
[1101] Reg. 11 of MARPOL 73/78 Annex VI 1997.

regulation explained above,[1102] it was stated that the common national take on CAC regulation[1103] captures the core features of several definitions. It was moreover added that this principal idea of CAC regulation operating through 'rule-based coercion', backed by State authority, in a direct and often detailed manner, can be transferred to regulatory scales above and beyond the national scale *mutatis mutandis*. Thus, the international counterparts of the core features typically found in national scale CAC regulation are what is sought for in MARPOL 73/78 Annex VI 1997, notwithstanding the fact that these features may not be identically expressed when compared to national regulation.

Assessing MARPOL 73/78 Annex VI 1997 in light of the definitions explained in Chapter 2, it can be concluded that it is a binding international undertaking between States, building on a direct and detailed prescriptive approach commanding its addressees how to behave, for example regarding the abatement of SO_x emissions. Additionally, its regulations are supported by the imposition of some negative sanction, the control, in this case clearly expressed in regulation for procedures of detections of violations and enforcement.[1104] As a complementary observation, it can further likewise be noted that the mechanism or modality mainly driving behavioural change in a wanted direction in MARPOL 73/78 Annex VI 1997 is command-based. That is, the provisions generally build on 'traditional legal commands', as opposed to for instance regulation including provisions relying on economic mechanisms like competition or market-based modalities as a central means for affecting the behaviour of regulatees.[1105] In view of the above, MARPOL 73/78 Annex VI 1997 thus also passes the test as CAC regulation according to the definitions in this study.

[1102] *Supra* Chapter 1 Section 2.2.6.
[1103] Explained by Morgan, Yeung (2007) p. 80 as 'the state promulgation of legal rules prohibiting specified conduct, underpinned by coercive sanctions (either civil or criminal in nature) if the prohibition is violated'.
[1104] *Supra* Chapter 1 Section 2.2.6.
[1105] *Supra* Chapter 1 Section 2.2.5.

Having completed the first purpose of the analysis with the method for standard-setting analysis, the second purpose is to identify which type of standard-setting is used in the now identified and confirmed CAC regulation. For this examination, it is necessary to look closer at the substantive[1106] SO_x emission provision in MARPOL 73/78 Annex VI 1997. Looking at this historical piece of regulation, it can be concluded that this specific provision is found in Regulation 14 of MARPOL 73/78 Annex VI 1997, which *inter alia* provides the following:

'Sulphur Oxides (SOx)

General requirements

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

…Requirements within SO_x Emission Control Areas

…(4) While ships are within SO_x Emission Control Areas, at least one of the following conditions shall be fulfilled:

(a) *the sulphur content of fuel oil used on board ships in SO_x Emission Control Areas does not exceed 1.5% m/m;*
(b) *an exhaust gas cleaning system, approved by the Administration taking into account guidelines to be developed by the Organization, is applied to reduce the total emission of sulphur oxides from ships, including both auxiliary and main propulsion engines, to 6.0 g SO_x/kWh or less calculated as the total weight of sulphur dioxide emission …*
(c) *any other technological method that is verifiable and enforceable to limit SO_x emissions to a level equivalent to that described in sub-paragraph (b) is applied. These methods shall be approved by the Administration taking into account guidelines to be developed by the Organization.'*[1107]

[1106] As stated *supra* Chapter 1 Section 1.3, only the substantive standards in regulation are analysed in Chapter 7 as regards type of standard.
[1107] Reg. 14 of MARPOL 73/78 Annex VI 1997, emphasis added.

Applying the definitions of regulatory standards as elaborated in Chapter 2[1108] to Regulation 14, it can firstly be concluded that both the global limit in Regulation 14(1) of an allowed maximum of 4,5% sulphur content in fuel, and the SO_x emission control area (SECA) limit in Regulation 14(4)(a) of a maximum of 1,5% sulphur content are basically *product standards*, although with different geographical scope. This is so, because they target the sulphur content in fuel oil as *a product* to reduce SO_x emissions. Thus, they sufficiently correspond to the description given above of a typical product standard, to the extent that they 'specify the properties or characteristics of design of a product'.[1109]

With respect to SECAs specifically, Regulation 14(4)(b) however also contains the possibility to fulfil the requirements by means of following an *emission standard* for an exhaust gas cleaning system with a specified acceptable total emission limit of 6.0 grams of SO_x emissions per kWh. This formulation qualifies as an emission standard according to the description above since it specifies 'levels for pollutants or nuisances that are not to be exceeded from installations or activities'.[1110] In contrast to the standards targeting the sulphur content in fuel oil, this source-related standard thus instead targets SO_x emissions by specifying limit values for grams of SO_x emissions per kWh emitted from ships.

Finally, Regulation 14(4)(c) provides that the requirements in SECAs may also be fulfilled 'by application of another technological method for emission reduction that could achieve an *equivalent result of the exhaust gas cleaning system*'. This flexible and open formulation does not express a specific standard in the same sense as the formulations already examined. Rather, the possibility of using another technological method for emission reduction that could achieve *an equivalent result* of the exhaust gas cleaning system could potentially be any 'self-imposed' source-related standard in the form of for

[1108] *Supra* Chapter 2 Section 2.2.8.
[1109] *Supra* Chapter 2 Section 2.2.8.
[1110] *Supra* Chapter 2 Section 2.2.8.

example a product, process, or emission standard.[1111] As long as the technological method has been 'approved by the Administration taking into account guidelines to be developed by the Organization', the requirements surrounding its use could thus potentially be formulated in several ways. Therefore, this final open and flexibly expressed standard will be categorized as a standard in the residual category 'other standards'.[1112]

Since there are several identified standards in Regulation 14, a consecutive question is also whether there is a priority in application between these standards? As regards application, the product standard specifying a maximum of 4,5% sulphur content in fuel is a primary standard, while the three other identified standards (product, emission, and the 'other standard') can all be followed in SECAs as *alternatives* or *equivalents* to each other, because Regulation 14(4) states that 'While ships are within SO_x Emission Control Areas, *at least one of the following conditions shall be fulfilled'*.[1113]

[1111] In this particular case, it is difficult to imagine an alternative/equivalent standard being a non-source specific *quality standard* formulated by reference to the target being protected, *i.e.* air. Instead, the provision's formulation is arguably limited to source specific standards demanding technological abatement methods that may well be expressed either as a product, process or emission standard.

[1112] *Supra* Chapter 2 Section 2.2.8.

[1113] The terms 'alternative' and 'equivalent' are somewhat ambiguously commented on in guidelines to MARPOL 73/78 Annex VI 1997. For instance, in Res. MEPC.130(53) p. 15, it is stated that the emission standard in Reg. 14(4)(b) is 'an alternative to that given in regulation 14(4)(a), *not an equivalent*', emphasis added. At the same time, Reg. 14(4) of MARPOL 73/78 Annex VI 1997 does not denote the three different SECA requirements as alternatives or equivalents, but as 'conditions'. Reg. 14(4)(c) of the same instrument does however mention 'any other technological method that is verifiable and enforceable to limit SO_x emissions to a level *equivalent* to that described in sub-paragraph (b)', emphasis added. Additionally, Reg. 4 of MARPOL 73/78 Annex VI 1997, with the heading 'Equivalents', similarly opens up for fulfilling other requirements by stating that 'The Administration may allow any fitting, material, appliance or apparatus to be fitted in a ship as an *alternative* to that required by this Annex if such fitting, material, appliance or apparatus is at least as effective as that required by this Annex', emphasis added. Later updated guidelines state that Reg. 4 allows 'with the approval of the Administration, the use of an *alternative* compliance method at least as effective in terms of emission reductions as that required by the Annex', Annex 1 Res. 259(68) p. 2, emphasis added. All in all, Now the results of the analysis in the second methodological step can easily be plotted in a matrix, which can thereafter be used as a start for the third methodological step: (3) systematising. Visually, a part of the final matrix with the plotted historical standards, which is introduced in section 7.3, can then be presented as follows:

HISTORICAL STANDARD-SETTING IN THE REGULATION OF SO_x EMISSIONS FROM TERRESTRIAL AND MARINE SOURCES			
TYPE OF STANDARD/ REGULATORY SCALE		TERRESTRIAL	MARINE
PRODUCT	INT.	-	■, ●
	REG.	-	-
	NAT.	-	-
PROCESS	INT.	-	-
	REG.	-	-
	NAT.	-	-
EMISSION	INT.	-	●
	REG.	-	-
	NAT.	-	-
ENV. QUALITY	INT.	-	-
	REG.	-	-
	NAT.	-	-
OTHER	INT.	-	●
	REG.	-	-
	NAT.	-	-

■ = Primary standard ▼ = Subsidiary standard ● = Alternative/equivalent standard - = Standard absent

Table 7.1 Four plotted types of standards in the historical regulation of SO_x emissions from marine sources.

As can be seen in this partially plotted matrix, there is thus one default or primary *product standard* with general application outside SECAs. Within SECAs, there are three standards that are alternative/equivalent, subject to specific conditions: a *product standard*, an *emission standard*, and another flexible and open standard *other standard* that could potentially take on a variety of

the terms 'alternative' and 'equivalent' are arguably used more or less interchangeably. In the following, these kind of standards will be commented as alternative/equivalent standards to include both terms.

forms, depending on what self-imposed standard an Administration proposes as an equivalent, 'taking into account guidelines to be developed by the Organization'.[1114] As a final part of this subsection, it is useful, once again, to remind the reader of the delimitations surrounding the analysis of standard-setting before turning to the presentation of the full graphical matrices and the analysis below.[1115]

First, this chapter's examination of standard-setting on different regulatory scales is performed to draw distinctions between regulatory scales. It is not performed to engage in a comparative study of for example conflicts of norms between regulatory scales or different States' legal systems, but to identify differences concerning one function (standard-setting) of regulatory design between the three defined regulatory scales.

Second, the analysis of standard-setting in historical and current regulation is only performed on standards in force, expressed in the substantive provisions dedicated to controlling SO_x emissions. Thus, any provisions in regulation that only incidentally relate to SO_x emissions, or are merely supportive of the dedicated main provisions, will not be analysed with regard to standard-setting, although such provisions have been commented on to some extent in Chapters 3-6 to provide context.

Third, the drawing of distinctions focuses only on the key differences in standard-setting between the regulation of SO_x emissions from terrestrial and marine sources, and thus not all possibly identifiable differences. This reasoning likewise applies to the ambition of tracing the main rationales or the most plausible explanations for these key

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1114 Here, the general equivalents regulation in Reg. 4 of MARPOL 73/78 Annex VI 1997, could also be marked as an 'other standard', since it similarly opens up for alternative or equivalent standards by stating that 'The Administration may allow any fitting, material, appliance or apparatus to be fitted in a ship as an alternative to that required by this Annex if such fitting, material, appliance or apparatus is at least as effective as that required by this Annex'. This standard is however not marked in the matrix above since it is a duplicate of an 'other standard' in the same analysed legal instrument.

1115 For the full applicable delimitations, see however *supra* Chapter 1 Section 1.3.

differences, based on the perspectives and materials presented in the previous chapters of this thesis.

Fourth, the form or type of standard is the centre of attention in the examination of differences instead of the specific numerical formulation in a regulatory standard, its stringency, or how the standard was arrived at. Here, the types of standards are analysed against the main four mentioned basic categories, and the possible fifth residual category.

Fifth, the plotted standards in the matrices will not be used for a quantitative evaluation of standard-setting, but are instead mainly used for qualitative evaluations. The matrices presented below are thus used to aid the examination of the variation of forms or types of standard-setting used in regulation, and their 'qualities' or traits, as for instance primary or subsidiary standards, or alternative/equivalent standards. To this end, the plotting itself foremost aims to visualize the variety of different types of standards that can be identified in substantive SO_x emissions regulation.[1116] When it comes to temporal delimitations, the plotting of standards is limited to historical and currently applicable standards. Standards in regulation that have been adopted but have not yet entered into force, are not plotted and analysed, although they are still commented on to some extent below.[1117] In some cases, the same standards may be plotted in both of the matrices for historical and current standard-setting. These cases are when a historical legal act contains a standard which remains and therefore is still the currently applicable standard.

Finally, the ambition to improve SO_x emissions regulation in the marine setting is delimited to potential improvements against the background of the key differences and the main rationales for these

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[1116] As stated *supra* Chapter 1 Section 1.3, regarding standards, there may be standard duplicates in a single piece of regulation. In such cases, and where the exact same type of standard is expressed several times over the course of amended legal acts, the standards will only be plotted as representing one type of standard. Hence, this is yet another aspect of the quality, i.e. the type, being the centre of attention and not the quantity of a certain type of standard. Note however, that the same type of standard in two different legal acts is all the same plotted as two standards in the matrices below.
[1117] *Infra* Section 7.4.2.4.

differences identified in the analysis of terrestrial and marine standard-setting. Consequently, the ambition to ameliorate regulation does not purport to include all potential improvements in general.

7.3 A Graphical Presentation of Standard-Setting in the Regulation of SO_x Emissions from Terrestrial and Marine Sources

As a bridge to the closer analysis of standard-setting in SO_x emissions regulation in the sections below, the following tables present an initial identification of standards from the materials presented in Chapters 3-6. At the same time, the matrices aid the analysis and the systematisation of the identified standards. The order in this chapter, that is, to first reveal part of the results used for later analysis, and then explain them further in detail, is intentional. This is so, because it is believed that keeping the matrices below in mind during the rest of the current chapter will be beneficial for the development of analysis and arguments. The matrices present both the regulation of SO_x emissions from terrestrial and marine sources in a historical and a current context. Historical and current standard-setting is however presented in separate matrices. Based on the materials from Chapters 3-6, the examples of identified historical standard types can be visually presented as follows:

HISTORICAL STANDARD-SETTING IN THE REGULATION OF SO_x EMISSIONS FROM TERRESTRIAL AND MARINE SOURCES			
TYPE OF STANDARD/ REGULATORY SCALE		TERRESTRIAL	MARINE
PRODUCT	INT.	■	■, ●
	REG.	■, ■	■
	NAT.	■, ■	■, ■, ●
PROCESS	INT.	▼	-
	REG.	▼	-
	NAT.	-	-
EMISSION	INT.	■, ■	●
	REG.	■, ■	-
	NAT.	■, ■	●
ENV. QUALITY	INT.	■	-
	REG.	■, ■	-
	NAT.	■, ■	-
OTHER	INT.	-	●
	REG.	-	●
	NAT.	-	●

■ = Primary standard ▼ = Subsidiary standard ● = Alternative/equivalent standard **-** = Standard absent

Table 7.2 Plotted types of standards in the historical regulation of SO_x emissions from terrestrial and marine sources.

