Enforcing International Maritime Legislation on Air Pollution through UNCLOS

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Introduction

Legislation that lowers the permissible sulphur content in marine fuel from a maximum of 3.5% to 0.5% may appear ordinary, rudimentary and unproblematic. This is, however, far from the reality. It is not ordinary or rudimentary, as such strengthened regulation can prevent 137,000 people worldwide from facing a premature death and 7.6 million children from developing asthma.[1] Nor is it unproblematic, as some shipowners can save billions of dollars each year by not adhering to this regulatory measure.

It is therefore essential that this sulphur limit, which is regulated in Annex VI to the International Convention for the Prevention of Pollution from Ships ('the MARPOL Convention'),[2] can be enforced effectively so that the global health benefits can be achieved. This obviously necessitates that shipowners who violate the regulations are not rewarded with higher profits but instead are penalised – appropriately and dissuasively.

Ships have traditionally enjoyed a special status within international law, regarding the exercising of jurisdiction over them. This distinct status has led to speculation as to whether the strengthened sulphur regulations can be enforced, and by whom, particularly when a ship violates the rules mid-ocean, far from any State.

It is the purpose of this book to establish that the United Nations Convention on the Law of the Sea (UNCLOS)[3] provides a legal basis for ensuring that the regulation of sulphur emissions by MARPOL Annex VI can be enforced effectively, regardless of where the violation occurs and which State the ship hails from.

The conclusions on enforcement through UNCLOS are also relevant and applicable for enforcing other international maritime legislation for protection of the environment, including impending legislative measures on reducing greenhouse gas (GHG) emissions from ships.

[1] See M Sofiev et al, 'Cleaner fuels for ships provide public health benefits with climate tradeoffs' (2018) 9:406 *Nature Communications* 4, available at https://www.nature.com/articles/s41467-017-02774-9#ref-link-section-d1456e583.

[2] International Convention for the Prevention of Pollution from Ships (adopted 11 February 1973, as modified by the Protocol of 17 February 1978, entered into force 2 October 1983) 1340 UNTS 61 (MARPOL), IMO Publication: IMO-520E.

[3] United Nations Convention on the Law of the Sea (adopted 10 December 1982, entered into force 16 November 1994) 1833 UNTS 3.

I. The Layout of the Book

This book is divided into five Parts consisting of 19 chapters.

Chapter 1 of Part I contains a brief introduction to the historic development of the MARPOL Convention and UNCLOS, the impact of sulphur pollution on human health and the potential savings for shipowners in not complying with the regulations. The challenges faced in detecting violations of and enforcing the regulations are also described.

The following chapters in Part I provide a basic introduction to the relevant regulatory frameworks of Annex VI of the MARPOL Convention (chapter 2) and UNCLOS (chapter 3). The practical enforcement of MARPOL, in accordance with UNCLOS, through Port State Control is analysed (chapter 4). The regional legislation under the European Union's (EU's) Sulphur Directive[4] is also examined, as the Directive has strong ties to MARPOL Annex VI (chapter 5). The final chapter of Part I describes the basic jurisdictional principles of international law and how these relate to a State's enforcement of international regulations (chapter 6).

Part II of the book contains a detailed analysis of the specific obligations and extended rights of different States to enforce rules for the protection and preservation of the marine environment, such as MARPOL Annex VI, in accordance with the special provisions of part XII of UNCLOS.

Following a general introduction to part XII of the Convention (chapter 7), the analysis will focus on the extended flag State obligations referred to in article 217 of UNCLOS (chapter 8) and the extended jurisdiction for coastal States according to article 220 (chapter 9) and for port States according to article 218 (chapter 10).

This gives way to an in-depth analysis of how UNCLOS, pursuant to article 228, governs questions of overlapping jurisdiction between States when enforcing environmental regulations in accordance with the legal basis of part XII (chapter 11).

The following chapter contains a brief overview of the procedural safeguards and general principles of dispute resolution found within UNCLOS (chapter 12). The final chapter of Part II offers a conclusion on the Part II analysis, including how the regulation of sulphur in marine fuels under Annex VI can be effectively enforced, irrespective of where a violation may occur (chapter 13).

In Part III of the book, the conclusions of the analysis in Part II are applied to enforcement of other international environmental maritime regulations (chapter 14). The conclusions of Part II are also put into perspective in relation to the enforcement of the anticipated future international regulation of GHG emissions from ships (chapter 15).

Part IV attempts to look at the enforcement of specifically international GHG regulation of ships from a completely different perspective. While Parts I–III of the book have a clear focus on analysing the enforcement of emissions regulations

[4] Directive 2016/802 of the European Parliament and of the Council of 11 May 2016 relating to a reduction in the sulphur content of certain liquid fuels [2016] OJ L132/58.

pertaining to sulphur and GHG through the 'classical' jurisdictional basis found in UNCLOS, Part IV discusses whether it is conceivable that the forthcoming GHG regulations pertaining to ships can, within the foreseeable future, attain the status of legislation protecting international recognised peremptory norms, that is jus cogens norms. The principles of jus cogens and erga omnes, and the ties to universal jurisdiction, are also explained (chapter 16).

The analysis itself is based on examined case law from the International Court of Justice (ICJ) and statements from the International Law Commission (ILC), read in conjunction with international scientific reports and predictions as to the negative climate developments due to continued release of GHG (chapter 17).

Finally, discussion is made of what the legal consequences would be if international regulations ensuring the reduction of GHG emissions from ships were to be deemed legislation protecting jus cogens norms, including the applicability of erga omnes enforcement principles (chapter 18).

In the last part of the book, Part V, an overall summary and conclusion is presented (chapter 19).

II. Man-made Pollution Emanating from Ships

Man-made pollution has resulted in the contamination of oceans from discharges of oil, chemicals, plastics, invasive species and other damaging substances, with devastating consequences for fragile undersea ecosystems and all living creatures therein.

One of the most harmful forms of man-made pollution is nevertheless *air pollution*, because it degrades the quality of the air on which living creatures and plants are so deeply dependent. For humans, inhalation of contaminated air may lead to the development of various diseases and disorders that, ultimately, can be life-threatening.

Some forms of air pollution can also lead to global warming, extreme weather, increased UV radiation, melting of the polar ice caps and rising sea levels, which can threaten the habitations and environment needed for the existence of most living things, including human survival. Furthermore, the socio-economic costs that such pollution can inflict on a society are gargantuan.

These are all examples of direct consequences resulting from anthropogenic air pollution, which includes such pollution emanating from ships.

As the destructive effects of man-made pollution became apparent, it naturally resulted in some States unilaterally attempting to reduce pollution through various measures, including national legislative measures. Yet much pollution, including air pollution, represents the total cumulative contamination emanating from various sources on land and at sea. Therefore, many international governing bodies, especially under auspices of the United Nations (UN), haven taken initiatives to seek the reduction of global air pollution, including the International

Maritime Organization (IMO), which is the UN's specialised agency responsible for ships and shipping. These initiatives include developing international rules and regulations through multilateral agreements[5] such as conventions and treaties.

The enforcement of IMO regulations on air pollution have, however, been the subject of much debate, as such enforcement must be carried out in accordance with basic principles of international law respecting the sovereignty and jurisdiction of all relevant States. Ships have a special place and status within international law, as distinct jurisdictions apply depending on a ship's flag and where it sails. This area of international law is usually referred to as the *law of the sea*.

Such jurisdictional principles pertaining to the international law of the sea are codified in UNCLOS, and consequently any State's enforcement of the IMO's environmental regulations must be exercised in accordance with the jurisdictional framework of UNCLOS, particularly the provisions of part XII of the Convention.[6]

III. The IMO

The IMO was established as a specialised UN agency in 1948, in accordance with article 57 of the UN Charter. It was founded as the Intergovernmental Maritime Consultative Organization (IMCO), but in 1982 its name was changed to the International Maritime Organization.

