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"The 0.5 global Sulphur cap and its implications on the tanker industry"

by

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CERTIFICATION OF THESIS PREPARATION

"I hereby declare that this particular thesis has been written by me, in order to obtain the Postgraduate Degree (MSc) in International Shipping, Finance and Management, and has not been submitted to or approved by any other postgraduate or undergraduate program in Greece or abroad. This thesis presents my personal views on the subject. All the sources I have used for the preparation of this particular thesis are mentioned explicitly with references being made either to their authors, or to the URL's (if found on the internet)."

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ABSTRACT

The dissertation investigates the available methods with which shipowners can comply with the Sulfur regulations of bunker fuels that will be enforced in 2020.

To begin with, general characteristics of the tanker shipping industry are presented, such as oil and oil products, ships carrying oil at sea, as well as sources of marine pollution.

In continuation, a deep literature review is being carried out on the regulations that have been or will be adopted regarding Sulfur limit and emissions from ships' engines. We also identify the sea areas to which stricter regulations apply, namely Emissions Control Areas (ECAs) and Particularly Sensitive Sea Areas (PSSAs).

The factors that shipowners need to take into consideration and can affect their decision concerning the choice of the optimal method of compliance, are also examined. Furthermore, the available methods with which shipowner can meet the new sulfur requirements, together with the advantages and disadvantages of each method are being analyzed.

Finally, a comparison between the various alternative methods is being performed using market reports, previous researches on that subject, a SWOT analysis, a cost comparison of the available methods for three tankers with different characteristics and an ECA calculator in order to calculate the payback period of the proposed investment**.**

Key words: tanker, emissions, bunkers, Sulfur

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LIST OF ABBREVIATIONS

GHG:	Greenhouse Gas
IMO:	International Maritime Organization
MEPC:	Marine Environmental Protection Committee
MARPOL:	Marine Pollution
HSFO:	High Sulfur Fuel Oil
MGO:	Marine Gasoil
HFO:	Heavy Fuel Oil
ECA:	Emission Control Area
WACC:	Weighted Average Cost of Capital
NOx:	Nitrogen Oxides
SOx:	Sulfur Oxides
PSSA:	Particularly Sensitive Sea Area
EU:	European Commission
UN:	United Nations
SBSTA:	Subsidiary Body for Scientific and Technological Advice
BAP:	Bali Action Plan
LNG:	Liquefied Natural Gas
LPG:	Liquefied Petroleum Gas
API:	American Petroleum Institute
GR:	Gravity
AVGAS:	Aviation Gas

DFO:	Distillate Fuel Oil
MDO:	Marine Diesel Oil
DWT:	Deadweight
VLCC:	Very Large Crude Carrier
MR:	Medium Range
LR:	Long Range
VOCs:	Volatile Organic Compounds
CO2:	Carbon Dioxide
CH4:	Methane
N2O:	Nitrous Oxide
HFCs:	Hydrofluorocarbons
PFCs:	Perfluorooctane Sulphonate
SF6:	Sulphur hexafluoride
PM:	Particulate Matter
IMDG:	International Maritime Dangerous Goods
CFCs:	Chlorofluorocarbons
HCFCs:	Hydro-chlorofluorocarbons
PCBs:	Polychlorinated Biphenyls
SEEMP:	Ship Energy Efficiency Management Plan
EEDI:	Energy Efficiency Design Index
EU:	European Union
MRV:	Monitoring, Reporting, Verification
ESSF:	European Sustainable Shipping Forum

EMSA:	European Maritime Safety Agency
UNFCCC:	United Nations Framework Convention on Climate Change
COP:	Conference of the Parties
EIAPP:	Engine International Air Pollution Prevention
KW:	Kilowatt
DME:	Dimethyl Ether
RFO:	Residual Fuel Oil
LSDO:	Low Sulphur Distillate Oil
CAPEX:	Capital Expenditure
OPEX:	Operational Expenditure
UK:	United Kingdom

CHAPTER 1 INTRODUCTION

1.1 Introduction

Emissions from the shipping currently represent 3% of the world's total greenhouse gas (GHG) emissions and the industry's share is increasing. A continued increase in international marine transport without any significant gains in energy efficiency may result in shipping being responsible for 6% of the world's GHG emissions by 2020 and 15% by 2050.

Exhaust emissions from marine engines can be harmful for human health and the environment. Adverse effects are experienced at local, regional and global levels and more specifically include contribution to climate change through increasing concentrations of CO2 in the atmosphere, respiratory damage, cancers and genetic mutation and damage to the natural and built environment.