Moreover, based on the same chapters, the examples of identified and analysed current applicable standard types can be visually presented as follows:

CURRENT STANDARD-SETTING IN THE REGULATION OF SO_x EMISSIONS FROM TERRESTRIAL AND MARINE SOURCES			
TYPE OF STANDARD/ REGULATORY SCALE		TERRESTRIAL	MARINE
PRODUCT	INT.	■	■
	REG.	■, ■	■
	NAT.	■, ■	■
PROCESS	INT.	■, ▼	-
	REG.	▼	-
	NAT.	-	-
EMISSION	INT.	■	-
	REG.	■, ■	-
	NAT.	■, ■, ■	-
ENV. QUALITY	INT.	■	-
	REG.	■, ■	-
	NAT.	■, ■	-
OTHER	INT.	-	●
	REG.	-	●
	NAT.	-	●

■ = Primary standard ▼ = Subsidiary standard ● = Alternative/equivalent standard - = Standard absent

Table 7.3 Plotted types of standards in the current regulation of SO_x emissions from terrestrial and marine sources.

The following sections will now turn to explain why the standards in the matrices have been plotted in a certain square. Furthermore, a closer analysis according to the research questions will be performed.

7.4 Differences in Standard-Setting in the Terrestrial and Marine Contexts

From the departure of the graphical matrices presented in the previous section, the main differences in standard-setting will now be examined according to the requirements of the research questions. The first subsection, section 7.4.1, considers whether there are any differences in standard-setting in the historical regulation of SO_x emissions from terrestrial and marine sources, and if so, what these main historical differences are. The second subsection, section 7.4.2, then proceeds to consider whether there are any differences in current standard-setting in the regulation of SO_x emissions from terrestrial and marine sources, and if so, what those differences are. Both of the subsections are rounded off with sections drawing some conclusions.

Although the plotting of standards was demonstrated with an example in section 7.2 above, section 7.4.1 below will initially also refer back to the definitions of standard types in Chapter 2 Section 2.2.8 for the sake of clarity. However, to avoid repetition, after these references the definitions will not be repeated at every instance of explaining the standard-plotting. As regards the analysis of standard type in the sense of primary, subsidiary or alternative/equivalent standards, it is only the subsidiary or alternative/equivalent nature of standards that is specifically discussed below. If nothing else is mentioned, it is implied that a standard applies as a primary standard, and is thus the default standard.

7.4.1 Historical Differences in Standard-Setting in the Regulation of SO_x Emissions from Terrestrial and Marine Sources

7.4.1.1 International Regulation of SO_x Emissions from Terrestrial and Marine Sources

At the international scale, the historical standards in the regulation of SO_x emissions from terrestrial sources are found in two protocols to the LRTAP Convention. In the First Sulphur Protocol, adopted in 1985, the standards were set as a single flat rate reduction, where each party agreed to achieve at least the fixed reduction of SO_x emissions of 30% as soon as possible, but no later than 1993, with 1980 as reference year. The 30% reduction requirement, which applied regardless of emission source, was set as an *emission standard* specifying an acceptable limit of SO_x emissions, or 'levels for pollutants or nuisances that are not to be exceeded from installations or activities'.[1118] This standard is therefore plotted as a historical emission standard for terrestrial sources on the international scale. In the Second Sulphur Protocol of 1994 however, a new approach that focused on the sensitivity to acidification of the environment was introduced. This new approach included the concept of *critical load*.

The concept of critical load could be translated into national emission ceilings for SO_x emissions, which basically meant that the standard in the Second Sulphur Protocol was formulated as a kind of *environmental quality standard*, since it formulated a quantitative estimate of an exposure to SO_x emissions below which significant harmful effects on the environment did not occur, regardless of emission source. Or, put differently, the standard fits the definition of environmental quality standards since these 'prescribe the levels of pollution, nuisance or environmental interference which are permitted and which must not be exceeded in a given environment or particular environmental media'.[1119] Thus, the standard is plotted as a historical environmental quality standard for terrestrial sources on the international scale. The Second Sulphur Protocol however also included *emission standards* in the form of emission limits values for major stationary combustion sources, *product standards* in the form of sulphur content limits for gas oils (diesel for on-road vehicles and other fuels) specifying 'the properties or characteristics of design of a product',[1120] and in some cases, subsidiary *process standards* in the form of desulphurization rate requirements for major stationary combustion sources 'which determine the requirements to be met in the course of the operation of installations',[1121] in cases were the

[1118] *Supra* Chapter 2 Section 2.2.8.
[1119] *Supra* Chapter 2 Section 2.2.8.
[1120] *Supra* Chapter 2 Section 2.2.8.
[1121] *Supra* Chapter 2 Section 2.2.8.

parties could not fulfil the primary standards.[1122] All of these standards are plotted as standards on the international scale in their respective category.

Looking at the historical standards in the regulation of SO_x emissions from marine sources, these are found in the original MARPOL 73/78 Annex VI 1997. As was stated earlier in Chapter 4, these standards mainly focused on setting limits for the sulphur content in fuels used on board ships. As such, both the then global limit of an allowed maximum of 4,5% sulphur content in fuel, and the SECA limit of a maximum of 1,5% sulphur content were basically *product standards*, although with different geographical scope, targeting the sulphur content in fuel oil as a product. These two standards are both plotted as product standards on the international scale, however with the difference that the standard which applied in SECAs is marked as an alternative or equivalent standard.

The SECA standard is an equivalent, because there were other possibilities in the original MARPOL 73/78 Annex VI 1997 to fulfil the requirements for SECAs as well. The requirements could also be fulfilled by following an *emission standard* for an exhaust gas cleaning system with a specified acceptable total emission limit of grams of SO_x emissions per kWh, or by application of another technological method for emission reduction that could achieve an equivalent result of the exhaust gas cleaning system. These two standards are plotted in the categories of international *emission standard*, and an *other standard*. The latter because the open formulation of applying another technological method with equivalent result is flexible enough to host various regulatory solutions building on different standards.[1123] Both of these two categorized standards are

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[1122] *Supra* Chapter 3 Section 3.1.3.

[1123] Here, the general equivalents regulation in Reg. 4 of MARPOL 73/78 Annex VI 1997, could also be marked as an *other standard*, as it similarly opens up for alternative or equivalent standards by stating that 'The Administration may allow any fitting, material, appliance or apparatus to be fitted in a ship as an alternative to that required by this Annex if such fitting, material, appliance or apparatus is at least as effective as that required by this Annex'. This is however not marked in the matrix also marked as alternative/equivalent, since they were two of three SECA standards that could possibly be followed as alternatives to each other.

7.4.1.2 Regional Regulation of SO_x Emissions from Terrestrial and Marine Sources

At the regional scale, in the regulation of SO_x emissions from terrestrial sources, gas oils used in some terrestrial stationary installations were targeted already in the mid-1970s with *product standards* defining maximum sulphur content limits for fuels.[1124] These product standards were later on expanded to include a greater variety of sources and types of fuels, including heavy fuel oils with the introduction of Dir. 1999/32/EC. In the end of the 1990s, the quality of petrol and diesel fuels was also regulated in a directive for automotive fuel quality for vehicles with petrol and diesel engines. The directive, Dir. 98/70/EC, *inter alia* introduced requirements for SO_x emissions by specifying sulphur content limits for petrol and diesel fuels that were formulated as *product standards*. These two standards are plotted as two historical regional product standards for terrestrial SO_x emission sources.

Starting in the mid-1980s, limit values for SO_x emissions were specified for industrial plants, including large combustion plants and waste plants.[1125] These limit values were formulated as different *emission standards* targeting specified industrial activities. Furthermore, in some cases, subsidiary *process standards* specifying rates of desulphurization were stipulated. All of these standards are plotted in their respective categories as historical regional standards for terrestrial SO_x emission sources.

Beginning with the first directive on SO_x emissions and particulates in 1980, the then European Economic Community for the first time introduced *environmental quality standards*, *inter alia* for SO_x

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above since it is a duplicate of an *other standard* in the same analysed legal instrument.

[1124] *Supra* Chapter 3 Section 3.1.4.

[1125] *Supra* Chapter 3 Section 3.1.4.

emissions.[1126] Later on, during the mid-1990s, the more concerted EU air quality policy efforts continued formulating air quality standards with an air quality framework directive and daughter directives, including limit values for SO_x emissions.[1127] Additionally, in 2001, the NEC Directive transposed the requirements of the 1999 Gothenburg protocol into EU law *inter alia* for SO_x emissions.[1128] The national emission ceilings for SO_x emissions, modelled after the Gothenburg Protocol, was likewise formulated as a kind of *environmental quality standards*. Both the standards in the air quality directive (amended over time) and in the NEC Directive are plotted as historical regional environmental quality standards for terrestrial SO_x emission sources.[1129]

Regarding historical regulation of SO_x emissions from marine sources on the regional scale, most requirements were found in the European directive regulating the sulphur content of certain liquid fuels, Dir. 1999/32/EC with amendments. As was stated earlier in Chapter 4, this directive covered terrestrial uses of fuels and was gradually expanded

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[1126] *Supra* Chapter 3 Section 3.1.4.
[1127] *Supra* Chapter 3 Section 3.1.4.
[1128] *Supra* Chapter 3 Section 3.1.5.
[1129] It is a fact that environmental quality standards, typically and by their very nature do not sort inputs affecting the environment according to emission source in the sense of terrestrial or marine emission sources. Indeed, this is the whole point of environmental quality standards: to protect for example the air regardless of the source from where the harming pollutant originates. All the same, the context in which the EU ambient air quality legislation targeting SO_x emissions was originally formulated in 1980, was arguably *mainly* a terrestrial pollution context. It was not until the early 2000s that the attention was turned to ship emissions' effects for air quality in Europe. Furthermore, this was done in discussions where it was more or less understood that IMO had the main mandate to regulate air pollution from international maritime traffic. Likewise, the regulation of air pollution from ships, and particularly SO_x emissions, has been realized in other legal acts targeting the sulphur content in liquid fuels. In sum, although the standards in EU legislation on ambient air quality apply to ship emissions in principle, they are all the same plotted as a 'terrestrial' environmental quality standard. The same applies to the environmental quality standards expressed in the NEC Directive, which principally applies to air pollution from national maritime traffic, but excludes emissions from international maritime traffic, *supra* Chapter 4 Section 4.1.3.1.

also to include fuels used for marine applications.[1130] Since 2005, the sulphur limits applying to marine fuels specified in the amendment directive, Dir. 2005/33/EC, set maximum sulphur content limits for all marine fuels in liquid form, introducing parallel requirements in the EU to those originally specified in the original MARPOL 73/78 Annex VI 1997.[1131] This more specifically meant an introduction of particular fuel specifications for SECAs, but also EU specific fuel requirements for passenger ships and for ships at berth. Additionally, the sulphur limits were also specified in terms of maximum allowed sulphur content in marine distillates (MGOs and MDOs) placed on the EU market. Moreover, the directive also stipulated allowed alternatives to the abovementioned limits for fuel oils by means of an approved emission abatement technology achieving emission reductions with an equivalent result of the specified fuel sulphur limits.

The approaches of the different requirements of Dir. 1999/32/EC (with revisions) were to target the fuels used by ships to achieve emission reductions by defining *product standards.* These standards set maximum allowed sulphur content limits for marine fuels as products, albeit the standards varied contingent on some additional criteria, like for instance ship class. All the same, these standards are represented by a plotted historical product standard on the regional scale for marine emission sources. The possibility to employ an approved emission abatement technology achieving an equivalent result is plotted as a historical and alternative/equivalent *other standard* for marine emission sources on the regional scale, since it is openly formulated and could be realized in requirements formulated as several different standards as an alternative to the product standard.

[1130] *Supra* Chapter 4 Sections 4.1.2-4.1.3.

[1131] As mentioned *supra* in Chapter 4 Section 4.1.1.2, the original MARPOL 73/78 Annex VI 1997 did not contain any definitions of 'fuel oil'. Nor did it make any distinctions between marine gas oils (MGOs) and marine diesel oils (MDOs) that can be found in European sulphur regulation. Instead, MARPOL 73/78 Annex VI 1997 generally referred to 'fuel oil used on board ships', although residual fuel oil was mentioned in Reg. 14(1) of MARPOL 73/78 Annex VI 1997.

7.4.1.3 National Regulation of SO_x Emissions from Terrestrial and Marine Sources – A Swedish Perspective

At the national scale, when it comes to historical standards in SO_x emissions regulation for terrestrial sources in Sweden, fuel oil mainly used in industries, for house heating, and in power plants were targeted with limits for sulphur content in fuel oil already in 1968.[1132] These limits, expressing *product standards* for fuel oil, later ended up in the ordinance on sulphurous fuels. These standards are examples of historical product standards at the national scale for terrestrial emission sources. Thus, a product standard is plotted in the matrix.

The historical Swedish standards regarding SO_x emissions from large combustion plants and waste incineration were specified in instructions from 2003 and 1993 respectively. Such instructions typically defined SO_x emission limits in the form of *emission standards* for these activities.[1133] These standards are therefore plotted above as two historical national emission standards for terrestrial emission sources.

Standards for ambient air quality were historically stipulated in an ordinance from 1998 on environmental quality standards, which specified limit values *inter alia* for SO_x emissions.[1134] These limit values specified *environmental quality standards* for Sweden and are plotted as an example of an environmental quality standard on the national scale for terrestrial emissions.

Finally, with respect to mobile emission sources, and sulphur in vehicle fuels, an act on motor vehicles exhaust emission control and motor fuels from 2001 contained sulphur limits for petrol and diesel. These were formulated as *product standards* with requirements for sulphur content in fuels as products and are therefore plotted as an example of yet another historical product standard on the national scale applying to terrestrial emissions sources.[1135]

1132 *Supra* Chapter 3 Section 3.1.6.
1133 *Supra* Chapter 3 Section 3.1.6.
1134 *Supra* Chapter 3 Section 3.1.6.
1135 *Supra* Chapter 3 Section 3.1.6.

The historical Swedish standards in the regulation of SO_x emissions from marine sources were first included in the Swedish Maritime Administration's instructions on measures for the prevention of pollution from ships. The instructions included specifications for the fuels used both outside and inside SECAs. Moreover, the instructions' 'in-SECA requirements' mirrored the original MARPOL 73/78 Annex VI 1997 in the sense that the requirements could also be fulfilled by use of an exhaust gas cleaning system with a specified maximum total emission limit for SO_x emissions, or by application of another technological method for emission reduction that could achieve an equivalent result of the exhaust gas cleaning system.[1136] Like in the case of the standards plotted above for MARPOL 73/78 Annex VI 1997, these national standards are thus plotted as two *product standards* (outside/inside SECAs), of which the latter one is marked as an alternative/equivalent standard. Furthermore, an alternative/equivalent *emission standard* and an alternative/equivalent *other standard* is plotted. All of these mentioned standards are plotted above as Swedish historical standards for marine emission sources.