The IMO consists of a General Assembly and several permanent committees and sub-committees addressing different maritime topics, such as safety in the Maritime Safety Committee (MSC) and legal issues in the IMO Legal Committee (LEG).

Of particular relevance to this book is the IMO's work on regulating environmental matters in the Marine Environmental Protection Committee (MEPC) and in the sub-committee on Pollution Prevention Response (PPR). The MEPC was created in 1973 and initially focused on regulating pollution of the sea in the form of spills and discharges of oil, toxic materials and other harmful substances. Yet in recent decades the MEPC has increasingly widened its legislative scope to encompass measures on the discharge of harmful substances into the atmosphere originating from ships. This includes regulations pertaining to sulphur and nitrogen, and, most recently, taking early steps towards regulating GHG emissions, including carbon dioxide (CO_2).

[5] An example of such an international agreement was the 'Action Plan' developed at the UN Conference on the Human Environment in Stockholm in 1972 (hereinafter 'the Stockholm Conference'). The participating States undertook commitments to reduce pollution, including air pollution and pollution of the seas. This Action Plan included a list of 109 recommendations, which the States should implement to address these problems. This has since contributed to the IMO's developing different international regulations to ensure the reduction of pollution coming from ships.

[6] M Dixon, *International Law* (Oxford University Press, 2007) 235.

IV. Development of International Maritime Rules for the Protection of the Environment

The focus of international maritime laws changed significantly throughout the 1960s and 1970s. The rules of the IMO (then IMCO) had primarily dealt with ensuring the safety of ships in relation to the dangers for passengers, crews and other vessels.[7] But several shipwrecks during those years,[8] resulting in significant oil spills and extensive damage to the marine environment, prompted a change in the regulatory focus of the IMO.

Developments in the construction of ships had, after the Second World War, led to their carrying more cargo, including liquid cargoes such as oil. Consequently, when such transport ships (tankers) were lost at sea, it resulted in more damage to the marine environment.

Trying to mitigate the risk from transporting such dangerous cargoes, the IMO adopted several international conventions addressing these concerns. One of the first of these conventions for protection of the marine environment against oil pollution was the International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL), which entered into force on 26 July 1958.[9] OILPOL essentially banned tankers from discharging oil within 50 nautical miles of a coast. Also, from 1969, the Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties ('the Intervention Convention') provided coastal States with special jurisdiction to counter pollution hazards from oil spills outside the coastal State's territory.[10]

In 1972, the Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ('the London Convention') was adopted.[11] It sought to address the pollution that occurred when ships, platforms, etc were intentionally dumped in the sea as waste. A Protocol to the Convention was adopted by the IMO in 1996.[12]

In 1973, extensive IMO work culminated in the adoption of one of the most comprehensive international regulatory frameworks for the protection of the

[7] The first version of the International Convention for the Safety of Life at Sea (SOLAS), dating from 1914, was made as a direct consequence of the sinking of the *Titanic* in 1912. The latest version of SOLAS was adopted on 1 November 1974 and entered into force 25 May 1980, 1184, 1185 UNTS 2.

[8] One of those incidents was the loss of the *Torrey Canyon* off the coast of England in 1965.

[9] International Convention for the Prevention of Pollution of the Sea by Oil (adopted 12 May 1954, entered into force 26 July 1958) UNTS.

[10] The Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (adopted 29 November 1969, entered into force 6 May 1975) 970 UNTS 211 ('the Intervention Convention'). In 1973, the scope of the Intervention Convention was widened to include a Protocol Relating to Intervention on the High Seas in Cases of Marine Pollution by Substances Other Than Oil (adopted 2 November 1973, entered into force 30 March 1983) 1313 UNTS 3.

[11] Convention for the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (adopted 13 November 1972, entered into force 30 August 1975) 1046 UNTS 120.

[12] The Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (adopted on 17 November 1996, entered into force 24 March 2006) (1997) 36 ILM 1 prohibits dumping of all waste, apart from certain specified exceptions.

marine environment from ship pollution – the MARPOL Convention. At the same time, work was ongoing within the UN to create a new regulatory framework Convention for the Law of the Sea, UNCLOS. The increased attention given to pollution from ships during this period also affected this UN work, resulting in the establishment of strengthened enforcement paradigms within part XII of UNCLOS.

The Action Plan adopted in Stockholm in 1972 at the UN Conference on the Human Environment made direct references to these – at that time – ongoing works within the UN and the IMO (IMCO).[13] Recommendation no 86(e) encouraged all States to participate in the work, creating and adopting international rules and regulations that could control and reduce such pollution, including pollution of the marine environment. The recommendation directly referred to States' participation in the IMO (IMCO) Conference on Maritime Pollution, as well as the United Nations Conference on the Law of the Sea, which later led to the adoption of, respectively, the MARPOL Convention and UNCLOS. The recommendation encouraged States to:

> Participate fully in the Intergovernmental Maritime Consultative Organization 1973 (IMCO) Conference on Maritime Pollution and the Conference on the Law of the Sea scheduled to begin in 1973.

Also, recommendation no 92 of the Action Plan invited all participating States to support the work of the UN and IMCO, with the development of rules that could protect the marine environment and human health. Therefore, both the early preparatory work on UNCLOS[14] and works relating to the MARPOL Convention[15] contain direct references to recommendation no 92.

A. The MARPOL Convention

The MARPOL Convention was adopted on 17 February 1973 and entered into force on 2 October 1983. Nevertheless, it needed supplementing with an Amending Protocol as early as 1978, since several maritime disasters[16] in the period 1973–78 showed the need for clarification and strengthening of the regulations adopted in 1973. The Amending Protocol also entered into force in October 1983.

The MARPOL Convention is thus sometimes referred to as MARPOL Convention 73/78, but this book will use the shorter title 'MARPOL Convention'.

[13] See n 5.

[14] See UN General Assembly Resolution on protection of the marine environment, UNGA 78, 50.

[15] See IMCO, 'General principles for assessment and control of marine pollution recommended by the United Nations Conference on the Human Environment (Recommendation 92)', MP/CONF/INF.6, 7 May 1973, 1.

[16] This included the loss of the *Metula* off the coast of Chile in August 1974, the *Argo Merchant* off the coast of Massachusetts (US) in December 1976 and the *Amoco Cadiz* off the coast of France in March 1978.

References to Annex VI to the Convention will be cited as 'MARPOL Annex VI' or simply 'Annex VI', depending on the context.

The MARPOL Convention contains several basic provisions that apply to the Convention, the Protocol and the Annexes, including definitions of certain basic expressions and concepts (article 2), and obligations regarding the dissuasive enforcement of violations (article 4) and for the certification and inspection of all ships (article 5). The Convention also entails provisions that seek to clarify the relationship between MARPOL and international maritime law, that is UNCLOS (article 9).

When it was adopted the MARPOL Convention included five Annexes, which to this day still impose specific requirements on ships to protect the marine environment from various sources of pollution. The five original Annexes covered 'Regulations for the Prevention of Pollution by Oil' (Annex I), 'Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk' (Annex II), 'Regulations for Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form' (Annex III), 'Regulations for Prevention of Pollution by Sewage from Ships' (Annex IV) and 'Regulations for Prevention of Pollution by Garbage from Ships' (Annex V). Only the first two Annexes entered into force together with the Convention and the amending Protocol in 1983, the other three being non-mandatory *operational Annexes*. The remaining three Annexes have since entered into force,[17] making their contents mandatory for the Contracting States.

B. MARPOL Annex VI – Regulations for Prevention of Air Pollution from Ships

After seeing and experiencing the tremendous, devastating impacts on the marine environment following different maritime disasters, the focus of the international community in the 1960s and early 1970s was on preventing such pollution from ships, to which focus the MARPOL Convention and its Annexes I–V bore testament. Then, in the late 1970s and especially in the early 1980s, another source of pollution attracted international attention, including from the IMO. This time, it was a form of pollution that can be difficult to see with the naked eye, and as a result of which the immediate damage from a single violation can be hard to determine – *air pollution*.