In response to these impacts, the International Maritime Organization (IMO), through its Marine Environment Protection Committee (MEPC), introduced regulations for the prevention of air pollution under Annex VI of the Marine Pollution (MARPOL) Convention. The past years have seen a number of new initiatives and regulations implemented around the world. These regulations, together with those anticipated to come into force in the coming years, will have a major impact on the future of the shipping industry.

With the current global trend towards a reduction of air emissions from all sectors, the shipping industry is experiencing increased pressure from stakeholders in general, and regulators in particular, to tackle its emissions and improve its energy efficiency. As emission limits become more stringent, compliance becomes more challenging and costly. There are a number of ways to comply, each of which presents different technical and operational challenges.

1.2 Objectives

The overriding objective of this dissertation is to suggest the most advantageous method of compliance with the new bunker regulations from a tanker ship owner's perspective. In doing so, the various alternatives are carefully examined in order to find out which method is best suitable for compliance.

Opting for the best practice requires a deep understanding of the extent to which air emissions from ships have reached, the necessity to minimize their effects

and the regulations that have been adopted to that end. As a result, the first aim of this dissertation is to present a brief account of the regulations, the conventions and the directives that set the norms of the 0.5% sulfur cap of 2020.

The operating life of the vessel, the geographical scope of its activities, the spread between High Sulfur Fuel Oil (HSFO) and compliant fuel options, the type of charter, the economic situation of the ship owner and the competition that prevails could result in the selection of different method of compliance. Thus, the dissertation also offers a review of the literature on the factors that may affect the ship owner's choice of method.

Furthermore, investigating the most appropriate method of compliance requires data sets of variables, such as the cost of the proposed investment, bunker costs, the premium of Marine Gasoil (MGO) over Heavy Fuel Oil (HFO), the time the vessel spends at Emission Control Areas (ECAs), as well as researches that have already been carried through in order to find out the advantages and disadvantages of each method and suggest the most suitable.

1.3 Significance of the study and of potential findings

Emissions from ships have peaked during the last decades and have become an important issue for the global shipping community, which requires the awareness and the immediate action of stakeholders. Shipowners and other companies of the maritime cluster have to be fully aware of the new bunkers' regulations and to that end we have presented analytically the main rules and guidelines that have been adopted on the subject matter.

Furthermore, as ship owing companies have to comply mandatorily with the new sulfur regulations, they should understand carefully the available methods of compliance and perform a technical, operational and economic research in order to find out which method suits more properly to the individual characteristics of their fleet. As a result, the potential findings of the thesis will pave the way for opting for the optimal solution for compliance from a ship owner's perspective.

1.4 Methodology

In order to carry out such dissertation we have performed secondary and primary research. Secondary research comprises the acquisition of knowledge of the regulations that have been adopted regarding the climate change, air emissions and

bunkers' sulfur content. In this area, IMO (1992) 'Marpol 73/78', C. J. Jepma – M. Munasinghe (1998), 'Climate change policy', United Nations (2012) 'Maritime transport and the climate change challenge', provided very deep knowledge on the above mentioned subjects.

Primary research includes data collecting and analyzing. Data related to the cost of HFO, the premium of MGO over HFO, the number of days per year that a ship spend in ECAs, the consumption of the vessel, the cost of the suggested method of compliance and the Weighted Average Cost of Capital (WACC) have been used to find out the payback period of the proposed investment. Also, ideas and points of view of shipping professionals have been systematically collected from shipping magazines, shipping reports and research institutes such as Lloyds Register, Lloyds' List and S&P Global Platts.

1.5 Structure of the dissertation

The second chapter of the dissertation includes general information and definitions so that the reader becomes familiar with the tanker industry. To that end, a brief account to the categories of oil and ships carrying oil at sea is being performed. Also, reference is being made to the main sources of marine pollution in order to associate air pollution with the Nitrogen Oxides' (NOx) and Sulfur Oxides' (SOx) emissions from ships, which is mainly attributed to the sulfur content of bunker fuels.

In the third chapter of the thesis, we present the regulations adopted by the International Maritime Organization, the European Union and the United Nations concerning air pollution and climate change, by focusing on the requirements imposed regarding the Sulfur content of marine fuels. In the same chapter, reference is being made to ECAs and Particularly Sensitive Sea Areas (PSSA) to which stricter provisions apply regarding airborne emissions from ships.