As regards marine gas oils, the instructions on measures for the prevention of pollution from ships also referred to a general Swedish ordinance on sulphurous fuel applying both to marine and terrestrial use of fuels.[1137] This ordinance later also implemented the EU specific requirements as required by Dir. 2005/33/EC, mentioned above. The standards expressed in this general ordinance on sulphurous fuel targeted marine gas oils by formulating requirements for maximum sulphur content. As before, such standards are examples of *product standards*, which is thus plotted above as representing such a standard in yet another legal act from the historical national setting, applying to marine emission sources.

[1136] *Supra* Chapter 4 Section 4.1.4.
[1137] *Supra* Chapter 4 Section 4.1.4.

7.4.1.4 Conclusions on the Historical Differences in Standard-Setting

Section 7.4.1 has attempted to answer whether there are any differences in standard-setting in the historical regulation of SO_x emissions from terrestrial and marine sources, with a point of departure from what was been presented in the graphical matrix in section 7.3.

A general observation from drawing distinctions between the terrestrial and marine setting in this section is that there are differences in standard-setting on all three regulatory scales. More specifically, the main historical differences are concluded to be the following:

On all regulatory scales, one main difference is the variety of standards expressed in the regulation of SO_x emissions from terrestrial and marine sources. While the regulation of SO_x emissions from terrestrial sources has employed several approaches of standard setting encompassing *product*, *process, emission* and *environmental quality standards*, the regulation of SO_x emissions from marine sources has mainly relied on a single approach: *product standards*, although contingent on varying factors on the different scales.[1138] At other instances in the regulation of marine sources, the standards expressed have been alternative/equivalent standards, detailing possible alternative ways of fulfilling what has historically been, and arguably still is, perceived as the main standard for SO_x emissions control in the marine setting, namely the *product standard*.[1139]

Another main difference is that the standards expressed in the regulation of SO_x emissions from terrestrial sources have multiple targets like combustion plants, liquid fuels, and air quality applicable both to stationary and mobile emission sources, while the standards in the regulation of SO_x emissions from marine sources mainly focus on

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[1138] That is, the product standards themselves vary on the international scale and the regional regulatory scales, since there are some differences in requirements in the original MARPOL 73/78 Annex VI 1997, and those that have historically applied according to EU law.
[1139] The reasons for this view is discussed further *infra* Section 7.5.1.2.

targeting liquid fuels used in mobile emission sources (ships). This however brings attention to the conclusion that not only differences, but also *similarities* in standard-setting can be found on all scales in the regulation of SO_x emissions from terrestrial and marine sources. These similarities relate exactly to the use of *product standards* to control the sulphur content in liquid fuels, both in the terrestrial and the marine setting.

As a final point, it can be concluded that the primary standards both in the regulation of SO_x emissions from terrestrial sources and from marine sources have been accompanied by standards with other orders of priority in application. Here, a difference has been that *subsidiary process standards* were historically allowed as options to some emission standards in the terrestrial setting. In the marine setting however, standards with another order of priority in application were instead formulated as alternative/equivalent standards, either as for example an *alternative/equivalent emission standard*, or as an *alternative/equivalent other standard*. The latter standards potentially opened up for a kind of rather flexible 'self regulation' that could formulate requirements including a wider range of standards. As long as the requirements for an alternative/equivalent standard had been approved, these could in principle take form as either an alternative/equivalent product, process or emission standard.[1140] Such alternative/equivalent standards for SO_x emissions from marine sources were rather open-ended and flexible in comparison to the subsidiary process standards for terrestrial emission sources, which were confined to rather limited circumstances in application.

[1140] As discussed *supra* Section 7.2, as the standards were historically, and still are, formulated *e.g.* in the original MARPOL 73/78 Annex VI 1997 and onwards, it is difficult to imagine an alternative/equivalent standard being a non-source specific *quality standard* formulated by reference to the target being protected, *e.g.* air. Instead, the provisions' formulations are arguably limited to source specific standards that may well be expressed either as a product, process or emission standard.

7.4.2 Current Differences in Standard-Setting in the Regulation of SO_x Emissions from Terrestrial and Marine Sources

7.4.2.1 International Regulation of SO_x Emissions from Terrestrial and Marine Sources

At the international scale, the current applicable standards in the regulation of SO_x emissions from terrestrial sources are found in the 1999 Gothenburg Protocol.[1141] In this protocol, SO_x emissions are targeted together with several other emissions at the same time according to a multi-effect and multi-pollutant approach. Binding national emission ceilings for 2010 with 1990 as base year were originally set *inter alia* for SO_x emissions. Each party was to reduce and maintain annual emission reductions following the emission ceilings and dates specified for each State in Annex II of the protocol. The ceilings were revised in 2012, but the revisions have not yet entered into force.

The concept of critical load introduced in 1994 with the Second Sulphur Protocol remained important when the concrete emission reduction commitments were formulated for the Gothenburg Protocol. In the latter protocol, emission reduction commitments in the form of emission ceilings are expressed as a kind of *environmental quality standard*, among other things for SO_x emissions, regardless of source.[1142] Thus, a current environmental quality standard can be plotted in the matrix for regulation on the international scale applying to SO_x emission from terrestrial sources.

The Gothenburg Protocol also includes obligations specifying limit values for SO_x emissions from stationary sources expressed as *emission standards*. These are plotted as a current emission standard

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[1141] As noted *supra* Chapter 5 Section 5.1.2, a revised version of the 1999 Gothenburg Protocol was adopted in 2012. However, since this has not entered into force it is not yet currently applicable. This section therefore comments on the original 1999 Gothenburg Protocol. See however the forward-looking comments regarding the adopted Revised Gothenburg Protocol 2012 and other instruments *infra* Section 7.4.2.4.

[1142] *Supra* Chapter 5 Section 5.1.2.

on the international scale for terrestrial emission sources. In some cases, subsidiary *process standards* are defined in the form of sulphur removal efficiency requirements as alternatives to the emission standards. In yet other cases, *process standards* are defined in the form of sulphur recovery requirements. These are plotted as two current standards on the international scale for terrestrial emission sources. However, one is plotted as a primary standard, and one as a subsidiary standard. Finally, *product standards* for fuels (gas oils) used in stationary sources are specified as limit values.[1143] Likewise, *product standards* for fuels (petrols and diesels) used in mobile sources are also included.[1144] These standards are plotted as an example of a current product standard on the international scale for terrestrial sources.

Considering the current applicable standards in the regulation of SO_x emissions from marine sources, these are found in the Revised MARPOL 73/78 Annex VI 2008. As was explained earlier in Chapter 6, the revised Annex VI sets limits for the sulphur content in fuel oil.[1145] The current applicable global limit of an allowed maximum of 3,5% sulphur content in fuel and the SECA/ECA[1146] limit of a maximum of 0,1% sulphur content, are basically *product standards* with different geographical scope, targeting the sulphur content in fuel oil as a product. These two primary standards are therefore plotted as representing a current product standard on the international scale for marine emission sources.[1147] With regard to the current global and SECA/ECA requirements, there are still alternative possibilities to fulfil these (and other requirements of the Revised MARPOL 73/78

[1143] *Supra* Chapter 5 Section 5.1.2.
[1144] *Supra* Chapter 5 Section 5.1.2.
[1145] *Supra* Chapter 6 Section 6.1.2.
[1146] As a matter of definition, sulphur emission control areas (earlier SECAs) are now sorted under the broader concept of emission control areas, ECAs, which can include limits both for oxides of sulphur, nitrogen and particulate matter.
[1147] Since both standards are primary standards and are located in the same regulation, Reg. 14 of the Revised MARPOL 73/78 Annex VI 2008, they are plotted as one example of a product standard.

Annex VI 2008) under the so-called 'equivalents rule'.[1148] Therefore, as long as an equivalent has been approved according to this rule, the sulphur content requirements could potentially be fulfilled with standards that are not product standards. Thus, this open standard is marked as an example of a current *other standard* on the international scale for marine emission sources.

7.4.2.2 Regional Regulation of SO_x Emissions from Terrestrial and Marine Sources

At the regional scale, the current applicable standards in the regulation of SO_x emissions from terrestrial sources are still found in several different acts that include various types of standards applicable to different emission sources. Thus, *product standards*, like before, are defined in the form of sulphur content limits for liquid fuels, both for fuels used in stationary installations and for fuels used in mobile emission sources like cars.[1149] These standards are plotted as two current product standards, since they appear in different acts, on the regional scale for terrestrial emission sources.

For stationary emission sources, the industrial emissions directive, the IED, currently defines *emission standards* for SO_x emissions in the form of emission limit values, *inter alia* for waste incineration. Additionally, emission standards in the form of emission limit values are defined for new and existing large combustion plants with a certain rated thermal input.[1150] These standards are plotted as an example of a current emission standard on the regional scale for terrestrial emission sources. Furthermore, for large combustion plants, *subsidiary process standards* are in some cases defined in the form of minimum rates of desulphurisation as alternatives to emission limit

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[1148] *Supra* Chapter 6 Section 6.1.2. It can be noted here, that since the revision of Annex VI, the SECA specific rules for alternatives/equivalent possibilities of fulfilling the requirements of Reg. 14 have been removed. Instead, the general equivalents regulation in Reg. 4 of the Revised MARPOL 73/78 Annex VI 2008 still opens up for possible alternative/equivalent ways of following the annex.
[1149] *Supra* Chapter 5 Sections 5.2.3 and 5.2.6.
[1150] *Supra* Chapter 5 Section 5.2.3.

values.[1151] Thus, a current subsidiary process standard is plotted on the regional scale for terrestrial emission sources. Recently, a directive targeting medium combustion plants was adopted. It contains emission limit values setting *emission standards* for SO_x emissions, applying both to existing and new medium combustion plants.[1152] Hence, yet another example of a current emission standard is plotted on the regional scale for terrestrial emission sources.

As regards air quality, a revised directive was adopted in 2008 for ambient air quality. This directive specifies air quality standards in the form of limit values for SO_x emissions in ambient air.[1153] A current *environmental quality standard* is thus plotted at the regional scale for terrestrial emission sources.

Since 2001, the European directive on national emission ceilings, the NEC Directive, has specified emission ceilings, among other substances for sulphur. These have basically been formulated as *environmental quality standards* founded on familiar concepts from the LRTAP Convention such as critical loads of sulphur.[1154] The standards in the NEC Directive that are still currently applicable, is plotted as an example of current regional environmental quality standards for terrestrial SO_x emission sources.

When it comes to the regional scale, the regulation of SO_x emission from marine sources is currently found in Directive (EU) 2016/802 relating to the reduction in the sulphur content of certain liquid fuels.[1155] The latest amendments have largely aligned the EU sulphur directive with the Revised MARPOL 73/78 Annex VI 2008, although some EU specific requirements remain.[1156] Principally, the revised directive sets maximum sulphur content limits *for all marine fuels* in liquid form.[1157] Like previously, the requirements come in the form of

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[1151] *Supra* Chapter 5 Section 5.2.3.
[1152] *Supra* Chapter 5 Section 5.2.3.
[1153] *Supra* Chapter 5 Section 5.2.4.
[1154] *Supra* Chapter 5 Section 5.2.5.
[1155] *Supra* Chapter 6 Section 6.2.4.
[1156] *Supra* Chapter 6 Section 6.2.4..
[1157] As mentioned *supra* in Chapter 6 Section 6.1.2, the Revised MARPOL 73/78 Annex VI 2008 includes a definition of 'fuel oil' as 'any fuel delivered to and

particular fuel specifications for SECAs/ECAs, but now also extend to cover areas outside the emission control areas, basically mirroring the global sulphur requirements of the Revised MARPOL 73/78 Annex VI 2008. The EU specific fuel requirements for passenger ships and for ships at berth have been kept in the revised directive as well as the specifications for gas and diesel oils placed on the EU market.[1158]

Although the current requirements have changed in terms of stringency compared to the historical standards, the approach of the revised directive is again to define *product standards* targeting the sulphur content in liquid fuels as products.[1159] Thus a current product standard at the regional scale is plotted for marine emission sources. Additionally, flexibilities have been kept in the form of allowed alternatives to the abovementioned limits for marine fuel oils by means of an approved emission abatement technology achieving emission reductions with an equivalent result of the specified fuel sulphur limits.[1160] Since the formulation is sufficiently open to accommodate several standards realizing the alternative emission reduction method, a current *other standard* marked as alternative/equivalent is plotted at the regional scale for marine emission sources.

7.4.2.3 National Regulation of SO_x Emissions from Terrestrial and Marine Sources – A Swedish Perspective

At the national scale, the current applicable standards in the regulation of SO_x emissions from terrestrial sources in Sweden are found in several different acts targeting a variety of emission sources with a variety of approaches. In current updated acts, *product standards*, like previously, are defined in the form of sulphur content limits for liquid

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intended for combustion purposes for propulsion or operation on board a ship, including distillate and residual fuels', Reg. 9.2 of the Revised MARPOL 73/78 Annex VI 2008. However, the revised Annex VI does not make any further distinctions between marine gas oils (MGOs) and marine diesel oils (MDOs) that can be found in European sulphur directive.

[1158] *Supra* Chapter 6 Section 6.2.4.

[1159] *Supra* Chapter 6 Section 6.2.4.

[1160] *Supra* Chapter 6 Section 6.2.4.

fuels both for fuels used in stationary installations, in the ordinance regarding sulphur content in fuels, and for fuels used in mobile emission sources in an act setting requirements for automotive fuel quality.[1161] These are thus plotted as two current product standards on the national scale for terrestrial emission sources.

For stationary emission sources, SO_x emission limits are defined as *emission standards* for industrial activities mainly in a Swedish ordinance aiming to implement the IED,[1162] but also in two ordinances regarding emissions from large combustion plants and waste incineration.[1163] These standards are all plotted as three examples of current emission standards on the national scale for terrestrial emission sources.

The currently applicable standards for ambient air quality are found in an updated ordinance on air quality aiming to implement the EU directive on ambient air quality. This ordinance contains *environmental quality standards* for Sweden in the form of air quality requirements for the protection of human health and vegetation from SO_x emissions.[1164] Thus, a current environmental quality standard is plotted on the national scale for terrestrial emissions.

Finally, regarding current regulation on national emission ceilings, *inter alia* for SO_x emissions, a Swedish ordinance from 2003 on national emission ceilings for air pollutants exists, but it does not itself contain any concrete standards. Instead, the ordinance refers back to the EU directive on national emission ceilings.[1165] Hence, yet another current *environmental quality standard* is plotted on the national scale for terrestrial emission sources.

With respect to the current applicable standards in the regulation of SO_x emissions from marine sources, these are mainly found in an

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[1161] *Supra* Chapter 5 Sections 5.3.1 and 5.3.4.
[1162] As mentioned *supra* Chapter 5 Section 5.3.1, the Swedish ordinance on industrial emissions links to EU decisions on BAT conclusions that also refer to sulphur emission limits under normal operating conditions for certain techniques.
[1163] *Supra* Chapter 5 Section 5.3.1.
[1164] *Supra* Chapter 5 Section 5.3.2.
[1165] *Supra* Chapter 5 Section 5.3.3.

updated ordinance regarding the sulphur content in fuels.[1166] This ordinance contains requirements for all types of marine fuels defining maximum sulphur content limits, and reflects both the Revised MARPOL 73/78 Annex VI 2008, and the most recently updated European directive on sulphur in liquid fuels, including the EU specific at berth and passenger ship requirements. The limits are formulated as *product standards* targeting the sulphur content in liquid fuels as products. Therefore, a current product standard is plotted on the national scale for marine emission sources.