Studies revealed that the air in many areas was contaminated by man-made pollution in the form of harmful particles and substances, including substances that also could destroy the ozone layer.[18] It was believed that some of these airborne

[17] MARPOL Annex V entered into force on 31 December 1988; MARPOL Annex III entered into force on 1 July 1992; and MARPOL Annex IV finally entered into force on 27 September 2003.

[18] See at https://www.theguardian.com/environment/2015/apr/18/scientist-who-discovered-hole-in-ozone-layer-warns.

pollutants, apart from having a negative impact on the environment due to acidification and eutrophication, also had a direct adverse effect on the human health by way of causing respiratory diseases and the development of cancers.

As a consequence, a series of international conventions were adopted following the Stockholm Conference, in an attempt to reduce man-made air pollution, including The Convention on Long-range Transboundary Air Pollution 1979 ('the LRTAP Convention'),[19] The Vienna Convention for the Protection of the Ozone Layer 1985[20] and The United Nations Framework Convention on Climate Change 1992[21] (UNFCCC or 'the Rio Declaration).[22] These measures were, however, largely aimed at reducing airborne pollution originating in land-based sources. During the 1980s and 1990s, the IMO (MEPC) expanded the scope of its regulatory protection scheme to encompass the reduction of air pollution from ships.

In 1991 the work of the IMO resulted in Resolution MEPC A.719(17) on Prevention of Air Pollution from Ships, which in 1997 led to the adoption of a new annex (Annex VI) to the MARPOL Convention. MARPOL Annex VI entered into force on 19 May 2005.

The objective of this Annex was to regulate and reduce emission levels of certain airborne pollutants primarily arising from the combustion of marine fuels, including emissions of sulphur oxide (SOx), nitrogen oxide (NOx), volatile organic compounds (VOCs) and ozone-depleting substances (ODS). Some of these requirements, including the regulation of sulphur in marine fuels, were strengthened in 2008 by the MEPC's adoption of Resolution MEPC.176(58), which revised MARPOL Annex VI. In 2011, through the adoption of Resolution MEPC.203(62), Annex VI was expanded to include regulations on increasing the energy efficiency of new ships relating to the reduction of CO_2.

Annex VI therefore sets itself apart from the first five Annexes of the MARPOL Convention, by changing the regulatory focus from hindering tangible pollutants of the marine environment with visible impacts to seeking an overall reduction of air pollution from international shipping because of its cumulative effects.

At the end of 2018, 158 States, which together account for 99.01% of the total merchant fleet in the world, had ratified the MARPOL Convention. In addition, 94 States, which together constitute 96.71% of the world's total merchant fleet, have ratified MARPOL Annex VI.[23]

[19] The Convention on Long-range Transboundary Air Pollution (adopted 13 November 1979, entered into force 16 March 1983) 1302 UNTS 217.

[20] The Montreal Protocol on Substances that Deplete the Ozone Layer (adopted 16 September 1987, entered into force 1 January 1989) 1522 UNTS 3 was adopted as a protocol to the Vienna Convention for the Protection of the Ozone Layer (adopted 22 March 1985, entered into force 22 September 1988) 1513 UNTS 323.

[21] The United Nations Framework Convention on Climate Change (adopted 9 May 1992, entered into force 21 March 1994) 1771 UNTS 107.

[22] See A Henriksen, *International Law* (Oxford University Press, 2017) ch 10.

[23] The ratification status of the different IMO conventions can be seen on the IMO's homepage at http://www.imo.org/en/About/Conventions/StatusOfConventions/Pages/Default.aspx.

Although the detailed content of MARPOL Annex VI will be reviewed in chapter 2 of this book, a brief introduction to regulation 14.1 of Annex VI, containing the global limits for the maximum allowed sulphur content of marine fuels, will be given here, as the question of enforcement of this regulation forms the basis of this book.

C. Regulation 14 of MARPOL Annex VI

Ships' emissions of sulphur particles are a major source of air pollution, which has a significant negative impact on human health and on the environment. Regulation 14.1 of MARPOL Annex VI therefore aims at the continuous reduction of the sulphur content of marine fuels.

Regulation 14.1 provides as follows:

> The sulphur content of any fuel oil used on board ships shall not exceed the following limits:
>
> 1. 4.50% m/m prior to 1 January 2012;
> 2. 3.50% m/m on and after 1 January 2012; and
> 3. 0.50% m/m on and after 1 January 2020.

Regulation 14.1.1 states that from the point of entry into force of the Annex in 2005 up to 31 December 2011, a global maximum limit of 4.50% (m/m)[24] sulphur in marine fuels applied. From 1 January 2012 the regulation was strengthened, with the permissible sulphur limit being reduced to 3.50% pursuant to regulation 14.1.2.

From 1 January 2020 the sulphur limit is once more to be lowered, this time significantly, to 0.50% according to regulation 14.1.3.[25] It is this regulation that has led to speculation about how the limit can be enforced effectively after coming into force.

It should be noted that an amendment to regulation 14.1, coming into force in March 2020,[26] will delete the references to the previous limit values of 4.50% and 3.50% pursuant to regulation 14.1.1 and regulation 14.1.2. Regulation 14.1 will thereafter consist of only one subparagraph and only one *global* limit value in the form of the 0.5 % limit, which, at that time, will have entered into force three months earlier. The reasoning behind this change is that the provisions

[24] Regulation 14.1 refers to the maximum allowed sulphur content in terms of '% m/m'. The abbreviation 'm/m' means 'mass/mass', and '% m/m' refers to 'mass/mass percent'. In other words, when, for example, reg 14.1.3 refers to marine fuels not having a maximum sulphur content exceeding '0.5% m/m', it means that a specific amount of fuel (fuel-mass) may not consist of more than 0.5% sulphur (sulphur-mass). This book, for reasons of simplicity, only refers to the percentage of sulphur, ie '0.5%', when referring to the global limit in reg 14.1.3.

[25] The 0.5% sulphur limit was adopted by Resolution MEPC.176(58).

[26] This change will be effectuated in connection with a planned revision of the regulation as part of the implementation of the so-called *carriage ban*, which is described later in this chapter.

(subparagraphs) that refer to the previous limits are obsolete and should be removed from regulation 14.1. Nevertheless, this book will refer to the subparagraphs applicable at the time where the 0.5% limit enters into force, that is, regulation 14.1.3.

D. EU Sulphur Directive

As noted in section I, the EU also regulates the sulphur content of marine fuels in Directive 2016/802 relating to a reduction in the sulphur content of certain liquid fuels, often referred to as the 'Sulphur Directive'.

The Directive has, since it was first adopted in 1993,[27] undergone several changes and amendments, until a codified version was presented in 2016.[28] It is the provisions of this 2016 version that are meant in this book when reference is made to the Sulphur Directive.

The Sulphur Directive is reviewed in chapter 5 of this book, but it will not be subjected to the same detailed analysis as regulation 14.1.3 of MARPOL Annex VI. The reason for this is that MARPOL Annex VI has global applicability, meaning that ships must comply with it wherever they sail, whether in the middle of the Pacific or the Atlantic Oceans, whereas the geographical applicability of the EU Sulphur Directive is limited to areas under the jurisdiction of EU Member States, and it is therefore often referred to as *regional* regulation.

V. Sulphur Pollution – Harmful to Humans and the Environment

That sulphur emissions are among the airborne substances regulated in Annex VI is based on scientific research proving that sulphur pollution can have a harmful impact on human health and on the environment.[29] This is directly specified, inter alia, in the fourth paragraph of the preamble to the EU Sulphur Directive:

> [E]missions from shipping due to the combustion of marine fuels with a high sulphur content contribute to pollution of the air by sulphur dioxide and particles that are harmful to human health and the environment, and which contribute to the formation of acid rain.

Furthermore, it is stated:

> Without the measures provided for in this directive the emissions from shipping before long would be higher than emissions from all land-based sources.