The forth chapter firstly provides the factors that ship owners should take into account in order to decide which method of compliance with the regulations of 2020 is most appropriate for them. Secondly, it analyses the available methods that ship owners have in order to meet the new sulfur limits.

In the fifth chapter of the dissertation a comparison is being prepared between the alternative methods of compliance. In order to achieve this we present the advantages and the implications of each method, based on market reports and

previous researches on that subject. Moreover, a cost comparison between the available methods is being described for three tankers with different characteristics, based on market reviews. Finally, we have created an ECA calculator in order to find out the optimal method of compliance from a ship owner's point of view.

In the sixth chapter, after concluding the work, we provide some elements for further research on this topic.

CHAPTER 2 GENERAL INFORMATION AND DEFINITIONS

This chapter provides general information and definitions of cargos and ships involved in the tanker industry. It also describes the main sources of marine pollution, with a focus on bunkers' emissions from ships.

2.1 Oil

As set out in Annex 1 of Marpol 73/78 convention, oil means petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products (other than those petrochemicals which are subject to the provisions of Annex II of the present Convention). A ship's petroleum wastes can be classified into the following categories:

- Mineral oils used
- Fuel residues
- Residues
- Centrinero
- Unclean ballast
- Tank washes

Annex II of MARPOL convention categorizes noxious and liquid substances into four categories (Category X, Y, Z, other substances) depending on the scale of the hazard they pose to marine resources and human health. As a result, depending on the category into each substance is included; there are rules that prohibit or allow their disposal into the marine environment, as well as rules that may impose a limit on the quality and the quantity of the discharge into the sea.

2.1.1 Crude oil

Crude oil is the base of all petroleum products and is the raw material of oil refineries. More specifically, crude oil is oily, flammable, has a distinct heavy odor and a color from yellowish to dark red, green fluorescent to black, varying according to its origin. It can be divided into at least one hundred and forty basic categories

according to its degree of lightness, which is measured in degrees API, namely American Petroleum Institute Gravity and ranges from a minimum 10.2 A.P.I GR. for the particularly heavy Venezuelan "Boscan" type up to a maximum of 44.5 A.P.I GR. for the ultra- light type "AGIP 100" in Libya. It is transported by sea in huge quantities over very long distances with crude oil tankers.

2.1.2 Petroleum products

Petroleum products are materials derived from crude oil as it is processed in oil refineries, such as naphtha, gasoline, diesel fuel, asphalt and many others. The products of a refinery are designated as "black" (residues) or "white" (spirits). Petroleum products are transported on a large scale by sea and since 1996 there has been a large increase in tons transported.

Within the scope of this dissertation, it should be noted that for technical reasons and due to environmental protection, very low sulfur content in all but the heaviest products is transformed to hydrogen sulfide via catalytic hydrodesulphurization and removed from the product stream via amine gas treating.

2.2 Ships carrying oil at sea

2.2.1 Crude oil carriers

Crude carriers are used for the deep-sea transport of unrefined oil from producing countries to refineries. They range in size from 50,000 deadweight to more than 400,000 deadweight (dwt) (taking into account the Ultra Large Crude Carriers which however are not in use anymore). These ships can usually carry one or two grades of cargo and have relatively simple pumping and pipeline systems for loading and discharging. Crude carriers are straightforward to build and operate because their cargoes are often homogenous. Even when different crudes are carried in the same ship there is little danger of contamination because the oil is stored separately and refined before sold to the customer. Many ships below 150,000 deadweight are capable of heating the cargo to maintain its pump ability (Institute of Chartered Shipbrokers, 2014).

Crude tankers include the following categories:

- Panamax: 60,00, - 79,999 dwt
- Aframax: 80,000 – 119,999 dwt
- Suezmax: 120,000 – 199,999 dwt

- Very Large Crude Carrier (VLCC): 200,000+ dwt

2.2.2 Petroleum products carriers

When refined, crude oil separates into various grades or products. At the lightest end are the gasolines, kerosenes and gasoils, while the heaviest constituents are known as fuel oils or residual oils. Product carriers are categorized according to the cargoes they carry as clean or dirty.

The tanks in clean product carriers need to be cleaned meticulously between each cargo carried. Therefore, tanks are coated with special paints that also serve to reduce corrosion. Tanks in dirty product carriers are also coated and in most cases are fitted with heating coils to make it possible to pump viscous high-density grades of fuel oil.