Additionally, in the Swedish Transport Agency's instructions on measures for the prevention of pollution from ships, the possibility of fulfilling the sulphur limit requirements with 'equivalents' is found.[1167] Thus, if an equivalent has been approved according to this rule, the sulphur content requirements could potentially be fulfilled with standards that are not product standards. Once again, this standard is plotted as a current *other standard*, marked as alternative/equivalent, at the national scale for marine emission sources.

7.4.2.4 Some Brief Comments on Future Expected Standards in the Regulation of SO_x Emissions from Terrestrial and Marine Sources

As previously mentioned, at the time of writing, there are some legal instruments regarding SO_x emissions that have been adopted, but are yet to enter into force. The current section offers some brief comments regarding such instruments on all three regulatory scales.

For SO_x emissions from terrestrial sources on the international scale, the Revised Gothenburg Protocol 2012, not yet in force, continues to build on the structure originally laid down in the Gothenburg Protocol as adopted in 1999.[1168] Thus, the revised protocol still builds on a multi-effect and multi-pollutant approach to prevent and minimize the exceedances of critical loads and levels of the regulated compounds.

[1166] *Supra* Chapter 6 Section 6.3.1.
[1167] *Supra* Chapter 6 Section 6.3.1.
[1168] *Supra* Chapter 5 Section 5.1.2.

The substantive standards of the Revised Gothenburg Protocol 2012 are mainly expressed as national emission reduction commitments defined in an annex.[1169] In its revised state however, the protocol instead of emission ceilings now contains emission reduction commitments for SO_x emissions expressed as *percentage reductions* for each State to be achieved in 2020 and beyond, with the contracting parties' 2005 emissions levels as baselines.

Nevertheless, these commitments are essentially still expressed as *environmental quality standards*, since they have been formulated on the basis of critical loads of sulphur for the geographical areas covered by the convention.[1170] As regards stationary sources and SO_x emissions, *emission standards* are still formulated as emission limit values specified for combustion plants. Additionally, *process standards* are still included in the form of demands for sulphur recovery rates and in some cases as subsidiary minimum rates of desulphurization requirements. Finally, sulphur fuel limits for gas oil used in stationary sources, and sulphur limits for mobile sources are set via environmental specifications for engine type and the fuels used in these engines, petrol and diesel. All of these sulphur limits for liquid fuels are still *product standards* targeting the sulphur content in fuels as products.

For SO_x emissions from terrestrial sources on the regional scale, the recently adopted directive that will repeal the NEC Directive with effect from 1 July 2018, is the directive on the reduction of national emissions of certain atmospheric pollutants (RNE Directive).[1171] The RNE Directive, which aligns the European emission reductions with the latest revisions of the Gothenburg Protocol 2012 under the LRTAP Convention for several pollutants, establishes *emission reduction commitments* for the Member States' anthropogenic atmospheric emissions, *inter alia* for SO_x emissions. Again, these are still expressed as a kind of *environmental quality standards*.

[1169] *Supra* Chapter 5 Section 5.1.2.
[1170] *Supra* Chapter 5 Section 5.1.2.
[1171] *Supra* Chapter 5 Section 5.2.5.

Finally, for SO_x emissions from marine sources on the international scale, a special case is the recently adopted global sulphur limit in the Revised MARPOL 73/78 Annex VI 2008. The instrument as such has been in force for some years, but the effective date of the global fuel oil standard in Regulation 14.1.3 of MARPOL 73/78 Annex VI 2008 has been undecided until recently, as a result of a planned fuel oil feasibility review. It has now been decided that the global fuel oil standard shall become effective on 1 January 2020. Thus, this is a requirement that is still formulated as a *product standard* applying to fuel oil as a product.[1172]

7.4.2.5 Conclusions on the Differences in Current Standard-Setting

Section 7.4.2 has attempted to answer whether there are any differences in standard-setting in the current regulation of SO_x emissions from terrestrial and marine sources, with a point of departure from what was presented in the graphical matrix in section 7.3.

Again, a general observation from drawing distinctions between the terrestrial and marine setting in this section is that there are differences in standard-setting on all three regulatory scales. In particular, the main current differences are the following:

Once more, a main difference between standard-setting in the regulation of SO_x emissions from terrestrial and marine sources is the variety of employed standards. While the regulation of SO_x emissions from terrestrial sources has continued to combine several regulatory approaches including *product*, *process*, *emission* and *environmental quality standards*, the regulation of SO_x emissions from marine sources still mainly relies on a single approach: *product standards*. Like before, the product standards have been contingent on varying additional factors on the different regulatory scales. Compared to historical standard-setting in the regulation of SO_x emissions from marine sources, this main difference is arguably even more articulated in current applicable regulation. The other instances in the regulation

[1172] *Supra* Chapter 6 Section 6.1.2.

of marine emission sources, where alternative/equivalent standards were earlier expressed, are now generally reduced to be found only in formulations that are expressed as general equivalents provisions expressing *other standards*. These provisions detailing possible alternative/equivalent ways of fulfilling regulatory requirements, are arguably still perceived as alternative ways of fulfilling the *main standard* for SO_x emissions control in the marine setting, namely the *product standard*.[1173]

Another main difference is still that the standards expressed in the current regulation of SO_x emissions from terrestrial sources have multiple targets applicable both to stationary and mobile emission sources, while the standards in the regulation of SO_x emissions from marine sources mainly focus on targeting liquid fuels used in mobile emission sources (ships). At the same time, it can be concluded that the same similarities in standard-setting in the terrestrial and the marine setting can still be found on all regulatory scales in current regulation. These similarities, like in the historical setting, relate to the use of *product standards* to control the sulphur content in liquid fuels in various ways, both in the terrestrial and the marine setting.

Moreover, like in the case of standard-setting in the historical regulation of SO_x emissions from terrestrial and marine sources, it can once again be concluded that the primary standards both in the regulation of SO_x emissions from terrestrial sources, and from marine sources, are still accompanied by standards with other orders of priority in application. Here, a difference is still that subsidiary *process standards* are allowed as alternatives to some emission standards in the terrestrial setting. In the marine setting however, standards with another order of priority in application are instead still formulated as alternative/equivalent standards.

Nevertheless, currently, these alternative/equivalent possibilities for fulfilling SO_x emission requirements are formulated in a slightly changed form. As an example, the Revised MARPOL 73/78 Annex VI 2008 still allows for alternatives/equivalents, but according to a general rule. This rule is mirrored on the regional and the national

[1173] See further *infra* Section 7.5.1.2.

regulatory scales in the marine setting. Albeit, slightly differently formulated, the instances where the alternative/equivalent standards appear still potentially open up for a kind of rather flexible 'self regulation' that could formulate requirements including a wider range of standards. As long as the requirements for an alternative/equivalent standard have been approved, these could in principle take form as either an alternative/equivalent product, process or emission standard. Such alternative/equivalent standards for SO_x emissions from marine sources are still rather open-ended and flexible in comparison to the current subsidiary terrestrial standards which are confined to rather limited circumstances in application.

Finally, as regards future expected standards in the regulation of SO_x emissions from terrestrial and marine sources, the coming requirements on all regulatory scales have been changed, but only regarding aspects such as terminology and the stringency of standards in regulation. Coming regulatory requirements have thus not changed regarding form or type of standard expressed in the regulation of SO_x emissions from terrestrial and marine sources.

7.5 The Main Reasons for the Key Differences Found in Historical and Current Standard-Setting

Having identified and examined historical and current differences in standard-setting in the regulation of SO_x emissions from terrestrial and marine sources, this section further analyses these differences by drawing on the examination of regulation set out in Chapters 3-6. In particular, the reasons for the key differences are sought for in the surrounding context of regulation also elaborated in these chapters. As previously stated,[1174] it is acknowledged that explaining all possible reasons for the results in the previous sections is not feasible. Therefore, the following sections focus on examining some select aspects that are believed to be both plausible and decisive explanations for the results above. These aspects have been chosen

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[1174] *Supra* Chapter 1 Section 1.3.

with regard to what was presented in Chapters 3-6. Accordingly, this section examines whether the arguably central aspect of the relation between standard type and emission source can explain the differences (and similarities) that were presented in the results of the two previous sections? By further scrutinizing this relationship, it is believed that some of the core aspects in the choice of standard in regulation are considered. Thus, the question whether an emission source that needs to be controlled is either stationary or mobile arguably has considerable implications for the possible choice of suitable regulatory standards.

For practical reasons, the overall explorative question is further broken down into parts, with questions posed in relation to the analytical results as presented in the previous Sections 7.4.1.4 and 7.4.2.5. Hence, the order of the following sections is that the explanations for the results are examined according to the order in which the main differences were presented above. First, the relation between standard type and the kind of emission source is considered as regards the results from the analysis of standard-setting in the historical regulation of SO_x emissions from terrestrial and marine sources. Then, the relation between standard type and the kind of emission source is considered with respect to the results from the analysis of standard-setting in current regulation. Finally, the subsections are rounded off with some conclusions.

7.5.1 The Relationship Between Standard Type and the Kind of Emission Source – Historical Regulation

7.5.1.1 Diversity of Standard Types

In Section 7.4.1.4 above, the main historical differences were explained. Here, it was firstly concluded that on all regulatory scales, one main difference between the terrestrial and marine setting was the variety of standards expressed in the regulation of SO_x emissions from terrestrial sources as compared to the marine sources. More specifically, the regulation of SO_x emissions from terrestrial sources historically contained several approaches of standard-setting encompassing *product*, *process, emission* and *environmental quality standards*. The current section examines whether the diversity of standard types in the historical regulation of SO_x emissions from terrestrial sources can be explained by considering the relation between standard type and kind of emission source?

Initially, it is reasonable to begin by considering what kind of emission source that is being regulated? In the case of the historical regulation of SO_x emissions from terrestrial sources, the emission source is not only of one kind. Instead, SO_x emissions from terrestrial sources were historically, and still are, of diverse kinds on all regulatory levels, and were represented both by mobile emissions sources such as cars, as well as stationary emissions sources like combustion plants.[1175]

Based on what was presented in previous chapters and sections, it may initially appear to be the case that the diversity of standards in the regulation of SO_x emissions from terrestrial sources are a consequence of the variety of terrestrial SO_x emission sources. This, since different standards have historically been used in the terrestrial setting, where both *mobile* and *stationary emission sources* have been controlled. Here, *product standards* have typically been associated with the control of terrestrial mobile SO_x emission sources, while combinations of *product, process, emission* and *environmental quality standards* have been associated with the control of stationary SO_x emission sources.[1176] Although certain types of regulatory standards have historically indeed been associated specifically either with terrestrial mobile or stationary SO_x emission sources, there are some important additional factors that can further explain the historical diversity of standards in the regulation of SO_x emissions from terrestrial sources, apart from the relation between these standards and the variety of terrestrial SO_x emission sources.

For instance, when considering the historical reliance on emission standards for the control of many terrestrial stationary SO_x emission sources in a broader context, this choice of standard can only partly be explained by the fact that the emission sources are in fact *stationary sources*. Even though it is true that terrestrial stationary emission

[1175] *Supra* Chapter 3.
[1176] *Supra* Sections 7.4.1.1-7.4.1.3.

sources have historically been controlled with *emission standards*, the use of such standards have also to a large extent been decided by other factors such as the *type of emission* to be controlled, and *suitable emission abatement technology*.[1177] Moreover, in the varied context of terrestrial standard-setting and emission sources, the use of other standards like *product*, *process* and *environmental quality standards* for terrestrial stationary emission sources further nuances the picture.[1178] Considering environmental quality standards specifically, these have largely been used to control terrestrial SO_x emissions, *irrespective of* whether these emissions have originated from *mobile* or *stationary emission sources*.[1179] Thus, the connections between the regulatory standards used in the terrestrial setting and the kinds of emission sources present are not necessarily decisive for the choice of a specific regulatory standard.

However, when considering the influence of other factors than the relation between standard type and kind of emission source, some further plausible explanations for the standard-setting in the historical regulation of SO_x emissions from terrestrial sources can be located. As shortly hinted already, the factor of emission type is relevant to consider. More specifically, in the historical setting of regulating SO_x emissions from terrestrial sources, *SO_x emissions* have been handled with a combination of product, process, emission, and environmental quality standards. Furthermore, some of these standards for SO_x emission control have been particularly associated with certain *emission abatement technologies*.

For example, given what was brought forth in previous chapters and the present chapter, *emission standards* took a central position in early regulation targeting large terrestrial stationary SO_x emission sources, like power plants. In these cases, it was historically considered particularly suitable to apply end-of-pipe solutions like flue gas desulphurization because of its then new possibilities to effectively reduce SO_x emissions from large point source emitters.[1180] Moreover,

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[1177] These factors are discussed further immediately below.
[1178] *Supra* Section 7.4.1.
[1179] *Supra* Section 7.4.1.
[1180] *Supra* Chapter 3 Sections 3.1.3 and 3.1.4.

because of practical reasons, these kind of end-of-pipe solutions were more suitable for stationary emission sources than for mobile emissions sources, where factors such as size and weight of the abatement equipment would limit the use of similar solutions for mobile emission sources. Hence, in practice, these technical solutions were predominantly used to meet posed SO_x emission requirements in the form of emission standards, and in extension to comply with environmental quality standards.

Finally, the state of knowledge about the effects of SO_x emissions for the terrestrial environment has differed historically compared to the marine environment. As may be recalled, the scientific knowledge about observable effects of SO_x emissions in the terrestrial environment paved the way for international cooperation against acidification in the Northern hemisphere, including Europe. This in turn led to a build up of technical and analytical expertise and knowledge within the LRTAP regime to start combatting the effects of SO_x emissions more effectively with the help of integrated assessment modelling (IAM), a modelling technique that typically helped formulate standards in the form of *environmental quality standards* targeting terrestrial emission sources.[1181]

In conclusion, the diversity of standards in the regulation of SO_x emissions from terrestrial sources can only partly be explained by considering it as a consequence of the relations between the diverse standards and varied kinds emission sources in the terrestrial setting. Although some connections between for example terrestrial stationary emission sources and the choice of emission standards in the regulation of SO_x emissions can be found, there were still several other strong decisive factors for how the historical standard-setting in the regulation of SO_x emissions from terrestrial sources was shaped, including the influence of emission type, certain emission abatement technologies, and the state of scientific knowledge regarding the effects of SO_x emissions for the terrestrial environment.

[1181] *Supra* Chapter 3 Section 3.1.2.