[27] Council Directive 93/12/EEC of 23 March 1993 relating to the sulphur content of certain liquid fuels [1993] OJ L74/81.

[28] Directive (EU) 2016/802 of the European Parliament and of the Council of 11 May 2016 relating to a reduction in the sulphur content of certain liquid fuels [2016] OJ L132/58.

[29] The previously described international regulation of air pollution, eg through the LRTAP Convention, has led to the reduction of sulphur pollution from land-based sources. Sulphur pollution originating from shipping has the same negative consequences.

To better understand the harmful effects of sulphur emissions, a brief introduction to the scientific origin of sulphur is needed.

Sulphur is a natural element that has the atomic number 16 in the periodic table, with the atomic character 'S'. Sulphur is naturally found in organic material, including in fossil fuels such as coal, natural gas and oil. Oil that is processed into marine fuel therefore contains natural deposits of sulphur.

When marine fuel is burned to create energy and propulsion of a ship, the combustion process starts a chemical reaction causing the sulphur (S) bound in the fuel to react with oxygen (O_2) in the air, resulting in the formation of sulphur dioxide (SO_2).

In the atmosphere, sulphur dioxide is converted to sulphate, which can be deposited either as salts or as sulphuric acid. Sulphuric acids are one of the main reasons that precipitation polluted with sulphur becomes acidic (acid rain). Sulphate also contributes to the formation of particulate matter. As the exact state of the released sulphur oxide can vary, it is often referred to as 'SOx' where the 'x' indicates the unknown state of the sulphur.[30] This book uses 'sulphur' and 'SOx' as general and generic terms to cover different sulphur components in the exhaust fumes from ships emitted into the atmosphere via the ships' funnels (smokestacks). Similarly, 'GHG' is used to cover the diverse types of greenhouse gas, including CO_2, methane, etc.

A. How Sulphur Emissions from Ships Affect Human Health

Sulphur oxides can, as previously described, travel in an airborne state over long distances[31] until, for example, they are absorbed by humans via inhalation, at which point they can contribute to the irritation of the eyes and mucous membranes, and eventually lead to chronic respiratory disorders and diseases, including asthma, chronic bronchitis, etc. They can also cause cardiovascular diseases and result in premature death.

Certain vulnerable groups of people, including the elderly, sick, children, infants and pregnant woman, are considered as being at increased risk of suffering such adverse effects of sulphur pollution.[32] A Finnish report from 2016[33] estimated excess sulphur pollution from shipping alone to be responsible for more than 100,000 premature deaths each year, with most of these casualties occurring in highly populated coastal and harbour areas, particularly in Asia and Africa.[34]

[30] See at https://ww2.arb.ca.gov/resources/sulfur-dioxide-and-health.

[31] See at https://www.nilu.no/en/research/atmosphere-and-climate/long-range-transport-of-air-pollutants/.

[32] See Sofiev et al, n 1.

[33] JJ Corbett et al, 'Health Impacts Associated with Delay of MARPOL Global Sulphur Standards' (Finnish Meteorological Institute, 12 August 2016), available at http://shippingwatch.com/article9069067.ece/binary/Svovl_tidlig_doed.pdf, where the report was attached as an annex to a Finish submission to the IMO.

[34] The Finnish report also assesses, from a socio-economic angle, the costs for society associated with each premature death resulting from sulphur pollution from ships to be approximately $277,000.

The term 'excess sulphur pollution' is in this context used to describe the global consequences of the 0.5% sulphur limit's not coming into force or not being enforced, meaning that the shipping sector would continue to use marine fuels with a content of up to 3.5% sulphur. The reason for applying the term 'excess sulphur pollution' is that the Finnish report examined the global consequences of postponement of the entry into force of the 0.50% limit from 2020 to 2025, leaving the 3.50% limit to apply for a further five years.[35]

In 2018, two years after the Finish report, the disturbing consequences of excess sulphur pollution were confirmed and – unfortunately – uprated, as a study predicted that excess sulphur pollution every year would result in up to 137,000 premature deaths worldwide.[36] The report also noted that approximately 15,000 (14,800) of these premature deaths due to the development of lung cancer could be directly attributed to atmospheric sulphur emissions from shipping.

The same study further calculated how many cases of asthma among children could be avoided. It concluded that 7.6 million children will avoid developing asthma each year if the shipping industry uses 0.5% sulphur in marine fuels instead of 3.5%.

If ships were to continue to use much cheaper marine fuels with higher sulphur content, that is 3.5% or more, this would lead to the same harmful consequences for human health as described in the two reports occurring *every year on a permanent basis*. These calculations will be used in this book to describe the potential health benefits that will not be fully achieved if the 0.5% limit is not complied with due to lack of effective enforcement.

B. How Sulphur Emissions from Ships Affect the Environment

When sulphur emissions from ships, after undergoing the previously described chemical reactions, fall as acid rain, this can have significant negative consequences for the environment.

If acid rain falls over land it can have damaging consequences for trees, plants, crops, etc, as they absorb the acidic water, which affects their growth and eventually causes them to wither away. This is particularly so in areas where the earth is

[35] The reason for this discussion of a five-year postponement of the entry into force of the limit was the review provision (reg 14.8) in MARPOL Annex VI, which stipulated that a study of the global fuel market should be made to determine the availability of 0.5% fuel on the market in 2020. If Parties, based on the study, decided that it was not possible for ships to comply due to lack of compliant fuel, the regulation would allow for the delaying of the entry into force of the 0.5% limit until 2025. The fuel availability study ('Assessment of fuel oil availability', carried out by CE Delft and presented in submission MEPC70/INF.6 at MEPC70 in 2016, available at https://www.cedelft.eu/publicatie/assessment_of_fuel_oil_availability/1858) showed that there would be sufficient quantities of 0.5% fuel in 2020, which led the MEPC in 2016 to conclude that the entry into force of reg 14.1.3 should not be postponed. The Finnish health study was submitted to the IMO as a part of these discussions. Reg 14.8 is discussed in ch 2.

[36] See Sofiev et al, n 1, 4–5.

not very calcareous and therefore not able to efficiently neutralise the sulphur, for example in Sweden, where acid rain in the past has caused widespread deforestation of woodland areas.[37]

If acid rain falls in streams and lakes it can acidify the water by lowering its pH value, which can have severe consequences for the local ecology and the animal life of those streams and lakes.

Acid rain can also acidify seawater, especially in coastal areas, bays and ports, due to the reduced ebb and flow of the water, which can lead to a greater concentration of pollution in confined areas. This can have a destructive impact on the biodiversity, particularly in fragile ecosystems, including having adverse effects on plankton, corals and other organisms that also provide habitats and food for other species and marine life.[38]

Acidification can further have a negative impact on the biodiversity and marine life of the open oceans. This has occurred in places to such an extent that scientists refer to some parts of the oceans as being *dead zones*,[39] where ecosystems and animal life have been destroyed or are under threat of destruction. This is attributed, inter alia, to the discovery of the SUP05 bacterium[40] in deep areas of the oceans.[41] This bacterium can oxidise sulphur and tie it into organic material, including into the tissue of living organisms and animals like clams. SUP05 is a bacterium that is always present in the sea, but when introduced to certain other substances such as sulphur, it interacts with them, causing the bacterium to multiply exponentially, leading to further oxidisation resulting in deleterious effects to the ecology and marine life in these areas.

As the number of ocean dead zones are presumed to be increasing, in November 2017 this, amongst other reasons, prompted 15,364 researchers from 184 countries to sign an open letter, 'World Scientists' Warning to Humanity: A Second Notice',[42] warning the international community against such devastating environmental developments.

VI. What Shipowners Can Gain by Not Complying with the Sulphur Regulations

It should be obvious, due to the previously cited scientific research proving the harmful effects of sulphur pollution from ships, that regulations seeking to reduce

[37] See at https://www.britannica.com/explore/savingearth/acid-rain/.

[38] See at https://ec.europa.eu/jrc/en/news/ocean-acidification-exacerbated-emissions-ships-major-shipping-routes.