Dirty product carriers can be of any size up to about 150,000 deadweight and even some VLCCs carry fuel oil. Clean product carriers may be able to carry at least four separate grades of cargo without risk of contamination. Double valve segregation is invariably required to avoid cross-contamination as a result of a faulty valve (Institute of Chartered Shipbrokers, 2014).

Product tankers range in size as follows:

- Handysize: 25,000 – 39,999 dwt
- Medium Range (MR): 40,000 – 59,999 dwt
- Long range (LR1): 60,000 – 79,999 dwt
- LR2: 80,000+ dwt

2.3 Sources of marine pollution

Pollution of the seas and degradation of coastal areas is one of the most important environmental problems on our planet. Particularly in closed seas, such as the Mediterranean, marine pollution is more pronounced due to the limited mixing of sea and ocean waters.

The United Nations' team of experts defines marine pollution as "human input to the marine environment (including estuaries) of substances or energy, directly or indirectly, resulting in poisonous effects such as damage to living organisms, hazards to human health, prevention of marine activities including fishing, reduction of quality for the use of seawater and reduction of water attractiveness.

In the above mentioned definition, human's responsibility for the pollution causes must be highlighted, so that any natural inflows into the sea resulting from tectonic activity, volcanoes or storms are excluded. At the same time, pollution includes at least some adverse effects, separating pollution from simple contamination. The mere introduction of a substance from the human being into the sea at levels above the natural level but without causing adverse effects is not considered pollution but simple contamination of the sea (Ε. Τσαπάκη).

2.3.1 Accidental pollution

The IMO in its resolution A849 regarding the adoption of the code for the investigation of marine casualties defines as maritime accident any incident which results in:

- The death of, or serious injury to, a person
- The loss of a person from a ship
- The loss, presume loss or abandonment of a ship
- Material damage to a ship
- The stranding or disabling of a ship, or the involvement of a ship in a collision
- Material damage to marine infrastructure external to a ship, that could seriously endanger the safety of the ship, another ship or an individual, or
- Severe damage to the environment, or the potential for severe damage to the environment, brought about by the damage of a ship or ships

However, a marine casualty does not include a deliberate act or omission, with the intention to cause harm to the safety of a ship, an individual or the environment (resolution MSC.255(84), 2008).

A very serious accident is considered to result in loss of life, loss of the ship or serious pollution. As serious accident is considered to be fire, explosion, collision, grounding, heavy damage due to weather conditions and breakdowns, resulting in damage to the ship which in turn results to unseaworthiness, pollution, damage or the need for towing or shore-based assistance (Βλάχος ,1995).

2.3.2 Pollution from operational activities

Regarding operational pollution, this term defines any non-accidental form of pollution that results from the normal operation of a merchant vessel to the marine

environment. Pollution from operational activities includes a wide range of oil outflows and its products which are generated on board during normal operations. Operational pollution can be sought at any stage in a ship's life cycle, namely, at the beginning during the construction of the vessel, during its normal economic life (maintenance and repairs, loading and discharging operations, fuel transfers, ballasting - deballasting operations) and at the end of the life cycle, namely during the scrapping of the vessel. Generally, operational pollution can be found at the shipyard (shipbuilding, regular and emergency maintenance and scrapping of the vessel), or as pollution resulting from operational disposals (loading and discharging operations, ballasting and deballasting operations, cargo tank washing operations), as well as air pollution from ships.

More specifically, regarding the pollution caused during shipbuilding, the marine environment is threatened during the assembly of the ship and the construction of the individual parts since the most common method of shipbuilding is the pre-construction of large parts (prefabricated sections) of the vessel, their transportation to the building dock or slipway and then they will be lifted into place. Assembly takes place inside the tank, whether it is a permanent or floating tank. In both methods, the risk emanates from the bottom contact point that rests on the ship to be built because it comes into direct contact with the marine environment as soon as the door of the tank opens.

With regard to the polluting substances produced during maintenance and repair operations they are the same with those produced during shipbuilding. The only difference is that no parts of the vessel are now assembled but all the machinery already operates on board but with a relative degree of wear and tear, that is likely to cause significant pollution depending on the requirements of the repairs. Sandblasting during the maintenance – repair operations is more dangerous because there is accumulation of the old paint layer at the bottom of the tank along with the amounts of sand and particles to be used. Moreover, in the dyeing phase there are additional scrapes including substances from cargo residues in the tanks and organisms in the outer shell of the ship and in the deck components.