7.5.1.2 The Role of Product Standards

In Section 7.4.1.4 above, it was concluded that the regulation of SO_x emissions from terrestrial sources historically relied on several approaches of standard setting encompassing *product*, *process, emission* and *environmental quality standards*. In contrast, it was however also concluded that the regulation of SO_x emissions from marine sources mainly relied on a single approach: *product standards.* The current section examines whether the role of product standards in the regulation of SO_x emissions from marine sources can be explained by considering the relation between standard type and emission source?

Once again, an important initial question to consider is which type of emission source that is being regulated? In the marine setting examined in this thesis, the emission source in question is only of one kind on all regulatory levels, namely the mobile emission source represented by ships. By contrast, the terrestrial SO_x emission sources examined are diverse on all regulatory levels, and are represented both by mobile emissions sources such as cars, as well as stationary emissions sources such as combustion plants.

These conditions raise the question whether the more or less predominant role of product standards in the regulation of SO_x emissions from marine sources is a consequence of relations between this type of standard and the exclusivity of mobile emission sources in the marine setting?

Based on what was presented in previous chapters and sections, the question may at an initial point of view be answered with a yes. This, since it is true that SO_x emissions from marine mobile sources have historically mainly been regulated with fuel quality demands, or *product standards* for fuel oils.[1182] However, the question is whether this is an exclusive truth for marine mobile emission sources? Looking also at terrestrial mobile emission sources makes the initial yes appear weaker. Even though it is true that marine mobile emission sources have historically been regulated with product standards for

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[1182] *Supra* Section 7.4.1.4.

fuels, so have terrestrial mobile emission sources.[1183] Can it then be concluded that product standards have specifically been associated with mobile emission sources, be they marine or terrestrial?

It is a fact that marine and terrestrial *SO_x emissions from mobile sources* have mainly been controlled with regulation relying on product standards. All the same, there are several historical examples of terrestrial *stationary SO_x emission sources* that have been controlled with *product standards* as well.[1184] Furthermore, considering the additional factor of emission type again, in this case SO_x emissions, and comparing this with another adjacent air emission type, NO_x emissions, a further nuance emerges. The latter type of emission has typically been controlled with *emission standards*, both in the regulation of marine and terrestrial mobile emission sources.[1185] Therefore, historically, product standards as such are not necessarily associated with the regulation of marine or terrestrial emission sources just because they are mobile. Stationary emission sources have also been controlled with the same type of standards. Moreover, the type of emission once again seems to have been a decisive factor for the choice of product standards in the regulation of SO_x emissions.

Additionally, as was noted above,[1186] other factors in the marine context were also crucial for the historical choice of regulating SO_x emissions from marine sources with fuel product standards in the form of sulphur requirements. For example, factors such as the cost of and available type of emission cleaning technology at the time,[1187] fears of

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[1183] *Supra* Section 7.4.1.4.

[1184] This can be seen on all regulatory scales, where the use of fuel oils, including gas oils, have historically been controlled with product standards when used in various stationary installations, *supra* Section 7.4.1.4.

[1185] *Supra* Chapters 5 Section 5.2.6 and Chapter 6 Section 6.1.2. *Cf.* Reg. 13(3)-(5) of Revised MARPOL Annex VI 2008, expressing typical *emission standards* that specify levels for pollutants, in this case NO_x, that are not to be exceeded during the operation of marine diesel engines.

[1186] *Supra* Chapter 4 Section 4.1.1.2.

[1187] As discussed *supra* Chapter 4 Section 4.1.1.2, the reduction of the sulphur content in fuels rather than using on-board abatement technology was historically considered to be a more feasible alternative, among other things because the latter alternative at the time was considered to be too complex and too costly in small-scale applications.

potential problem shifting,[1188] the cost-effectiveness of regulation, and the state of knowledge about SO_x emissions and the marine environment at the time,[1189] were also decisive for the choice of regulatory standard. Furthermore, it is reasonable to believe that the context in which the regulatory standards for fuels were formulated contributed to the main choice of product standards for SO_x emission from marine sources. Air pollution from ships had been brought up in the context of fuel oil quality in MARPOL 73/78 Annex I discussions at IMO from the beginning, that is, in discussions where the properties of fuel of oils were considered. Additionally, standards of marine fuels were noted early on as an important area of cooperation for the environment also in other fora, such as HELCOM.[1190]

In conclusion, the more or less predominant role of product standards in the regulation of SO_x emissions from marine sources can only partly be explained by considering it as a consequence of the relation between this kind of standard and the exclusivity of mobile emission sources in the marine setting. As has been explained above, there were also several other important decisive factors for the choice of product standards in the regulation of SO_x emissions from marine sources. Again, emission type was important for the choice of product standards in regulation. Furthermore, other influential factors were the cost of and available type of emission cleaning technology, fears of potential problem shifting, the state of scientific understanding of the effects of SO_x emissions in the marine environment at the time, and the institutional context in which the standards were formulated.

[1188] In this case, shifting from the problem of air pollution to a waste disposal problem as a consequence of producing hazardous waste via air pollution scrubbers.

[1189] That is, the discussions initiated at IMO in the end of the 1980s were clearly driven by raised awareness about the effects of acidification *on land*. Additionally, before the adoption of the original MARPOL 73/78 Annex VI 1997, IMO's focus had been on more visible sources of pollution like for instance oil, as opposed to the diffuse kind of pollution represented by SO_x emissions to the air from marine sources, see *supra* Chapter 4, Section 4.1.1.2.

[1190] *Supra* Chapter 4, Section 4.1.1.2.

7.5.1.3 Differences Between what Standards have Targeted

Yet another conclusion presented in Section 7.4.1.4 above, was that the standards expressed in the historical regulation of SO_x emissions from terrestrial and marine sources differed regarding what they targeted. Terrestrial standards had multiple targets, like combustion plants, liquid fuels, and air quality, while the standards in the regulation of SO_x emissions from marine sources mainly focused on targeting liquid fuels. The current section examines whether the differences between what standards have targeted in the regulation of SO_x emissions from terrestrial and marine sources can be explained by considering the relation between standard type and kind of emission source?

Firstly, recalling what was stated above regarding standard-setting in the regulation of SO_x emissions from terrestrial sources, there has historically been several standards in the terrestrial setting, applied both to mobile and stationary emission sources. As was stated before, typically *product standards* were employed in the control of terrestrial mobile SO_x emission sources, while combinations of *emission, product, process* and *environmental quality standards* were employed to control stationary SO_x emission sources. In more concrete terms, the different standards targeted liquid fuels (product standards), emissions from certain industrial activities like large combustion plants (emission standards), combustion processes for certain industrial activities (subsidiary process standards), and the concentration of sulphur in air (environmental quality standards).[1191]

As likewise stated above, although certain types of regulatory standards have historically indeed been associated specifically either with terrestrial mobile or stationary SO_x emission sources, there are other factors that also plausibly explain the historical diversity of standards in the regulation of SO_x emissions from terrestrial sources, apart from possible connections between standards and the variety of terrestrial SO_x emission sources. Relating to the examples of targets from the terrestrial setting, the historical reliance on product standards for fuels used in both terrestrial mobile and stationary emission

[1191] *Supra* Section 7.4.1.4.

sources can once again most probably be explained as an effect of *the type of emission*, and the rather straightforward and practical way of controlling *SO_x emissions* specifically by formulating fuel quality requirements. That is, by reason of the direct link between the sulphur content in fuel and the resulting air emissions when it is combusted, lowering the sulphur content with product standards will immediately lower the amount of SO_x emissions.[1192]

Additionally, in the terrestrial setting as compared to the marine setting, the use of emission standards has to a large extent also been decided by the *type of emission in combination with* suitable abatement technology for terrestrial SO_x emissions. As stated above, this technology was especially suitable for terrestrial stationary sources not only because it was available, but also because of size and weight reasons, which were and still are significant limiting factors in the marine setting.[1193] As regards the reasons for some (subsidiary) process standards formulated in regulation to control SO_x emissions from terrestrial sources, some rather narrow circumstances were decisive for including for instance rates of desulphurization. Such standards were specified in cases where the combustion of certain indigenous fuels could not fulfil the default emission standard requirements.

Finally, considering environmental quality standards, these were primarily a result of the state of scientific knowledge about SO_x emissions in the terrestrial environment, and the international cooperation against acidification in the Northern hemisphere, including Europe. The specific historical choice and development of environmental quality standards to control SO_x emissions from terrestrial sources, irrespective of mobile or stationary source, was clearly connected to the rise of technical and analytical expertise and

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[1192] See further about this link in the marine setting, commented below in the current section.
[1193] *I.e.* space for bulky, but nonetheless effective, emission abatement equipment is not as freely available on a ship as on industrial land.

knowledge within the LRTAP regime's integrated assessment modelling (IAM) that helped formulate more advanced standards.[1194]

In conclusion, the diversity of standards in the regulation of SO_x emissions from terrestrial sources with its multiple targets, can only partly be explained by considering it as a consequence of relations between the diverse standards and the varied emission sources in the terrestrial setting. Although some connections between for example terrestrial stationary emission sources and the choice of emission standards in the regulation of SO_x emissions can be found, there were still several other strong decisive factors for how the historical standard-setting in the regulation of SO_x emissions from terrestrial sources was shaped. These were factors like emission type, suitable abatement technology, and the historical development of the state of scientific knowledge surrounding SO_x emissions.

Considering what has already been stated regarding standard-setting in the regulation of SO_x emissions from marine sources, it is suitable to recall some points from the discussion above that similarly bear relevance for the present question. As was stated, there has historically been a near exclusive employment of products standards for controlling SO_x emissions from marine sources on all regulatory scales.[1195] Moreover, these product standards have specifically addressed the sulphur content in *liquid fuels* as products by demanding that certain characteristics must apply to such fuels. In this thesis, the fuel quality requirements for sulphur content in fuels, expressed as specified allowed limits of sulphur percentage, have already been discussed above.[1196]

Judging from the results above and what has been brought forth in earlier chapters, there is a historical trend in the choice of product standards to control SO_x emissions from mobile emission sources in the marine setting. However, as was equally explained above, this

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[1194] Chapter 3 Section 3.1.3.
[1195] Near exclusive in the sense that there were still possibilities for equivalents and possible alternative regulatory standards if the equivalents rules on the different regulatory scales could successfully be applied.
[1196] *Supra* Chapter 4.

trend is not exclusive for the marine setting, but can also be noted when it comes to terrestrial mobile emission sources, and even for terrestrial stationary emission sources. Once again, other decisive factors seem to offer further explanations for the choice of product standards targeting liquid fuels used by mobile emission sources than simply the consideration of possible linkages between standards and emission source. Therefore, it is here argued that *the factor of emission type*, that is SO_x emissions, has had a more decisive role for the choice of product standards in marine regulation to target liquid sulphur containing fuels, than possible relations between choice of regulatory standard and emission source. This is essentially the case because of the properties of sulphur in liquid fuels and its direct relation to the composition of air pollutants in the form of SO_x emissions when it is combusted. As was stated above, one of the vital factors for the amount of SO_x emissions from the combustion of fuels is the sulphur content of the liquid fuels.[1197] A high sulphur content in a liquid fuel basically means a high concentration of SO_x emissions in exhausts when the fuel is combusted. Thus, lowering the sulphur content of a fuel with product standards specifying fuel quality requirements, *directly affects* SO_x emissions in a manner that is not possible for other adjacent emissions like for example NO_x emissions.[1198]

Targeting the sulphur content in fuels has therefore historically been a rather straightforward and practical way of controlling SO_x emissions, both from marine mobile and terrestrial mobile and stationary emission sources. In the marine setting however, the target of liquid fuels has additionally been influenced by certain practical and economic factors like the cost of and the historically limited availability of alternative cleaning technologies compared to using product standards to lower the sulphur content in fuels, and in extension, SO_x emissions to the air. Furthermore, as was also mentioned above, certain historical institutional factors were likely also important, like for instance the fact that the original discussion

[1197] Another important factor that influences air emission composition is the combustion characteristics of typical marine engines, *supra* Chapter 1, Section 1.2.
[1198] *E.g. supra* Chapters 5 Section 5.2.6 and Chapter 6 Section 6.1.2.

context at IMO of the control of air pollution from marine sources was MARPOL 73/78 Annex I discussions, where fuel oil quality was simultaneously considered for other reasons than pollution to air.[1199]

In conclusion, targeting liquid fuels via product standards in the marine setting can not be sufficiently explained only by considering possible relations between choice of regulatory standard and emission source. Even though there is a historically noticeable pattern to target liquid fuels used in marine mobile emission sources with product standards, the actual targeting of liquid fuels with such standards can further also be explained by considering other decisive factors that have been mentioned above.

7.5.1.4 Similarities in Standard-Setting

Another conclusion presented in Section 7.4.1.4 above, was that not only differences, but also similarities in standard-setting could be identified on all regulatory scales in the regulation of SO_x emissions from terrestrial and marine sources. These similarities relate to the use of *product standards* to control the sulphur content in liquid fuels, both in the terrestrial and the marine setting. The current section considers whether the similarities in standard-setting in the regulation of SO_x emissions from terrestrial and marines sources can be explained by considering the relation between choice of regulatory standard and kind of emission source?

In the results of the historical section above, it was concluded that similarities could be identified among the chosen standards in the historical regulation of SO_x emissions from terrestrial and marine sources on all examined regulatory scales. More specifically, these similarities related to the historical use of *product standards* to control the sulphur content in liquid fuels used both in terrestrial and marine emission sources. Moreover, not only did the product standards target fuels used both in terrestrial and marine emission sources, the standards were used to control the sulphur content in liquid fuels used in *mobile* as well as *stationary* emission sources.

[1199] *Supra* Chapter 4, Section 4.1.1.2.

Recalling once again what was previously stated regarding product standards and similarities in standard-setting in the regulation of SO_x emissions from terrestrial and marine sources, it was argued that a central decisive factor for these similarities, spanning both marine and terrestrial regulation as well as mobile and stationary SO_x emission sources, was the factor of *emission type*.

It is therefore here once again argued that the shared reliance on product standards in the terrestrial and marine setting for the control of SO_x emissions rather has to do with the fact that *SO_x emissions per se* are to be controlled, than with the actual type of emission source in question (that is, mobile or terrestrial emission sources). Furthermore, the similarities in standards can positively be explained by the fact that certain properties of sulphur in liquid fuels bridge the marine and terrestrial regulatory settings. Thus, the direct relation between sulphur content in fuels and the composition of the resulting SO_x emissions when sulphur containing fuels are combusted, is equally relevant whether the fuel is combusted at sea or on land, or whether this is done in a mobile or stationary emission source.[1200] Therefore, lowering the sulphur content of a fuel with product standards specifying fuel quality requirements directly affects the SO_x emissions in a manner that is independent of a terrestrial and marine regulatory setting. Ultimately, the approach of lowering the sulphur content in fuels has thus shown to be a rather effective way to control SO_x emissions, regardless of origin.