[39] Seeathttps://www.cbc.ca/news/technology/dead-zone-microbe-measures-ocean-health-1.814677.

[40] See at http://aem.asm.org/content/79/8/2767.full.

[41] See at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3554405/.

[42] See at https://academic.oup.com/bioscience/article/doi/10.1093/biosci/bix125/4605229.

these pollutants, such as regulation 14.1.3 of MARPOL Annex VI, ought to be complied with. The responsibility for ensuring such compliance lies with the shipowners.

In this book, the term 'shipowner' is used as a generic reference to the individual, legal person or entity (often a company) responsible for a ship, including being responsible for instructing the ship to use non-compliant fuel, and who or which stands to gain economically by not complying with the regulations.[43] UNCLOS also uses the same term.[44]

It is predicted that there will be a significant financial incentive for shipowners not to adhere to the more stringent 0.5% sulphur limit, as marine fuel with a low sulphur content will be much more expensive than high-sulphur marine fuel.[45] Different estimates and calculations have been made setting out the potential price difference between 0.5% fuels and 3.5% fuels, as the latter will continue to be available on the market after 2020.[46] These estimates place the price spread between 0.5% and 3.5% marine fuel in the range of $150–$200 per ton.[47] Based on such predictions, a large containership could save around $750,000 sailing from a port in Asia to a port in Europe[48] when using non-compliant 3.5% marine fuel instead of compliant 0.5% fuel. A shipowner with a large fleet of merchant ships could therefore save billions of dollars annually by failing to comply with the 0.5% limit.

This would create an uneven playing field for shipowners that comply with regulation 14.1.3 of MARPOL Annex VI, as some expect to spend more than $2 billion extra on fuel each year.[49] Some calculations have shown that the container

[43] Different commercial agreements, for instance the chartering of a vessel, can result in different constellations of responsibilities when operating a commercial ship, eg in accordance with the International Safety Management Code (ISM Code). It is not the intention of this book to illustrate the different persons, companies or legal entities that might be liable for a ship's violation. The relevant authorities (environmental, maritime, public prosecutors, etc) in the country where a violation is detected will be able, on a case-by-case basis, to utilise the jurisdictional basis of UNCLOS, as described in this book, to prosecute the correct person or legal entity responsible for it.

[44] See art 115 of UNCLOS.

[45] Due to the lack of demand, 0.5% marine fuel will not be a commodity available in larger quantities on the global fuel market before the coming into force of the new regulation, hence making the exact price of this fuel difficult to assess up until that point.

[46] Marine fuels with a high sulphur content, such as 3.5% products, will continue to be available after 1 January 2020. One of the reasons for this is that it will be legal for a ship to use fuel with a high sulphur content exceeding 0.5% if the vessel is employing an approved Exhaust Gas Cleaning System (EGCS), which cleans and purifies the emissions/gases from the ship by spraying water into the exhaust fumes, resulting in these having the same low levels of sulphur as those of a ship using 0.5% fuel. Many of these EGCS systems are so-called 'scrubber systems'. The rules and requirements for using such systems are described in ch 2.

[47] B Schieldrop, IMO 2020 Report #2, Skandinaviska Enskilda Banken (SEB) (25 October 2018) 9. This report even suggests a spike in the price spread between 0.5% and 3.5% fuel in 2020 of $360 per ton, before dropping down to the $200 range from 2021 onwards (ibid table 3). See at https://webcache.googleusercontent.com/search?q=cache:A-3iUin-QPIJ:https://webapp.sebgroup.com/mbs/research.nsf/alldocsbyunid/65BE99C18C39C835C12583310043C55F/%24FILE/2018_10_25_SEB_IMO_2020_Enough_MFO_05_if_the_price_is_right_Final.pdf+&cd=1&hl=da&ct=clnk&gl=jp.

[48] See at https://www.bloomberg.com/news/articles/2018-08-29/maersk-sees-fuel-bill-soaring-by-2-billion-from-2020-rules.

[49] ibid.

shipping industry alone will face an extra $10 billion fuel bill every year.[50] These costs will to a considerable extent be passed on the customers through increased freight rates or special surcharges.[51]

Non-compliant shipowners would not face these extra fuel bills, allowing them to generate greater profits for themselves and their shareholders, and at the same time to offer reduced freight rates to customers compared to compliant competitors.

Lack of effective enforcement of regulation 14.1.3 could therefore quickly create a vicious circle, where compliant shipowners are faced with the bleak outlook of either being strong-armed out of the shipping market by non-compliant competitors, or becoming non-compliant themselves in an attempt at self-preservation and survival in an uneven competitive market. As most international shipowners in such a scenario steadily become non-compliant, or disappear, the environmental and human health benefits from using maximum 0.5% instead of maximum 3.5% marine fuels are consequently also lost.

So, from environmental, human health and business viewpoints, strong enforcement of regulation 14.1.3 of MARPOL Annex VI is key. Enforcement that relies on the jurisdictional grounds embodied in UNCLOS.

VII. UNCLOS – A *Lex Superior* Framework Convention of the Sea

To obtain the full potential beneficial environmental and health-related impacts of the 0.5% limit, and to avoid commercial speculation in non-compliance, the Annex VI sulphur regulations must be enforced effectively. This means that regulation must be controlled and that any violation that is detected must be sanctioned so severely that it discourages future violations, especially considering the economic incentive for shipowners not to comply with the regulations.

This requirement for control and effective enforcement falls upon States, that is, the relevant government authorities for dealing with such violations, often the environmental or maritime (port) authorities who – sometimes in collaboration with the police and public prosecutors – bring such cases before a court, where the penalty normally consists of a fine. Many States provide the defendant with the option of paying the fine before going to court, thereby allowing the person or company to avoid additional court fees and the expense of legal representation, etc. Such fines can be issued by the police or as administrative fines directly imposed by the responsible (environmental or maritime) authority.

[50] See Report from AlixPartners, *2019 Global Container Shipping Outlook* (February 2019) 5, available at https://www.alixpartners.com/insights-impact/insights/2019-global-container-shipping-outlook/.

[51] See at https://www.maersk.com/en/news/2018/09/17/maersk-to-change-fuel-adjustment-surcharge-ahead-of-the-2020-sulphur-cap.

Irrespective of any State's national legal system, all violations of international maritime rules, such as MARPOL Annex VI, must be enforced in accordance with the jurisdictional framework provided for in UNCLOS, as the Convention specifies which rights and obligations different States have at sea. UNCLOS is therefore often referred to as a framework convention[52] or as being the Constitution of the Sea,[53] as it codifies many basic customary principles of international law (ie the law of the sea), including different enforcement paradigms for different States, depending on whether these are designated as *flag*, *coastal* or *port States*.

UNCLOS bestows different rights and imposes different obligations on each of these three types of State, including prescribing different jurisdictions for enforcing violations of international environmental regulation. One State can of course be a flag State, a coastal State and a port State if it has a ship registry, a coastline and one or more ports. It depends on the specific circumstances of a given situation whether a State is considered a flag, coastal or port State in terms of which UNCLOS regulations can be invoked.

If a State wishes, or is under duty, to implement, control or enforce regulation over ships that are registered in the State, and which are thus sailing under (flying) that State's (country's) flag, the State is deemed a *flag State*. On the other hand, if a State wants to implement, control or enforce rules governing *foreign ships*,[54] for example when they are sailing in areas of the sea under the State's jurisdiction, that State is considered a *coastal State* or a *port State*. This means that a State that is party to MARPOL Annex VI must ensure that the rules of the Annex, including regulation 14.1, are enforced in accordance with UNCLOS over ships flying its flag (as a flag State) and in areas under its jurisdiction (as a coastal or port State).

No national, regional or international regulation can therefore be applied and enforced at sea by a State, without this being in accordance with UNCLOS. Thus, the rights and responsibilities set out in UNCLOS regulate the grounds for controlling, stopping, investigating, prosecuting and sanctioning vessels that do not comply with these rules.