Scrapping of vessels also poses a significant threat to the marine environment due to gaseous, liquid and solid waste. The low value of some solid materials in high concentration leads to frequent disposal of these materials at sea. In addition, during the execution of various iron cutting operations with oxygen and plate dismantling

operations, due to the high temperature, high levels of smoke and dust are being produced causing atmospheric pollution, while many metallic materials are discharged into the marine environment. Moreover, the accumulation of significant amounts of rust, sludge, iron scraps, wood and plastics increases solid waste. The pollution caused by liquid and solid wastes depends on the sizes of the ships that will be scrapped, the relative degree of purity of the residues and the careful working method (Βλάχος, 2007).

Concerning ship building, maintenance, dismantling activities the principal emissions are dust, particles, gases, odors and aerosols. Considering specific activities, the emissions of volatile organic compounds (VOCs) from metal degreasing and painting activities represent a major problem. As regards hull surface cleaning, paint removal, changes of zinc anodes and paint application, the main elements that have an impact on the environment are dust emissions and emissions of solvents, where solvents contain VOCs and hazardous air pollutants. The demolition or major modification of ships can produce asbestos, heavy metals, hydrocarbons, ozone depleting substances and other pollutants (Miola & Ciuffo & Giovine & Marra, 2010)

Then, during loading or discharging operations, marine pollution can also take place in different ways depending on whether the cargo is bulk wet or dry. Loading and discharging of bulk wet cargo is most likely to cause pollution. In such a case, crude oil and petroleum products escape from the pipelines on the way between the terminal and the cargo tank and are disposed to the marine environment, creating a slow but constant pollution. Here, the root causes are the worn material (pipeline, orifices, terminal pipelines) and the ignorance, negligence or inability to find the appropriate spare parts on site for the necessary repairs or replacements and not the financial cost of the project, which is rather negligible.

Fuel transfers (land – to – ship or ship – to – ship) can create the same type of problems and should therefore be considered alongside loading and discharging operations. However, fuel transfers concern all merchant vessels and not only bulk carriers (Βλάχος, 2007).

If the cargo is dry bulk, pollution to the marine environment can again be caused. Both during loading and discharging and irrespective of the method to be used (silos, grabs) part of the cargo may fall on the ship or in the intermediate space between the terminal and the ship. In this case, the cause of the pollution might be a

strong wind or even (and most commonly) incorrect calculation or negligence of the operator of the loading / discharging machine. The situation is exacerbated when the usual practice required that the deck of the ship should be flushed, resulting in the disposal of the remains of the cargo directly at sea.

Finally, ballasting and deballasting operations apply mainly to oil tankers which are forced by the structure of the market to carry out one of the two voyages in ballast condition, since they travel from a petroleum consuming area to a production – exporting place (Βλάχος, 2007).

2.3.3 Emissions

The shipping industry has become a key component of the world's economy as over 90% of global trade is carried by sea. Like other transportation companies, shipping companies require fossil fuel to conduct their operations. The combustion of fossil fuel used by a vessel's engines produces greenhouse gases as well as non-GHG emissions.

Under the GHG protocol, six gases are categorized as greenhouse gases: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorooctane sulphonate (PFCs) and Sulphur hexafluoride (SF6). CO2 is the most relevant to the shipping industry. Globally, 1050 million tons of CO2 were emitted by shipping in 2007, doubling 1990 levels. Shipping CO2 emissions represent approximately 3% of the world's total CO2 emissions. Regarding the other GHG, annual aggregated emissions of CH4, N2O and HFCs represent 21 million tons of CO2 equivalent. Emissions of PFCs and SF6 are considered negligible.

In addition to GHGs, shipping produces other air emissions, most notably Sox, NOx and particulate matter (PM). More specifically, the shipping industry is among the top emitters of Sox. A total of 2.3 million tons of SO2 was emitted by ships in the seas surrounding Europe in 2000. Globally, 15 million tones of Sox were emitted by shipping in 2007, representing a 50% increase from 1997 levels. Sox emissions from shipping represent between 5% and 8% of the world's total Sox emissions.

Shipping also accounts for a significant portion of the world's NOx emissions. A total of 3.3 million tons of NOx was emitted by ships in the seas surrounding Europe in 2000. Globally, 25 million tons were emitted by shipping in 2007, representing a 39% increase from 1997 levels. NOx emissions from shipping represent around 15% of the world's total NOx emissions.