Additionally, targeting liquid fuels with product standards has also been influenced by certain practical and economic factors like the cost of and historical availability of alternative cleaning technologies compared to using product standards to lower the sulphur content in fuels, and in extension, SO_x emissions to the air. This is true both for

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[1200] Another aspect is nevertheless that there has been and still are differences in the possibilities to change the end-of-pipe result with the aid of cleaning technology when comparing SO_x emissions from terrestrial and marine sources. This however still does not change the basic relation between the sulphur content in fuel and the sulphur concentration in the resulting air emissions when the fuel is combusted. If a fuel contains less sulphur, the air emissions will contain less sulphur even before it reaches any end-of-pipe cleaning technology.

the control of terrestrial and marine emission sources to the extent that sulphur abatement was simultaneously performed with effective end-of-pipe cleaning technology in the terrestrial setting.[1201] Furthermore, in the marine setting, certain historical institutional factors were also important, like for instance the fact that the original discussion context at IMO of marine air pollution control was MARPOL 73/78 Annex I discussions, where fuel oil quality was simultaneously considered for other reasons than pollution to air.[1202]

In conclusion, the similarities between what terrestrial and marine standards have targeted historically can not be explained as an effect of possible relations between choice of regulatory standard and emission source. Product standards have been used irrespective of whether the emission source has been terrestrial or marine, mobile or stationary. The central decisive factor for the identified similarities appears to be the common emission type to be controlled in both regulatory settings, namely SO_x emissions. Again, additional factors like available emission abatement technology, and institutional context, seem to further explain the choice of product standards to control the sulphur content in liquid fuels, both in the terrestrial and the marine setting.

7.5.1.5 The Existence of Subsidiary and Alternative/Equivalent Standards

As a final point in Section 7.4.1.4 above, it was concluded that the primary standards both in the regulation of SO_x emissions from terrestrial sources and from marine sources were historically accompanied by standards with other orders of priority in application. Here, a difference was that following *subsidiary process standards* were historically allowed as options to some primary emission standards in the terrestrial setting. In the marine setting however, standards with another order of priority in application were instead formulated as alternative/equivalent standards, either as for example an *alternative/equivalent emission standard*, or as an

[1201] *Supra* Chapter 3 Sections 3.1.3.
[1202] *Supra* Chapter 4, Section 4.1.1.2.

alternative/equivalent other standard. This section considers whether the existence of subsidiary and alternative/equivalent standards in the regulation of SO_x emissions from terrestrial and marine sources can be explained by considering relations between choice of regulatory standard and kind of emission source?

From what was previously stated about subsidiary and alternative/equivalent standards in the regulation of SO_x emissions from terrestrial and marine sources, it was argued that there were different ways to follow the primary formulated standards. In the case of SO_x emissions from terrestrial sources, subsidiary standards could be identified in the historical regulation on the international and the regional regulatory scales. These were rather specific subsidiary *process standards* that could be applied if certain indigenous fuels contained too much sulphur to fulfil the *emission standard* when combusted.[1203]

In the case of SO_x emissions from marine sources on the international scale, there were alternative/equivalent standards that included the option of complying with an alternative/equivalent *emission standard* for fulfilling the requirements of SECAs in the original MARPOL 73/78 Annex 1997, or by application of another technological method for emission reduction that could achieve an equivalent result of the exhaust gas cleaning system. Furthermore, there were also possibilities to fulfil alternative/equivalent standards under the general equivalents regulation in the same annex. In principle, these could take the form of either product, process or emission standards.

Considering the existence of the mentioned subsidiary and alternative/equivalent standards, these do not appear to be a result of standard-setting in relation to a certain kind of emission source. Rather, from what was presented above, they seem to have emerged as a result of various practical reasons. For example, in the case of SO_x emissions from terrestrial sources and subsidiary standards, the practical reasons of some indigenous fuel characteristics, making some European countries' possibilities to comply with standards

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[1203] *Supra* Chapter 3.

smaller, seem to have shaped the formulation of the subsidiary standards.

In the marine setting, the alternative/equivalent *emission standard* or an equivalent technology for SECAs in the original MARPOL 73/78 Annex VI 1997 could be seen as safety clauses broadening the possibilities for States to comply with the stipulated sulphur requirements. Moreover, the general equivalents regulation potentially allowing for various other standards could be likened to other alternative/equivalents provisions in IMO conventions. That is, in general such provisions with alternative/equivalent standards are included as a way to avoid restraining innovation.[1204]

In conclusion, it is not feasible to explain the existence of subsidiary standards in the regulation of SO_x emissions from terrestrial and marine sources as a consequence of the relations between choice of regulatory standard and the kind of emission source. Rather, various practical reasons seem to have decided the inclusion of subsidiary and alternative/equivalent standards both in the regulation of SO_x emissions from terrestrial and marine sources.

7.5.1.6 Examining the Relation Between Standard Type and the Kind of Emission Source – Current Regulation

Since the conclusions in Section 7.4.2.5 above regarding the differences in standard-setting in the *current regulation* of SO_x emissions from terrestrial and marine sources were practically identical with the conclusions regarding the differences in historical regulation in Section 7.4.1.4, the current section will not once again go through these results and pose the same questions as in sections 7.5.1.1-7.5.1.5. To avoid unnecessary repetition, this section will therefore move directly to drawing some conclusions about the main reasons for the key differences found in current standard-setting.

[1204] *E.g.* MSC.1/Circ.1455, Annex, p. 1 where it is stated that 'Prescriptive regulations may sometimes restrain the level of innovation that is feasible in design … Currently, there are provisions in many IMO conventions for acceptance of alternatives and/or equivalents to prescriptive requirements in many areas of ship design and construction'.

Given that the conclusions for the historical differences in standard-setting also were true (with slight differences) regarding current differences in standard-setting, it is arguably reasonable to assume that the main reasons for the key differences identified in historical standard-setting still remain true for current standard-setting. Thus, it can be concluded that the more or less unchanged situation make the conclusions given in Section 7.5.1 with subsections above as relevant for the current section, and can also sufficiently explain the differences identified in current standard-setting.

7.5.1.7 Conclusions Regarding the Relationship Between Standard Type and the Kind of Emission Source

The previous main section, Section 7.5.1, sought to address the question *what are the main reasons for the key differences found in historical and current standard-setting?* As a starting point for this examination, a further explorative question was posed. This question enquired *whether the relation between standard type and the kind of emission source could explain the differences (and similarities) that were presented in the results of the two previous conclusions sections?*[1205]

This explorative question was chosen because it was assumed that the relation between standard type and kind of emission source could be a decisive and plausible starting point for trying to explain the results above, based on what was brought forth in Chapters 3-6. With this intention, the question was examined by breaking it down into a couple of additional questions, all posed in relation to the results from previous sections. Considering the main reasons for the key differences identified in historical and current standard-setting in the regulation of SO_x emissions from terrestrial and marine sources, the following overall conclusions can be drawn:

Against the background of previous Chapters 3-6 and the present chapter, the relation between the choice of standard type in regulation and kind of emission source can only partly explain the main reasons for the key differences identified in historical and current standard-

[1205] *I.e.* Sections 7.4.1.4 and 7.4.2.5

setting. The question is not irrelevant to pose, but as shown above, its relevance differed as a means to provide explanations for the key differences identified in historical and current standard-setting in SO_x emissions regulation. Although there have indeed been some historically, and arguably still currently important connections between certain terrestrial and marine kinds of emission sources and choice of regulatory standard, for instance in the regulation of mobile emission sources with *product standards* in both regulatory settings, there are still several other stronger decisive factors that could plausibly explain why certain standards were chosen. In some cases, for instance where it was considered whether the employment of subsidiary and alternative/equivalent standards could be explained by considering the relation between standard type and kind of emission source, the question did not provide plausible explanations for the choice of standards.

Nevertheless, with a point of departure in this explorative question, the extent of other influential factors for choice of standards in regulation surfaced. Particularly, *the type of emission* to be controlled, that is SO_x emissions, seems to have had a crucial influence on the chosen type of standard. For example, the historical and current similarities in standard-setting in the terrestrial and marine context can arguably to a large extent be explained by reason of emission type, essentially because of the properties of sulphur in liquid fuels and its direct relation to the composition of air pollutants and the concentration of SO_x emissions when the fuel is combusted.

Other crucial factors revealed above that could plausibly also provide the main reasons for the key differences in standard-setting, were the availability and cost of certain abatement technologies like flue gas desulphurization, and the limiting factors for its use, such as size and weight. Furthermore, certain technologies have also historically been specifically associated with particular regulatory standards, like flue gas desulphurization and *emission standards* in the terrestrial setting.

Moreover, the state of knowledge about the effects of SO_x emissions for the terrestrial environment differed historically compared to the marine environment. This influenced the choice of regulatory standards in the two regulatory settings. Also, technical and analytical expertise and knowledge within the terrestrial setting, like integrated assessment modelling (IAM), influenced the formulation of regulatory standards, in particular the possibilities to develop and include *environmental quality standards* in SO_x emissions regulation.

Yet other factors like fears of potential problem shifting, the cost-effectiveness of regulation, and the institutional context (the forum of IMO) in which the regulatory standards for fuels were formulated also seems to have contributed to the main choice of *product standards* to control SO_x emission from marine sources.

Finally, some practical reasons for the choice of standards in the terrestrial and marine setting can be identified. For instance, the main reasons for the existence of subsidiary standards in the terrestrial setting seems to have been the practical reasons of some indigenous fuel characteristics, that is, a naturally high sulphur content in fuels, making certain countries' possibilities to comply with SO_x emission standards harder. Moreover, the existence of provisions with alternative/equivalent standards in the marine setting were arguably included as 'safety clauses' and as ways to avoid restraining innovation. All in all, there were thus several other reasons for the differences in standards in the terrestrial and marine setting than the relation between standard type and emission source. These other reasons were *inter alia* of technical, economic, scientific, practical, and institutional character.

7.6 The Effects of the Key Differences Between Standard-Setting in the Regulation of SO_x Emissions from Terrestrial and Marine Sources

After having examined the differences between historical and current standard-setting in the regulation of SO_x emissions from terrestrial and marine sources, it is now time to consider the research questions: *What are the effects of the key differences between standard-setting in the regulation of SO_x emissions from terrestrial and marine sources?* And, *can the regulation of SO_x emissions from marine sources be improved against this background? If so, how?*

These questions will be answered in separate sections, commencing with the question regarding the effects of the key differences between standard-setting in the regulation of SO_x emissions from terrestrial and marine sources. In relation to what was presented regarding the key differences in standard setting above, the following can be concluded.

First, regarding the effects of the use of varied standards in the terrestrial regulatory setting, it can be concluded that various 'tools' in the form of different regulatory standards have been used, and are still used, in the regulation of SO_x emissions from terrestrial sources. Considering standard-setting in CAC regulation, which this thesis is limited to, terrestrial standard-setting then appears rather diverse in comparison to standard-setting in the regulation of SO_x emissions from marine sources, where a more or less single standard has been used in regulation to control SO_x emissions. The subsequent question is then what are the effects of this regulatory reality?

Regarding the control of SO_x emissions, it can be argued that the varied use of standards during the years in the terrestrial setting has provided ample room for trial and error in relation to what works in standard-setting. Moreover, this has provided opportunities for regulatory development in the case of standard-setting. By way of example, from beginning with instrumental and source-related standards like *emission*, *product* and *process standards*, terrestrial regulation has with time come to include more advanced goal-based standards in the form of *environmental quality standards*.

As has been expressed in regulatory literature, the effects of combining different types of regulation can potentially be beneficial in the sense of 'net regulation'. Basically, what this means is that the sum of effects of regulatory modalities is relevant to consider when a certain phenomenon is regulated. As Lessig puts it, a 'policy trades off among these … regulatory tools. It selects its tool depending upon what works best'.[1206] Although in this particular quote, Lessig considers the effect of combining different *regulatory modalities*, including non-CAC type regulation,[1207] a similar thinking could

[1206] Lessig (1999) p. 508.
[1207] *Supra* Chapter 2 Section 2.2.5.

arguably be applied to the potential benefits of combining various *regulatory standards* in CAC regulation. This line of reasoning would then acknowledge the strength also of creating 'regulatory mixes' with different standards to control a particular phenomenon, for instance SO_x emissions from ships. A combination of standards could thus enhance each other's effects by creating synergies. For instance, a *product standard* in the form of maximum sulphur limits for a fuel, combined with a *process standard* expressed as requirements on sulphur recovery, can yield better emission values to fulfil *emission* and *environmental quality standards*. In this sense, combinations of standards that target various parts of 'a cycle' could achieve a better end result. An assumption here is that there is no 'one size fits all' standard of regulation that can solve all problems associated for example with SO_x emissions. It is thus not a question of either or here, but the point of departure is to be open for a beneficial mix of regulatory standards in the design of regulation.[1208]

This point of view also has support in cybernetic thinking, shortly discussed in Chapter 2,[1209] where a belief in mixes and combinations of regulatory tools for optimal regulatory results has been referred to as the 'law of requisite variety', or the belief that 'only variety can destroy variety'.[1210] Applied to the 'regulation of systems' in the legal setting, the dependence on various regulatory standards in a regulatory setting where there are many different kinds of pollution sources, in this case the terrestrial setting, could thus be advantageous. As it has

[1208] Again, Gunningham's explanation of the central tenets of 'Smart Regulation' are relevant to recall to support this line of reasoning. As Gunningham describes, although considering broader combinations of regulatory tools, 'Smart Regulation' is a term used 'to refer to an emerging form of regulatory pluralism that embraces flexible, imaginative, and innovative forms of social control which seek to harness not just governments but also business and third parties … *The central argument* is that, in the majority of circumstances, the use of *multiple* rather than *single policy instruments* and *a broader range of regulatory actors*, will produce better regulation. Further, that this will allow the implementation of complementary *combinations* of instruments and participants tailored to meet the imperatives of *specific environmental issues*', Gunningham (2012) p. 131, emphasis added. See also Baldwin *et al.* (2012b) pp. 265-267.

[1209] *Supra* Chapter 2 Section 2.2.4.