If there is a discrepancy between other regulations (national or international) and UNCLOS, the latter must be followed, as to a considerable extent it codifies the fundamental principles of the law of the sea. UNCLOS must therefore be considered *lex superior* to other rules and regulations when it comes to determining a State's sovereignty and jurisdiction over ships under its flag and over different maritime areas and the foreign ships therein. National authorities and courts must

[52] See Advocate General Wahls, Advisory Opinion, in Case C-15/17 *Bosphorus Queen Shipping Ltd Corp v Rajavartiolaitos*, 28 February 2018, ECLI:EU:C:2018:557, para 59. This case is reviewed in ch 5.

[53] H Ringbom, 'Enforcement of the Sulphur in Fuel Requirements: Same, Same but Different', available at https://webcache.googleusercontent.com/search?q=cache:EBk8-0aReA0J:https://www.duo.uio.no/bitstream/handle/10852/61600/SO-Artikel-Ringbom.pdf%3Fsequence%3D4%26isAllowed%3Dy+&cd=1&hl=da&ct=clnk&gl=no, 20.

[54] The term 'foreign ships' refers to ships not flying the flag of the State but flying a foreign flag.

respect the jurisdictional paradigms laid out in this Convention when enforcing legislation at sea, in this instance the 0.5% sulphur limit.

Furthermore, some of the regulations under UNCLOS could be said to have the status of *lex specialis* themselves, as the Convention contains specialised provisions that, unlike some national legislation, distinguish what sort of a violation a ship has committed, for example whether it is a *discharge* or a *dumping* violation.

A. Flag State Jurisdiction on the High Seas – A Historical Principle

As described, a *flag State* is the State where a ship is registered, and it therefore sails under the flag of that State.

The right of States to let ships register and fly their flags has, since the adoption of the Declaration recognising the Right to a Flag of States having no Sea-coast in 1921, also applied to landlocked States.[55] This was later codified in article 90 of UNCLOS, giving rights to all States, including landlocked States, to let ships sail under their flags.

A ship can, pursuant to article 92, only sail under the flag of one State, and it is thereby, apart from exceptions set out in UNCLOS, etc, also subject to the exclusive jurisdiction of that State when sailing on the high seas.[56]

Article 94 stipulates that the flag State shall effectively exercise its jurisdiction over ships flying its flag, including ensuring that these ships comply with national and international rules on safety, working environment, crewing, etc. The flag State is therefore, pursuant to article 94(6), also obligated to investigate and take necessary action when foreign States inform the flag State of a violation committed by a ship under its flag.[57]

Article 94 also requires a flag State to maintain a register of ships flying its flag, with relevant information about the ships. Shipowners often pay a fee to the flag State for the registration of a ship, and continue to make payments to the State in the form of paying taxes (tonnage tax).

A flag State's responsibility to ensure that ships flying its flag comply with international environmental regulations, including MARPOL Annex VI, is regulated in the specific (*lex specialis*) provisions covering this in part XII of UNCLOS,

[55] Declaration recognising the Right to a Flag of States having no Sea-coast (adopted 20 April 1921, entered into force 8 October 1921) 7 LNTS 73. See NK Mansell, *Flag State Responsibility – Historical development and contemporary issues* (Springer-Verlag, 2009) 21.

[56] The 'high seas' is a legal term used to describe areas of the sea that are located outside any State's territorial waters and Exclusive Economic Zone (EEZ). See UNCLOS, art 86. These areas are therefore not subject to the territorial jurisdiction of any State. Examples of such areas are large parts of the Pacific, Atlantic and Indian Ocean.

[57] NM Hosanee, '*A critical analysis of flag State duties as laid down under article 94 of the 1982 United Nations Convention on the Law of the Sea*', The United Nations-Nippon Foundation Fellowship Program (2009–2010).

articles 192–237. According to article 217, this includes special obligations for the flag State to investigate, effectively enforce violations and promptly notify the IMO and other States of their effective enforcement. Article 217 is discussed in more detail in chapter 8 of this book.

The common denominator of articles 92, 94 and 217 is that they codify a historical founding principle within the law of the sea,[58] referred to as *the flag State principle*. The flag State principle dictates that, apart from codified exceptions, for example found in part XII of UNCLOS, only a flag State has jurisdiction when a ship under its flag violates an international rule whilst sailing on the high seas.

In practice, the flag State principle not only bestow flag States with an exclusive right to enforce international rules, it also entails an obligation to do so, as explicitly stated in articles 94 and 217.

B. Open Registry States – Flag States that Fail to Enforce Effectively

Despite the clear requirements in UNCLOS for flag States to effectively enforce international rules on ships flying their flags when sailing on the high seas, some do not fully live up to these obligations. The reason for this is often related to the aforementioned fact that shipowners pay a registration fee and a tax for having a ship registered in a flag State. These fees and taxes represent a significant revenue base for some flag States. Hence, some States offer (implicitly) particular advantageous terms for shipowners in an attempt to gain as large a merchant fleet as possible under their flag. These advantageous terms can, for example, involve the flag State's not exercising its jurisdiction over ships flying its flag when they violate international laws, or at least not exercising such jurisdiction effectively. Such flag States are often referred to as being 'open registry States'.[59] Another term used to describe such flag States is that they offer a 'flag of convenience'.[60] This book uses the term 'open registry flag States'.

It could be a potential win–win scenario for shipowners and open registry flag States, if the latter do not effectively penalise violations of the 0.5% sulphur limit. Shipowners could save billions of dollars on fuel expenses each year, and delinquent flag States could attract new shipowners, giving those flag States a larger income from the extra registered ships.

Open registry flag States could potentially also attract new non-compliant shipowners even if they enforce the regulations under MARPOL Annex VI, if this

[58] There are references to the principle in the verdict of the Permanent Court of International Justice in the *Lotus case* from 1927 (*SS Lotus (France v Turkey)* PCIJ Rep Ser A No 10 (7 September 1927) – see ch 6) and it was codified in art 11(1) of the Convention on the High Seas 1958 (adopted 29 April 1958, entered into force 30 September 1962) 450 UNTS 11, which today is implemented in art 97 of UNCLOS (see ch 3).

[59] See Mansell, n 55, 18, fn 14.

[60] See Henriksen, n 22, 165.

enforcement is ineffective. As savings for a shipowner could be in the range of $750,000 for a single non-compliant trip from Asia to Europe, a potential fine from a flag State to a shipowner of, for example, $50,000[61] for such an infringement would – although constituting a high fine compared to fines usually issued for violations of international regulations in other regulatory areas, such as safety, crewing, etc – nonetheless amount to *ineffective enforcement*, as the shipowner could pocket a $700,000 saving for the violation.

This could quickly lead to the previously envisioned vicious circle, forcing otherwise compliant shipowners to re-register their fleets with an open registry flag State to survive in an uneven competitive market, completely negating the potential environmental and health benefits expected from the 0.5% sulphur limit in MARPOL Annex VI.

It is therefore important to determine whether other States than flag States, that is coastal or port States, can exercise jurisdiction over such violations of regulation 14.1.3 of Annex VI committed by foreign ships, to counter any lack of enforcement by open registry States and prevent the vicious-circle effect. This author believes that part XII of UNCLOS provides such a jurisdictional basis, which will be analysed in Part II of this book.

VIII. Challenges with Detecting and Proving Violations on the High Seas

The purpose of this book is to clarify whether there is a legal basis for non-flag States to effectively enforce MAROL Annex VI,[62] ensuring that violations are met with effective sanctions (fines). There is, however, another aspect of ensuring the effective enforcement of the 0.5% sulphur limit that this book does not address in detail, regarding practical enforcement, that is, *detecting violations*.

The initial test of whether the fuel on board is non-compliant is carried out by examining the Bunker Delivery Note (BDN), which is issued by the fuel supplier to the ship each time marine fuel is 'bunkered' (taken on board). This follows from regulation 18.5 of MARPOL Annex VI.