Moreover, in 2000 250,000 tones of PM were emitted by ships in Europe. Globally, 1.9 million tons of PM was released in 2007, representing a 50% increase from 1997 levels. The amount of PM released by ships is much lower than that of SOx or NOx emissions. It should be noted that PM and SOx emissions are correlated: a decrease in SOx emissions reduces emissions of PM.

Shipping emissions are an important contributor to several major environmental problems. GHG emissions contribute to climate change, while non-GHG can cause acid rain, damage to monuments, reductions to agricultural yields, water contamination, modification of soil biology and deforestation. Some non-GHG emissions are also linked to increases in ground-level ozone. Air pollution from non-GHG can also result in health problems, affecting the heart and lungs, consequently worsening the condition of people with cardiovascular and respiratory diseases (Helfre & Couto Boot, 2013).

The health and environmental impacts of air pollutants are highly dependent on the proximity of the emission sources to sensitive receptor sites. This means that, compared to land-based sources, at least some maritime emissions have less obvious health and environmental impacts since they can be released far from populated areas or sensitive ecosystems. However, in harbor cities ship emissions are often a dominant source of urban pollution and needs to addressed, in particular when considering fine particulate matter.

Furthermore, emissions from ships are transported in the atmosphere over several hundreds of kilometers and thus can contribute to air quality problems on land even if they are emitted at sea. This pathway is especially relevant for the deposition of Sulphur and nitrogen compounds.

CHAPTER 3 RULES, REGULATIONS AND THEIR IMPLEMENTATION TO THE RESPECTIVE AREAS

In this chapter we present the rules and regulations that have been adopted regarding fuel emissions from ships, by focusing on the requirements imposed on the sulfur limit of bunker fuels. We also describe the areas to which stricter limits and controls apply, namely ECAs and PSSAs.

3.1 IMO regulations

IMO is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. In 1948 an international conference in Geneva adopted a convention formally establishing IMO. Currently it has 170 Member States and three Associate Members (http://www.imo.org/About/Membership/Pages/NGOsInConsultativeStatus.aspx,1 March 2017)

3.1.1 International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978

Marpol is the main international convention covering prevention of pollution of the marine environment by ships from either operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and also includes the Protocol of 1997 (Annex VI). It has been updated by amendments through the years. MARPOL was adopted on 2nd November 1973 at IMO and covered pollution by oil, chemicals and harmful substances in packaged form, sewage and garbage. The MARPOL Protocol of 1978 was adopted at the Conference on Tanker Safety and Pollution Prevention in February 1978 held in response to a spate of tanker accidents in 1976-1977. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention.

The Convention includes regulations aimed at preventing and minimizing pollution from ships and currently includes six technical Annexes. Special areas with strict controls on operational discharges are included in most Annexes. A state must accept Annex I and II in order to become a party to MARPOL. Annexes III-VI are

voluntary while the most important Annex, from the point of view of Sulphur emissions, is Annex VI.

Annex I Regulations for the Prevention of Pollution by Oil (entered into force 2nd October 1983, ratified by 152 States/Parties). It covers prevention of pollution by oil from operational activities as well as from accidental discharges. The 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and introduced a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003.

Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2nd October 1983, ratified by 152 States/Parties). Annex II details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. Some 250 substances were evaluated and included in the list appended to the Convention. The discharge of their residues is allowed only to reception facilities when certain concentrations and conditions (which vary with the category of substances) are complied with. In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land. More stringent restrictions are applied to the Baltic and Black Sea areas.

Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1st July 1992, ratified by 138 States/Parties). Annex III contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications for preventing pollution by harmful substances. The International Maritime Dangerous Goods (IMDG) Code has, since 1991, included marine pollutants.

Annex IV Prevention of Pollution by Sewage from Ships (entered into force 27th September 2003, ratified by 131 States/Parties) contains requirements to control pollution of the sea by sewage.

Annex V Prevention of Pollution by Garbage from Ships (entered into force 31st December 1988, ratified by 144 States/Parties). This document deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The requirements are much stricter in a number of "special areas" but perhaps the most important feature of the Annex is the complete ban imposed on the dumping into the sea of all forms of plastic (IMO, 1992).