[1210] Beer (1994) p. 279.

been formulated, 'variety in forms of activity requires an equal or greater variety of bases for control if regulation is to be effective'.[1211] All the same, regulatory literature has also discussed the dangers of too much faith in the potential of regulatory mixes, or as it has been described, a '"smorgasboard" approach, where the greater the number of instruments and actors the better'.[1212] As has been argued, there are limits to the administrative burden that can reasonably be placed on regulatees, and the wrong kind of regulatory mixes may well lead to 'neutralisation' where instruments may negate or dilute each other.[1213]

Second, considering the almost exclusive reliance on product standards in the marine setting, this may initially appear as a weak choice for the control of SO_x emissions seen against the belief in the potential of regulatory mixes. On the other hand, it should not be ruled out that a single standard may all the same rather effectively combat an environmental problem on its own. In the case of SO_x emissions from marine sources, it has for instance been stated that the recently decided new global cap of a 0.5% limit for the sulphur content of the fuel oil used by ships applying from 1 January 2020 will mean

'a significant reduction from the current cap of 3.5 per cent and it will cut shipping SO_2 emissions by nearly 80 per cent, or around 9 million tonnes per year, and prevent more than 100,000 annual premature deaths'.[1214]

Returning again to consider the fact that the employment of various standards in the terrestrial setting has provided opportunities for regulatory development in the case of standard-setting, and that the variety of explored standards has lead to an evolution of terrestrial standards, this must also be contrasted with the marine setting. In the terrestrial setting, different 'generations' of standards have been tried and refined, while standard-setting in the marine context has more or

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[1211] Murray, Scott (2002) p. 501. In this particular article, variety in activity and bases for control is discussed in relation to problems of regulating such multi-faceted phenomena as the Internet or globalisation.
[1212] Gunningham *et al.* (1999) p. 16.
[1213] Gunningham *et al.* (1999) p. 16.
[1214] Acid News No. 4 (2016) p. 2.

less stuck to product standards. Here, the discussion about 'crude' and 'fine' standards may be recalled.[1215] Graded after what has been described as an increasing level of sophistication, legal scholars have argued that

'standards are crude when they relate to the *environmental performance* of products (product standards) or industrial installations (emission standards) *without having regard to the receiving environments* (water, air, soil) they are intended to protect. By way of example, emissions by diesel-engines have been regulated (product standards) without regard to the impact of the sum-total of the growing number of diesel-engines on climate change.'[1216]

As previously stated,[1217] standards that are drafted with regard to the receiving environments, that is, environmental quality standards, provide much more precise standards in terms of what is targeted, and furthermore also in relation to effectiveness and the cost of standards relating to environmental protection. Here, the evolution of the standards within the LRTAP Convention's sulphur protocols in the terrestrial setting provide a good example. With the introduction of the critical loads approach, the standards have become increasingly refined and sophisticated in relation to what they target. However, these standards, drafted with regard to the receiving environments, at the same time require 'much higher levels of scientific and administrative expertise'[1218] than cruder standards. Thus, the employment of different and increasingly sophisticated standards in the terrestrial regulatory setting may have become increasingly precise, but they have also 'come at a hefty price'.[1219]

Indeed, the reliance on cruder standards may therefore not necessarily be a bad choice. These standards are less sophisticated, require less scientific and administrative expertise, but as it has been stated 'one of the most attractive features of crude standards is that they are

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[1215] *Supra* Chapter 2 Section 2.2.8.
[1216] Goodwin, Somsen (2010) p. 113, emphasis added.
[1217] *Supra* Chapter 2 Section 2.2.8.
[1218] Goodwin, Somsen (2010) p. 114. See also, Abbot (2006) pp. 68-69.
[1219] Goodwin, Somsen (2010) p. 114.

enforceable'.[1220] From the perspective of developing countries in particular, this may therefore be a much more feasible choice in standard-setting than relying on finer and more sophisticated standards.[1221] Using the recently decided global sulphur in fuels limit of 0,5% as a case in point, it has for instance been stated that

'More than 90 per cent of these health benefits [from the 0,5% sulphur limit] will take place in the Asia-Pacific region, Africa and Latin America. (Because the sea areas around Europe and North America already have stricter fuel sulphur standards, they will receive only relatively small additional health benefits from the global cap.)'[1222]

Furthermore, the cornerstone of finer and more advanced standards associated with air quality modelling, like environmental quality standards, require reliable and more precise data. Compared to the terrestrial setting, obtaining this kind of data has until recently been problematic in the marine setting.[1223]

Third, when it comes to the effects of the differences between what terrestrial and marine standards have targeted, one effect is that the regulatory standards in the terrestrial setting by necessity have had to apply to more kinds of sources than in the marine setting. In the former setting, different standards have targeted various kinds of emission sources, both stationary and mobile. In the latter, the

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1220 Goodwin, Somsen (2010) p. 114.

1221 As argued by Goodwin, Somsen (2010) p. 115-116 'research suggests that where governance capacity is weak, it is better to avoid legal instruments that require high levels of administrative capability to be effectively implemented. Contrary to theory based upon Northern models, for developing countries setting out precise rules in legislation is more likely to be effective than flexible instruments containing vague standards. Fixed rules have lower implementation and compliance costs than variable standards, thus making them more suitable in systems with low capacity; in leaving little scope for discretion, fixed rules are also less vulnerable to corruption at the implementation stage', footnote omitted.

1222 Acid News No. 4 (2016) p. 4.

1223 Jalkanen *et al.* (2016) pp. 71 and 80 and EMEP (2016) p. v. These sources *inter alia* consider data for air quality modelling generated by so-called Automatic Identification Systems (AIS), tracking ships starting as late as 2011. According to the latter source, same page, AIS data for air quality modelling from years before 2006 is not available.

emission standards have targeted one kind of source. Arguably, dealing with various emission sources may have had the effect of ‘boosting’ standard-setting in the terrestrial context compared to the marine regulatory context.

Fourth, a related point is the effect of the similarities between standard-setting in the terrestrial and marine setting. Here, one effect is probably the valuable lessons of successfully applying product standards in the terrestrial setting for SO_x emissions control, which with time have moved into regulation in the marine setting.

Finally, considering the effects of the key differences with regard to subsidiary and alternative/equivalent standards in regulation, it can be argued that the terrestrial subsidiary process standards have a ‘securing’ effect for regulatory requirements. The process standards were originally included to respond to some States’ difficulties to comply with emission standards, but these subsidiary standards were, and are still confined to rather limited circumstances in application.

In the case of standard-setting in the regulation of SO_x emissions from marine sources, the inclusion of alternative/equivalent possibilities for fulfilling SO_x emission requirements can be argued to keep a door open to (regulatory) innovation. The effects of this is that the provisions potentially open up for a kind of rather flexible ‘self regulation’ that could formulate requirements including a wider range of standards. As long as the requirements for an alternative/equivalent standard have been approved, these could in principle take form as either an alternative/equivalent product, process or emission standard.

A fear here could of course be that a ‘self-regulating’ Flag State could try to avoid the main regulatory standards by creating its own standards, which could potentially weaken the effect of the common international main standards. All the same, as an illustration, the examples of actual application of the equivalents rule in Regulation 4 of MARPOL 73/78 Annex VI 2008 are few. Only a handful of examples have been communicated to IMO for circulation,[1224] which

[1224] To current date, only ten between the years 2010 – 2014, see MEPC.1/Circ.729, 768, 789, 798, 799, 826, 831, 832, 835 and 836.

may suggest that States primarily attempt to comply with the commonly formulated main international standards, that is, the product standards. Furthermore, some attempts to apply equivalents, like in the case 'sulphur emissions averaging schemes', have lately been rejected in the IMO MEPC, *inter alia* because these schemes were essentially seen as a kind of a market-based instrument applying to a group of ships.[1225] In any case, with currently available information, it is not possible to confirm the fear of States avoiding regulatory requirements by self-regulating with alternative/equivalent standards.

7.7 Improving the Regulation of SO_x Emissions from Marine Sources

Recalling that this thesis initially stated that the regulation of SO_x emission from marine sources will require even further development to 'catch up' with the ambitions of terrestrial regulation,[1226] it is now time for the final research question, namely: *can the regulation of SO_x emissions from marine sources be improved against this background? If so, how?* From what has been concluded above, it will be apparent that the answer to this question can both be *yes* and *no*, depending on perspectives and priorities.

The answer is *yes* if the ambition is to refine the precision of standard-setting in the regulation of SO_x emissions. If standards are to be less instrumental, or less 'crude', more balanced in cost-effectiveness, and optimized in relation to SO_x emissions abatement, the LRTAP regime with its sophisticated and highly refined goal-oriented standards building on the concept of critical loads could be an inspiration for the reformulation of marine standards. However, these kinds of standards would require much more advanced emission assessments and modelling for ship emissions to air in marine areas. As was stated in the previous section, the possibilities for this have only recently started to improve with the gathering of better data for ship emissions to the air.

1225 MEPC 65/22 (2013) p. 25-26.
1226 *Supra* Chapter 1 Section 1.1.

The answer could arguably also be *yes* from the point of view that a combination of different standards can potentially aid the control of pollution by approaching the problem from various different angles. Adding a combination of standards could further secure the effective abatement of SO_x emissions. Further, different standards could work in synergy as they could address various parts of 'a cycle' to achieve a better end result together.

The answer is *no* with regard to the fact that the main choice of using *product standards* to control SO_x emissions from marine sources seems sensible when such emissions originate from the combustion of liquid sulphur containing fuels. This is furthermore a standard choice that has been successfully used for a long time to control SO_x emissions in the terrestrial regulatory setting.

The answer is moreover *no* with regard to the perspective of developing countries, which to a large extent are expected to benefit from the coming standards in the regulation of SO_x emissions from marine sources.[1227] The fact that the standards are crude can here be regarded as a strength, both from the perspective of implementation of these less complicated standards, and from the perspective of their cost, compliance and enforcement.

Finally, the answer could both be *yes* and *no* in relation to improving the alternative/equivalent standards. *Yes,* if the possibility of employing alternative/equivalent standards would be used as a loophole for avoiding commonly formulated international SO_x emission standards. As to yet, there is however too little available information to draw any strong conclusions here. From an innovation perspective, the answer is *no*. It is sensible to allow an open door for innovation with flexible standards so that States at least have the possibility to comply with requirements in alternative ways. It is thus possible that the drive to come up with even better and affordable solutions than the primary regulatory standard choice may well hold the key to future successful abatement strategies. Furthermore, this thinking is already an acknowledged regulatory strategy in several IMO instruments, and in environmental law in general.

[1227] See previous section.

’And this is the end,
the car running out of road,
the river losing its name in an ocean,
the long nose of the photographed horse
touching the white electronic line.
This is the colophon, the last elephant in the parade,
the empty wheelchair,
and pigeons floating down in the evening’[1228]

8 Summary, Concluding Remarks and Outlook

8.1 Summary and Main Results

This thesis has examined the regulation of vessel-source air pollution. More specifically, an examination of standard-setting as an important regulatory component of CAC regulation in the area of SO_x emissions control has been performed. The purpose of this study was to identify and examine the differences between standard-setting in the largely successful regulation of SO_x emissions from terrestrial sources, and the regulation of SO_x emissions from marine sources. In particular, distinctions were drawn across three regulatory scales (the international, regional, and national scales), with the aim of identifying the underlying rationales for the key differences in standard-setting, the regulatory effects of these differences, and the possibilities of improvement of SO_x emissions regulation in the marine setting. In other words, the point of this thesis was to examine what could be learned for standard-setting in the regulation of SO_x emissions from marine sources from examining standard-setting in the regulation of SO_x emissions from terrestrial sources.

[1228] Collins (1998) p. 100, lines 52-59.

Before summarising the main results, the research questions formulated in Chapter 1[1229] should be recalled:

1. *Does the regulation of SO_x emissions from terrestrial and marine sources differ in standard-setting and if so how and why?*
2. *What are the effects of the key differences between standard-setting in the regulation of SO_x emissions from terrestrial and marine sources?*
3. *Whether and if so in what manner the regulation of SO_x emissions from marine sources can be improved against this background?*

In relation to research question (1.), this thesis has shown that the regulation of SO_x emissions from terrestrial and marine sources differed in standard-setting on all regulatory scales, and that the historical approaches to regulatory standard-setting have largely remained unchanged both in the terrestrial and the marine context. One of the key differences between standard-setting in the regulation of SO_x emissions from terrestrial and marine sources was that these have differed in the variety of standards used in regulation. Whereas the regulation of SO_x emissions from terrestrial sources has relied on a combination of several regulatory approaches including product, process, emission and environmental quality standards, the regulation of SO_x emissions from marine sources has primarily relied on a single approach: *product standards*. Moreover, the standards expressed in the regulation of SO_x emissions from terrestrial sources have had multiple targets, both stationary and mobile, whereas the standards in the regulation of SO_x emissions from marine sources have mainly focused on targeting liquid fuels when used in mobile emission sources represented by ships.

Nevertheless, some similarities in standard-setting in the terrestrial and the marine setting were also found on all regulatory scales in both historical and present regulation. More specifically, these similarities related to the historical use of *product standards* to control the sulphur content in liquid fuels used both in terrestrial and marine emission

[1229] *Supra* Chapter 1 Section 1.2.1.

sources. In addition, in both the historical and current regulation of SO_x emissions from terrestrial and marine sources, the primary standards were accompanied by standards with other orders of priority in application. Here, a difference was that subsidiary *process standards* were allowed as alternatives to some emission standards in the terrestrial setting. In the marine setting however, standards with another order of priority were formulated as alternative/equivalent standards.

Regarding the main rationales for the key differences found in historical and current standard-setting, it was concluded that there were several reasons other than the relationship between standard type and the kind of emission source that had a decisive effect on the choice of standard in regulation. Particularly, the type of emission to be controlled, that is SO_x emissions, was arguably one of the most crucial influencing factors for the choice of type of standard in regulation. Other reasons, which in several cases related and were linked to each other, were *inter alia* of a technical, economic, practical, scientific, and institutional character.

With respect to research question (2.), the conclusions surrounding the effects of the key differences were that the use of varied standards in the terrestrial regulatory setting provided various ‘tools’ in the form of different regulatory standards as compared to the marine setting. On the one hand, the combination, and the experience of using different standards could be beneficial for the effective control of pollution. On the other, however, the almost exclusive reliance on product standards in the marine setting does not necessarily have to be a bad choice. From a SO_x emissions abatement perspective, these ’simple’ standards are all the same predicted to deliver considerable health benefits in the future, especially in developing countries. Furthermore, there are obvious advantages with so-called cruder regulatory standards from the perspective of developing states, since such standards require less administration and are generally considered easier to enforce than other more advanced standards.

When it comes to the effects of the differences between what terrestrial and marine standards have targeted, one effect is arguably that various emission sources in the terrestrial setting may have had the effect of ‘boosting’ standard-setting in the terrestrial context compared to the marine regulatory context. Furthermore, one effect of the similarities in standard-setting is probably a transfer of tested and working standards from the terrestrial to the marine setting for SO_x emissions control.

Considering the effects of the key differences with regard to subsidiary and alternative/equivalent standards in regulation, it can be argued that the terrestrial subsidiary process standards have a 'securing' effect for regulatory requirements, and the standard-setting in the regulation of SO_x emissions from marine sources keeps a door open to (regulatory) innovation.

As regards research question (3.), the answer could be both *yes* and *no* depending on perspectives and priorities. For instance, if the ambition is to refine the precision of standard-setting in the regulation of SO_x emissions the answer could be yes. Marine standards could be changed from being rather instrumental, to becoming more balanced in cost-effectiveness, and optimized in relation to SO_x emissions abatement if it would be possible to create more sophisticated and refined goal-oriented standards that are present within today's LRTAP regime.