The BDN specifies the sulphur content of the delivered fuel, and a (port) State's authority will begin a control (inspection) of a ship by examining this document. The inspection will also focus on whether the BDN itself meets the formal requirements of appendix 5[63] of MARPOL Annex VI.

[61] Ringbom, n 53, 21, fn 74.

[62] The conclusions of Part II regarding enforcement of the sulphur limit of reg 14.1.3 can be applied to the enforcement of other emission regulations, including future GHG measures, which are described in Part III of this book.

[63] The BDN is described further in ch 2.

If a BDN shows that fuel being used has a non-compliant sulphur content, or if the BDN is missing, flawed or can be suspected of being falsified, it will give the authorities grounds for examining the fuel in greater detail by drawing a fuel sample and analysing it. Fuel samples can also be drawn and analysed on grounds that do not directly relate to the BDN. In fact, the drawing of fuel samples is an integral part of Port State Control (PSC) that many port States perform. This PSC is described in chapter 4.

Fuel samples are drawn from the ship's fuel system, usually as close as possible to the engine where the fuel is combusted.[64] The fuel sample is afterwards taken to a laboratory for an analysis that determines the precise sulphur content of the fuel.

If the analysis shows that non-compliant fuel is being used, and the ship has not yet departed, the port State can demand that the ship debunker (remove) the non-compliant fuel and bunker compliant fuel instead. The port State can further demand that the ship (shipowner) post economic security (bail) to cover any potential fine before the ship is permitted to sail. The posting of economic securities by non-compliant ships is a key factor in achieving effective legal enforcement of MARPOL Annex VI.[65]

Yet a fuel sample taken from the main engine fuel oil system merely provides evidence as to whether the ship was using compliant fuel coming into port. It can be difficult to detect and prove any prior violation of the sulphur regulations, especially infringements that may have occurred days or weeks earlier on the high seas.

It should be noted in this regard that many ships have several fuel tanks on board that can contain different types of marine fuel, such as fuels with 0.1% and 0.5% (and 3.5%) sulphur content. The ship can switch the fuel tank that supplies the last (day/settling) tank before the fuel reaches the engine. It is therefore possible that a ship might sail for weeks on end, for instance when crossing the Pacific, on non-compliant 3.5% fuel and then, perhaps 24 hours prior to arrival in port, change to compliant 0.5% fuel stored in another tank on board.

Such a switch, carried out shortly before entering port, could nevertheless potentially lead to a *positive* (ie non-compliant) test result, as 3.5% residues in the combustion system could contaminate the 0.5% fuel, resulting in a higher sulphur value. In spite of that, given the chance of potentially saving billions of dollars a year, some non-compliant shipowners may approach such switchovers with scientific accuracy to determine when a fuel changeover from a non-compliant to a compliant fuel could be made without resulting in a positive test result. This leads to challenges with *practical enforcement* of regulation 14.1.3, regarding the detection and proof of non-compliance during a voyage on the high seas, for example in the middle of the Pacific.

[64] Fuel samples are therefore normally drawn from the day (/settling) tank, as these tanks often feed fuel directly into the engine.

[65] PSC and the possibilities for detaining ships and requiring economic security (bail) are discussed in ch 4.

A. Developing Advanced Methods and Technologies for Detection

Because of the abovementioned challenges in proving non-compliance, research and development of alternative technical solutions to aid such detection have evolved into a fast-growing area of business. Some of the most promising and scientifically recognised solutions will briefly be touched upon in the following to underline that one or more of these solutions, perhaps used in conjunction with fuel sampling, will be able to detect and prove non-compliance during any part of a voyage, including on the high seas.

One of the most developed and promising solutions for external detection of infringements of the sulphur limit is the use of a *remote sensing technology*, which measures the SO_2/CO_2 ratio in the exhaust fumes (emissions) coming out of a ships funnel. Too high a SO_2/CO_2 ratio in the exhaust fumes is a clear indication that non-compliant fuel is being used.

The devices utilising this remote sensing technology are often referred to as *sniffers*, and they can be fitted to bridges,[66] aircraft, helicopters, other ships and drones. Research has shown that sniffers attached to long-range solar-operated drones might be an effective way of detecting non-compliant ships in the middle of an ocean, as these drones can operate for extended periods of time, flying over ships and shipping lanes, measuring funnel output and combining the data with AIS data.[67] These combined data could immediately identify a ship not complying with the sulphur regulations and inform the authorities in the ship's next port of call. Further development of this technology and positive empirical data on the level of confidence resulting from the measures could lead to remote sensing (sniffers) being used as the sole evidence for proving non-compliance.

Another possibility is to install continuous monitoring of the emissions output. Noting this internal (on-board) detection technology is often abbreviated to CEMS ('Continuous Emission Monitoring System'), and it is already applied on most ships using an Exhaust Gas Cleaning System (EGCS),[68] which cleans the emissions from ships' exhaust gases, as described in chapter 2.

[66] In Denmark, the Danish Environmental Protection Agency has used a fixed sniffer attached to the Great Belt Bridge to detect non-compliant ships sailing through the Great Belt. See at https://eng.mst.dk/about-us/news/news-archives/2017/okt/two-shipping-companies-reported-to-the-police-for-sulphur-pollution/. It should be noted that some in some areas, including the waters off Denmark, a lower 0.1% sulphur limit already applies. This is described in ch 2.

[67] AIS refers to the Automatic Identification System that all merchant ships must use. The AIS data are transmitted continuously from a transponder on board a ship, sending GPS updates on the ship's position, along with information about the ship, eg the ship's unique identification number (IMO number), its name, its next port of call, etc.

[68] Regulation 4.1 of MARPOL Annex VI allows for the use of alternative means of compliance, eg approved technologies that reduce the sulphur emission levels to levels equivalent to using compliant fuel in accordance with the conversion table (table 1) implemented in MEPC Resolution MEPC.259(68).

Other promising means of detecting violations anywhere on the open seas is through *satellite monitoring*. Satellites have already been launched from different companies, and have shown themselves to be able to monitor and measure large emissions of SOx, NOx, CO_2, etc on a busy sailing route. Still, this technology must be developed further to be able to identify the emissions from specific ships. The satellite data could be used in conjunction with the aforementioned sniffers attached on a helicopter, plane or drone, using the sniffer to carry out exact measurements of a particular ship as a follow-up to a satellite's indication of general non-compliance in a particular area.

Development of a *fuel calculator* has also been mentioned as a possible means of detecting non-compliance. It is a method of calculation that is meant to determine the amount of fuel that a ship *should* have used, and which then compares the result to the ship's information on the amount of fuel *actually* used to find any discrepancies. This to prevent ships from filling a fuel tank with unregistered non-compliant fuel and burning that fuel before coming into the next port.[69] The method uses various data for the calculation, including the ship's size and engine, its cargo, speed, weather conditions, etc.

As mentioned, the fuel sampling that is drawn in port requires that the samples are sent to a laboratory for testing according to a specific reference method.[70] It is a procedure that can take several days to achieve a result, depending on the distance to the laboratory, etc. During this time the ship from which the sample was drawn has usually continued its journey. This can complicate the ensuing investigation and court proceedings. *Hand-held fuel-sampling devices* could resolve some of these challenges, as they allow authorities to conduct an on-board analysis of the fuel and instantaneously receive measurement of the sulphur content. Even though hand-held devices might not enable better detection of non-compliance on the high seas, they will offer port State authorities an easier and faster way of determining non-compliance, thereby giving them (clear) grounds for detaining a ship for further investigation during PSC. Hand-held fuel-sampling devices are already used by some port State authorities, but could be developed further and applied by other (or all) port States.

B. Ban on Having Non-compliant Fuel on Board – The 'Carriage Ban'

Finally, one of the most effective and important means of detecting and proving non-compliance had already been achieved in 2018 through a procedural change

[69] Fuel calculating was initially developed for ensuring compliance in SECA zones (described in ch 2), where a 0.10% sulphur limit applies.