Annex VI Prevention of Air Pollution from Ships (entered into force 19th May 2005, ratified by 76 States/Parties). The regulations in this Annex set limits on SOx and NOx emissions from ship exhausts as well as PM and prohibit deliberate emissions of ozone-depleting substances. Emission control areas set more stringent standards. It was prepared by the MEPC in 1990s and added to the MARPOL Protocol in 1997. It established many rules such,a global cap of 4.5% of Sulphur in marine fuels; a lower limit of 1.5% of Sulphur in SOx ECAs in Europe the Baltic Sea was regarded as such (fully implemented in May 2006). Also set limits on emissions of NOx from diesel engines. A mandatory NOx Technical Code, which defines how this shall be done, was adopted. Deliberate emissions of ozone depleting substances, which include halons and chlorofluorocarbons (CFCs), are prohibited. New installations containing ozone-depleting substances are prohibited on all ships. But new installations containing hydro-chlorofluorocarbons (HCFCs) are permitted until 1st January 2020; The on-board incineration of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs), is prohibited;

The MEPC initiated the discussion of strengthening Annex VI with additional amendments in July 2005. The North Sea was adopted as a SECA at that time, while the date of entry into force of this amendment was 22nd November 2006 with full implementation 12 months later.

The MEPC agreed on the need to undertake a review of Annex VI and the NOx Technical Code with a view to revising the regulations to take account of current technology and the need to further reduce emissions from ships. Between 2005 and 2007 a sub-committee carried out the review focusing in particular on available and developing techniques for the reduction of emissions of air pollutants and the potential for a reduction of NOx and PM emissions. The revised version of Annex VI was adopted in October 2008 (The Association of European Vehicle Logistics (ECG), 2013).

3.1.2 **Data collection system – New requirements** (Lloyds' Reregister, 2017)

IMO released the text of resolutions MEPC.278(70) on Amendments to MARPOL Annex VI and MEPC.282(70) on 2016 Guidelines for the development of a Ship Energy Efficiency Management Plan (SEEMP).

Amendments to Marpol Annex VI requiring mandatory fuel oil consumption data collection and reporting have been adopted. These will enter into force on 1 March 2018, with the first reporting period being for the 2019 calendar year.

IMO has previously agreed to address ship energy efficiency through a three-step approach: a) Data collection, b) Data analysis and c) Deciding on what further measures, if any, are required. The IMO MEPC 70 meeting worked on the data collection stage and adopted amendments to MARPOL Annex VI. According to these:

Ships of 5,000 gross tonnage and above will be required to submit to their Administration annual reports on fuel consumption and transport work parameters, via a methodology to be included in the SEEMP.

Upon Verification of the submitted data, the Administrations will issue to the ships a Statement of Compliance related to fuel oil consumption.

Finally, the Administrations will submit aggregate data to the IMO, which will maintain an anonymized IMO Ship Fuel Oil Consumption Database.

Ships will need to use a standardized reporting format, developed by the IMO, to submit data on:

- Identity of the ship – IMO number
- Technical characteristics of the ship : ship type, gross tonnage, net tonnage, deadweight, power output (rated power)of main and auxiliary reciprocating internal combustion engines over 130kw, Energy Efficiency Design Index (EEDI), ice class, etc
- Fuel oil consumption, by fuel oil type, in metric tons, and methods used for collecting fuel oil consumption data
- Distance travelled
- Hours under way

Ship owners and operators will need to start considering the means for collecting the fuel oil consumption data that are most appropriate for each ship and updating the SEEMPs of their ships to reflect this process.

MEPC 70 adopted resolution MEPC.282(70) on 2016 Guidelines for the development of a SEEMP, which supersedes the 2012 Guidelines (MEPC.213(63)) and provides guidance on developing a ship-specific methodology for the collection and reporting of the required data.

The IMO is also developing Draft Guidelines for Administration data verification procedures in order to assist Administrations with the verification of the reported data and the issuance of the Statement of Compliance.

3.2 European Union's Regulations

3.2.1 Directive 1999/32/EC and its amendments relating to the Sulphur content of marine fuels

Directive 1999/32/EC specifies limits for the Sulphur content of certain liquid fuels. The requirements concerning the Sulphur content of gas oil appear in this Directive which also addresses the Sulphur content of heavy fuel oil, heating oil and marine fuels following the incorporation into European Union (EU) law of rules adopted by the IMO. The Directive came into force on 12 may 1999 aiming at reducing emissions of Sulphur dioxide resulting from the combustion of certain liquid fuels.