The answer could arguably also be *yes* from the point of net effects of different standards, where a combination of standards could further secure the effective abatement of SO_x emissions. Further, different standards could work in synergy to address various parts of 'a cycle' and achieve a better end result together.

The answer could be *no* with regard to the fact that the main choice of using *product standards* to control SO_x emissions from marine sources seems sensible when such emissions originate from the combustion of liquid sulphur containing fuels. This has furthermore been a standard choice that has been successfully used for a long time to control SO_x emissions in the terrestrial regulatory setting.

The answer is moreover *no* with regard to the perspective of developing countries, which to a large extent are expected to benefit from the coming standards in the regulation of SO_x emissions from marine sources. The fact that the standards are crude can here be regarded as a strength and not a weakness, both from the perspective of implementation, cost, compliance and enforcement.

Finally, the answer could both be *yes* and *no* in relation to improving the alternative/equivalent standards. *Yes* if the possibility of employing alternative/equivalent standards would be used as a loophole for avoiding commonly formulated international SO_x emission standards. From an innovation perspective, the answer is *no*. It is sensible to allow an open door for innovation with flexible standards so that States at least have the possibility to comply with requirements in alternative ways, since this may lead to even better and affordable solutions than the primary regulatory standard choice.

8.2 Concluding Remarks

In this concluding section, it is suitable to round off with some remarks from a panoramic view. Leaving the more immediate results already developed in the foregoing sections, this section focuses on highlighting some final contributions, theoretical and other, offered by this study in a broader setting. The remarks in this section can therefore be regarded as a way of tying together the study, with one part recapitulation to the former discussion about the contribution of this study in Chapter 1 section 1.4 above, and one part additional reflections in the rear-view mirror in this final chapter.

This thesis took a point of departure in theories and methods that are common to the field of regulatory studies. However, considering how this thesis progressed, it may perhaps appear that such a takeoff in the end was not very different from a traditional legal perspective. After all, many sources analysed in this study are normal for such a perspective. Moreover, what could be more traditional than examining CAC regulation? Strictly formulated, could this study have been accomplished even *without* regulatory studies?

It is exactly by posing this kind of question that the final contributions of this thesis in general, and the added value of regulatory studies in particular can be explained. Again, considering points of departures, an important stepping stone for the current thesis was the initial theoretical mindset. This must be compared to where a more traditional legal study would arguably have started a similar examination. While it is true that this thesis has indeed examined classic CAC regulation located in traditional sources, the actual use of regulatory studies including some of the basic concepts from this field, for instance the generic trio of regulation, could at the same time have entirely changed the shape and results of this study.

By way of example, consider if terrestrial SO_x emissions regulation had to a large extent instead built on market-based measures and informal approaches to regulation besides classic CAC type regulation.[1230] In such a situation, the significance of other types of regulation in a wider sense could have easily been overlooked from a more traditional legal perspective, with a default focus on classic CAC regulation. In contrast, an examination of the regulation from the viewpoint of regulatory studies would have the potential to provide a totally different picture of the regulatory landscape. Put another way, this study did not end up examining classic CAC regulation because it was a given starting point, but because the initial broadly covering overview of regulation revealed that the control of SO_x emissions[1231] had been handled with CAC type regulation *and not other types of regulation*.

In the same way, standard-setting for SO_x emissions control as a component of CAC regulation could certainly have been examined from a traditional legal point of view as well. Nevertheless, what regulatory studies provides in comparison is a more inclusive initial theoretical mindset, which at the same time provides a backdrop to aid a deeper understanding of for instance the design and the mechanics of regulation. As was explained before,[1232] standard-setting is only one component of the generic trio of regulatory functions that are commonly referred to in regulatory studies. Again, the added value of studying standard-setting from the viewpoint of regulatory studies is a start in a broader perspective which draws on a pool of growing systematised knowledge about standard-setting (and regulation) from multiple research disciplines. This arguably creates possibilities for the examination of quite different, new, and exciting aspects of regulation compared to a more traditional legal perspective.

[1230] *Supra* Chapter 2 Section 2.2.5.
[1231] Obviously, not all kinds of regulatory efforts to control SO_x emissions, but the regulation examined within the delimitations of this study, see delimitations *supra* Chapter 1 Section 1.3.
[1232] *Supra* Chapter 2 Sections 2.2.4 and 2.2.7.

A matter related to the inherent openness to multidisciplinary knowledge in regulatory studies is that this study has contributed with an analysis of standard-setting against a rather rich surrounding explanatory context. As detailed above,[1233] this analysis involved going beyond a mere overview of history and trends in the design of the regulation of SO_x emissions from terrestrial and marine sources by considering traditional legal sources. It further involved looking closer at the influence on the shape of SO_x emissions regulation of several other important decisive factors of a technical, economic, scientific and institutional nature. By also considering factors such as these, this study has contributed with a deeper understanding of SO_x emissions regulation in general, and standard-setting in the same kind of regulation in particular. Additionally, this study has contributed with an increased understanding of the effects of the choice of standards, and their potential improvement.

All of these broader kinds of understanding, and their interlinkages, are novel and useful, especially when examining standard-setting and regulation from the sphere of interest of the legislator rather than the judge.[1234] In this study, it was exactly by posing the question of why standard-setting had been designed differently in terrestrial and marine regulation, that these other factors surfaced. Namely, such factors were the influence of specific characteristics of a certain type of emission and how this creates challenges for standard-setting in regulation, how important technical breakthroughs like cleaning abatement equipment can 'open doors' for yet new kinds of standards, or even create new challenges like in the historical case of the introduction of new innovations for marine engines in the 1950s that made possible the use of heavier sulphur content fuels on the seas.

Yet another contribution offered by this thesis is the multiscale mapping of regulation in context. Here, the contribution is twofold. First, on a theoretical level, this thesis has demonstrated how tools from regulatory studies can be used to analyse large quantities of regulatory material including several different parameters such as:

[1233] *Supra* Chapter 1 Section 1.4.
[1234] *Supra* Chapter 2 Section 2.1.

different regulatory settings, regulatory scales, while also covering different kinds of emission sources. Certainly, the study of regulatory design in the form of standard-setting only highlights one piece of the regulatory puzzle, and if a fuller picture of regulation is to be given, other pieces and their linkages must also be studied. Nevertheless, considering that standard-setting is arguably one of the most central functions in CAC regulation, focusing on this can still reveal quite a lot about regulation.[1235] From the sections above, it has been shown that the point of departure of examining standard-setting can evoke multiple important questions, that deepens the understanding of how regulation works and how it could potentially be changed. For instance, identifying and analysing the choice of standard-setting in regulation can spark questions as to whether using other standards would give better regulatory results, why, how, and why not?

Second, a more practical or systematic contribution of the multiscale mapping of regulation in context of this thesis is that the examination of standard-setting has helped to yield a better overview of the regulatory landscape regarding the regulation of terrestrial and marine SO_x emissions. This systematisation of regulatory material focusing on standard-setting, with an additional surrounding context, has been an extensive and complicated task including multiple regulatory settings and scales. There are no comparable studies, and the systematisation in the current study is therefore a significant contribution in itself.

Finally, yet another contribution from a broader point of view is that this study has increased the potential for further regulatory development in the area of SO_x emissions control. As stated in the beginning of this thesis, regulatory requirements for SO_x emissions from marine sources will need to continue developing further in the years ahead. However, the methods for studying standard-setting in regulation used in this thesis could arguably also be used for the generic study of the regulation of yet other pollutants. This means new possibilities for regulatory analysis, design, and development for the future; something that can be useful for stakeholders including

[1235] *Supra* Chapter 1 Section 1.2.

national legislators, IMO Member States, maritime industry actors, and NGOs with an interest in policy dialogue and regulatory development in the field of SO_x emissions control, *or* other pollutants.

8.3 Outlook – Future Issues and Possible Further Research

As presented above in sections 8.1 and 8.2, the distinctions drawn in this thesis between standard-setting in the largely successful regulation of SO_x emissions from terrestrial sources and the regulation of SO_x emissions from marine sources resulted in several conclusions about the design of the regulation of SO_x emissions. Looking into the future, the examination of the following issues could potentially yield further results as a continuation of the current study:

First, the implementation and the enforcement/application in practice of standards in the regulation of SO_x emissions from marine sources could be useful to examine further. Putting a standard in place is only one piece of the regulatory puzzle, albeit an important one. As current discussions are held, leading environmental NGOs recommend the shipping and oil industry to 'focus their attention on establishing effective systems for compliance monitoring and enforcement'.[1236] This is a sensible recommendation for a couple of reasons. One is that the enforcement dimension, and the application in practice of SO_x emissions regulation to control such emissions from marine sources has not yet been explored, theoretically and practically, to any larger extent. As stated earlier,[1237] this partly has to do with the rather recent entry into force of the revised standards in the Revised MARPOL 73/78 Annex VI 2008. All the same, enforcement and application in practice of regulation remain necessary parts of the behaviour-modificating function of regulation, the latter being at the same time a component of the so-called generic trio of regulation.[1238] Bluntly put, there is no use in continuing to focus on creating stricter and stricter standards if they are not enforced and do not lead to behavioural

[1236] Acid News No. 4 (2016) p. 2.
[1237] *Supra* Chapter 1 Section 1.3.
[1238] *Supra* Chapter 2 Section 2.2.4.

changes in the end. Yet another reason to focus on enforcement/application in practice is of a more hands-on technical and/or natural scientific nature. Increased possibilities to measure SO_x emissions with more precision will not only open up for better preconditions for successful enforcement of regulation,[1239] but it will potentially also open new doors for the application of new standards in regulation, like environmental quality standards applied in the marine context. This is basically so, because better data can be gathered. As mentioned before, more precise data is a requirement for more advanced and precise standard-setting.[1240]

Second, the consideration of the complementary use of other regulatory instruments to traditional instruments and standards in the form of CAC regulation for the control of SO_x emissions could be fruitful. For instance, the complementary use of economic instruments, such as charges and subsidies could be studied. These are often mentioned as a way to speed up the process towards achieving environmental goals in combination with more traditional instruments.[1241]

Third, the consideration of interlinkages between the regulation of different adjacent emissions, and the 'bargaining' of requirements between emissions that could be reduced together (politically and technically) would be relevant to consider. This, because it is increasingly common to view the regulation of different air emissions, such as *air pollutants* and climate changing *GHGs* as two sides of the same coin.[1242] In this sense, different air emissions are susceptible to bargaining in international fora in order to create different balances in air emission control. Such bargaining is optimally based on integrated

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[1239] *I.e.* basically for the simple reason that something has to be able to be measured and compared with a set standard so that a breach or non-breach of a certain rule can be ascertained.

[1240] See discussion about this *supra* Section 7.6.

[1241] *E.g.* Acid News No. 4 (2016) p. 2. Although mentioned in connection to *NO_x emissions* in this particular article, experimentation with complementary economic instruments is neither unknown nor untried with regard to SO_x emissions, just not widely spread.

[1242] See especially the comments on terminological distinctions between *air pollutants* and *air emissions*, *supra* Chapter 1 Section 1.1.

assessment modelling that optimizes control of different harmful substances where most environmental protection is achieved at lowest possible cost. However, considerations of bargaining between the control of different pollutants can also be based on other reasons.

Fourth, to the knowledge of this author, no closer examinations have been performed on the control of SO_x emissions in relation to waste regulation. It could possibly be argued that residual fuels are a form of waste, and should therefore not be treated as a product to be sold and used.

Fifth, although it is perhaps premature to try to predict how well the theories and methods used in this thesis could be applied for examining other fields and regulatory problems, it would nevertheless be interesting to try their potential, changing what needs to be changed.

The questions above are, however, beyond the scope of this thesis and will be left for future research.

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Naturvårdsverkets föreskrifter om utsläpp till luft av svaveldioxid, kväveoxider och stoft från förbränningsanläggningar med en installerad tillförd effekt på 50 MW eller mer

NFS 2016:9
Naturvårdsverkets föreskrifter om kontroll av luftkvalitet

SFS 1874:68
Hälsovårdsstadga

SFS 1968:551
Lag (1968:551) om begränsning av svavelhalten i eldningsolja

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SFS 1970:621
Kungörelse (1970:621) om begränsning av svavelhalten i eldningsolja

SFS 1980:424
Lag (1980:424) om åtgärder mot förorening från fartyg

SFS 1980:789
Förordning (1980:789) om åtgärder mot förorening från fartyg

SFS 1983:463
Lag (1983:463) om ändring i lagen (1980:424) om åtgärder mot vattenförorening från fartyg

SFS 1996:527
Lag om ändring i lagen (1980:424) om åtgärder mot vattenförorening från fartyg

SFS 1996:528
Förordning (1996:528) om ändring i förordningen (1980:789) om åtgärder mot vattenförorening från fartyg

SFS 1998:808
Miljöbalk

SFS 1998:897
Förordning (1998:897) om miljökvalitetsnormer

SFS 1998:946
Förordning (1998:946) om svavelhaltigt bränsle

SFS 1998:1707
Lag om åtgärder mot buller och avgaser från mobila maskiner

SFS 2000:372
Förordning (2000:372) om ändring i förordningen (1998:946) om svavelhaltigt bränsle

SFS 2001:1080
Lag (2001:1080) om motorfordons avgasrening och motorbränslen

SFS 2003:65
Förordning om nationella utsläppstak för luftföroreningar

SFS 2010:477
Luftkvalitetsförordning

SFS 2011:318
Avgasreningslag

SFS 2011:319
Drivmedelslag

SFS 2011:345
Avgasreningsförordning

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Drivmedelsförordning

SFS 2012:907
Lag om ändring i miljöbalken

SFS 2013:250
Industriutsläppsförordning (2013:250)

SFS 2013:251
Miljöprövningsförordning (2013:251)

SFS 2013:252
Förordning (2013:252) om stora förbränningsanläggningar

SFS 2013:253
Förordning (2013:253) om förbränning av avfall

SFS 2014:509
Svavelförordning (2014:509)

SJÖFS 1985:19
Sjöfartsverkets kungörelse om åtgärder mot vattenförorening från fartyg

SJÖFS 2005:8
Sjöfartsverkets föreskrifter och allmänna råd om åtgärder mot förorening från fartyg

SNFS 1993:14
Kungörelse med föreskrifter om utsläpp till luft från anläggningar för förbränning av kommunalt avfall som beviljats tillstånd enligt miljöskyddslagen (1969:387) efter den 1 januari 1994 och anläggningar med nominell kapacitet lika med eller större än 6 ton per timme som beviljats tillstånd enligt samma lag före den 1 januari 1994

TSFS 2010:96
Transportstyrelsens föreskrifter och allmänna råd om åtgärder mot förorening från fartyg

TSFS 2016:128
Föreskrifter om ändring i Transportstyrelsens föreskrifter och allmänna råd (TSFS 2010:96) om åtgärder mot förorening från fartyg

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Utrikesutskottets betänkande 1995/96:UU17 – Havsrättskonvention och tillämpningsavtalet

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