[70] For reference methods see ISO 3685:1998 or ISO 12185:1996 and ISO 8754:2003; see app 5 to MARPOL Annex VI.

of the wording of regulation 14.1 of MARPOL Annex VI. This procedural change is often referred to as the acceptance of the 'carriage ban'.

To understand the reasoning behind the carriage ban, the precise wording of regulation 14.1 must be recalled: 'The sulphur content of any fuel oil used on board ships shall not exceed the following limits …' The phrase 'any fuel oil used on board' indicated that it was not illegal to have non-compliant fuel in some fuel tanks on board if the fuel *used*, that is the fuel fed directly into the engine, was compliant. As a result, fuel samples taken during a PSC were often, as described, taken from the day (/settling) tank or from the part of the fuel system that feeds directly into the engine. There was no reason for examining the sulphur content in other fuel tanks on board, as it was not illegal to *carry* non-compliant fuel in those tanks due to the wording of regulation 14.1.

This could potentially have caused severe problems in proving non-compliance, as it would be possible for shipowners, with intent to avoid compliance, to perfect the aforementioned changeover procedures, allowing the ship to undertake an entire voyage, perhaps lasting several weeks, on non-compliant fuel, finally changing over to compliant fuel just before sailing into port.

Resolution of this problem was sought by the IMO and its Member States, by amending the wording of regulation 14.1 to extend the prohibition to encompass fuel used 'or carried for use', thus rendering it illegal to carry fuel with more than 0.50 % sulphur content in any fuel tank on board.[71] Tankers, etc are still allowed to sail with such fuel carried as cargo in their cargo tanks.[72]

The introduction of the carriage ban will facilitate the detection of non-compliance and ease the burden of proof for many port States, as it will enable fuel sampling of several or all fuel tanks on board, making it impossible to engage in changing over from non-compliant to compliant fuel just before arriving in port.

C. IMO Work on Consistent Implementation of Regulation 14.1.3 of MARPOL Annex VI

The PPR committee has, under the auspices of the MEPC, also discussed several different means of effective detection as part of the Committee's ongoing work on ensuring *consistent implementation of regulation 14.1.3 of MARPOL Annex VI*. One of these means is developing a standard FONAR template and reporting system.

[71] The changing of the wording (implementing the carriage ban) was done in accordance with an expedited IMO procedure where it was first presented and agreed upon in the PPR committee at PPR5 in February 2018. The MEPC committee approved the carriage ban at MEPC72 in April 2018 before finally adopting it at MEPC 73 in October 2018. Following a mandatory 16-month implementation period, the carriage ban enters into force on 1 March 2020. As previously mentioned, at that time the other procedural changes to reg 14.1, ie the deletion of references to the former sulphur limits of 4.5% and 3.5% pursuant to regs 14.1.1 and 14.1.2, will also come into force.

[72] Ships using an approved EGCS (see n 46) will, needless to say, also be allowed to carry non-compliant fuel, as they are using an alternative means of compliance. This is described in ch 2.

A FONAR is a 'Fuel Oil Non-availability Report', which a ship can use to inform its flag State and the next port State of any non-availability of compliant fuel in the last port of call, requiring the ship to bunker and use non-compliant fuel.[73]

A FONAR issued on a truthful basis should allow the ship to use the non-compliant fuel without being penalised, provided the FONAR requirements are met. This means that the ship took every conceivable action to try to obtain compliant fuel elsewhere, including from other fuel suppliers, and that the ship bunkered only just enough non-compliant fuel to get it to the next port, meaning that it would be illegal to fill all tanks with the non-compliant fuel.

The FONAR system ensures that ships cannot justify any non-compliance by pleading the lack of compliant fuel at their last port of call; this must be reported using a FONAR. This system should, when used in conjunction with the ship's sailing plan, indicate whether a ship or shipowner deliberately, perhaps on a recurring basis, sought out ports and regions where compliant fuel is usually unavailable. This renders the use of a FONAR invalid.

The FONAR is not an exception as such from the sulphur regulations, as port States are merely required to take it into consideration. The authorities are conversely always within their rights to reject a FONAR.

The MEPC (PPR) work on consistent implementation of regulation 14.1.3 of MARPOL Annex VI has, in addition to FONARs, also included work on developing and amending guidelines on: designating sampling points for fuel sampling; PSC; confidence levels for fuel samples; safety implications; EGCSs, fuel oil suppliers; and a non-mandatory Ship Implementation Plan.[74]

D. Most Plausible Means of Detecting Violations of the Sulphur Limit

The abovementioned solutions show that detecting and proving violations of the 0.5% limit are achievable, including on the high seas.

The carriage ban will, upon entering into force in March 2020, undoubtedly have an immense impact on ensuring the practical enforcement of regulation 14.1, as it will complement the other possible detection methods described. For instance, if a violation on the high seas is detected by using a sniffer attached to a long-distance drone, perhaps initially patrolling the area due to data provided by satellite, this information on non-compliance can be used to target the ship for a PSC in the next port, where all fuel tanks on board, by way of the carriage

[73] The legal basis for the FONAR reporting system is found in reg 18.2 of MARPOL Annex VI, which addresses claims of non-availability from ships not able to bunker compliant fuel. This regulation is discussed in ch 2.

[74] See at http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Index-of-MEPC-Resolutions-and-Guidelines-related-to-MARPOL-Annex-VI.aspx.

ban, will be subject to fuel sampling, for example by using a hand-held detection device, perhaps backed up by a fuel calculation. The possible application of these detection methods as part of PSC, pertaining to their constituting *clear grounds* for detailed inspections, is discussed in chapter 4.

It should be noted that the sniffer technology could eventually be considered so well-advanced, and the sniffer results so reliable, that the information provided by the sniffer would by itself be sufficient evidence for proving non-compliance on the high seas and issuing a fine on that basis. So if the next port State the ship visits does not react to the information and does not target the ship for a PSC, other States can enforce the detected violation at a later stage when the ship calls into their ports, as the evidence provided by the sniffer(-drone) is sufficient to prove that a violation occurred on the high seas.

This author therefore believes that the challenges with the *practical enforcement* of regulation 14.1.3, that is in detecting and proving non-compliance by a ship at any point during its voyage, can be overcome.

This leaves one challenge unresolved before effective enforcement of the 0.5% limit is completely ensured: establishing that there is a *legal basis* in UNCLOS for non-flag States, that is coastal and port States, to ensure the sanctioning of violations, irrespective of where they are committed.

IX. Conclusion

The development of the MARPOL Convention and its Annexes reflects in many ways the general legislative advances within maritime law for protection of the marine environment and human health.

First, the original focus on the visible, tangible pollution of the sea by oil, etc has changed to include contamination of the atmosphere by airborne pollutants such as sulphur emissions from ships, as such emissions are harmful to both the environment and human health. Sulphur emissions from ships are regulated in Annex VI to the MARPOL Convention. Regulation 14.1 of MARPOL Annex VI sets the global limit values for the maximum sulphur content allowed in marine fuels. From earlier limit values of 4.5% and 3.5%, the limit has dropped significantly to 0.5%, which, if enforced effectively, will prevent 137,000 premature deaths and millions of children from developing asthma every year, particularly in highly populated coastal and port areas.

Still, some shipowners will have a huge economic incentive for not complying with the regulations, especially if they fly flags from an open registry flag State, as such a State might not meet its obligations to penalise violations of the 0.5% limit effectively, thereby neglecting to adhere to the flag State principle.

The detection and proving of violations that take place on the high seas are likely to be achieved by several different means used in conjunction, such as CEMS or sniffers and fuel sampling.

Part XII of UNCLOS provides a jurisdictional basis for coastal and port States to enforce compliance with regulation 14.1 of Annex VI if the flag State fails to do so.

The jurisdictional basis of part XII of UNCLOS is also of relevance when looking at enforcement of other international (IMO) rules for protection of the environment, including future legislative measures for reducing GHGs.