Directive 1999/32/EC was amended by Directive 2005/33/EC to include new provisions relating to the limits for the Sulphur content of marine fuels. The amended Directive introduced, inter alia, the IMO concept of SECAs and the associated stricter fuel standards. The maximum Sulphur content of marine fuel was limited to a maximum of 1.5% for ships operating in the Baltic Sea as from 2006 and in the North Sea and the English Channel as from 2007. In addition, and in recognition of the need to further improve air quality for the protection of human health beyond the SECAs, some requirements that went beyond the IMO rules were introduced of which the most important are the following: Firstly, the obligation for ships at berth or anchorage in EU ports to use fuels containing maximum 0.1% Sulphur. Secondly, the obligation for passenger ships on regular service to EU ports to use fuels containing a maximum Sulphur content of 1.5% and thirdly, the introduction of a possibility to test and use the emission abatement technologies.
(http://ec.europa.eu/environment/air/transport/directive.htm, 1 June 2017)

Furthermore, Member States are responsible for sampling and inspecting log books and bunker delivery notes to check compliance with the requirements of the directive. More specifically, member States shall by 30 June of each year provide the Commission with a short report on the Sulphur content of the liquid fuels falling within the scope of the Directive and used within their territory during the preceding calendar year. The report shall include the quantity of fuel used, the calculated

average Sulphur content and a record of the total number of samples tested by fuel type.

3.2.2 Maritime transport strategy till 2018

In January 2009, the Commission presented the main strategic objectives for the European maritime transport system up to 2018. The strategy identified kea areas where action by the EU will strengthen the competitiveness of the sector while enhancing its environmental performance.

In September 2016, the Commission published a staff working document on the implementation of the EU maritime transport strategy 2009-2018 which provides an overview of all maritime transport policy activities and focuses on five areas: Maritime safety and security, digitalization and administrative simplification, environmental sustainability and decarbonisation, raising the profile and qualifications of seafarers and maritime professions and EU shipping: A stronger global player.
(https://ec.europa.eu/transport/themes/strategies/2018_maritime_transport_strategy_en, 1 June 2017)

Environmental sustainability and decarbonisation belong to the long-term objective of "zero waste, zero emission" maritime transport. To this end, the following actions have already taken place and some of them are going to take place in the next few years.

Regarding GHG emissions, the Commissions and the EU member states actively supported the adoption by the IMO, in July 2011, of a mandatory limit on the EEDI for ships built as of 2013. A SEEMP was also made compulsory for all ships.

In June 2013, the Commission set out a strategy to integrate maritime emissions into the EU's policy for reducing domestic GHG emissions. The strategy consists of three consecutive steps: Monitoring, reporting and verification (MRV) of CO2 emissions from large ships using EU ports, setting up GHG reduction targets for the maritime transport sector and further measures, including market based measures, in the medium to long term. The first step has been achieved with the adoption of the Regulation 2015/757 of the European parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of CO2 emissions from maritime transport that applies to ships above 5000 gross tonnage, regardless of their flag, calling at EU ports, as of 1st of January 2015.

Furthermore, new Sulphur emission limits were globally adopted in 2008 and included in directive 2012/33/EU of the European parliament and of the Council of 21 November 2012 amending Council directive 1999/32/EC as regards the Sulphur content of marine fuels: they impose 0.1% Sulphur fuels as of 1 January 2015 in SECAS. The Directive also reduces Sulphur content to 0.5% as of 2020, in all other EU waters. In order to comply with these new limits, operators may use low Sulphur fuel, install on-board filters (scrubbers) or adopt alternative fuel technologies. The latter solution is mainly contemplated for new ships as it would require major modifications.

In 2013, the Commission set up the European Sustainable Shipping Forum (ESSF) to facilitate implementation of and compliance with environmental legislation in the maritime sector.

Clean and sustainable shipping will be further promoted with the effective implementation of Directive 2014/94/EU on the deployment of alternative fuels infrastructure (especially with the promotion and use of LNG as marine fuel), ensuring the necessary standardization and set up of a basic fuel supply infrastructure before 2025 with EU financial support.

For the shipping sector, the EU has a strong preference for a global approach led by the IMO. The EU and its member states have supported the adoption by the IMO , in 2016, of a mandatory and robust system to collect and report fuel consumption of ships on a global scale, accompanied by a viable verification mechanism to ensure data quality.

Finally, greater use of short sea shipping also depends on a reduction of maritime air pollution. The studies and stakeholders strongly advocate the removal of obstacles to the adoption of cleaner fuels and in particular favor the development of EU-wide guidance for LNG bunkering procedures, harmonization of standards and increased knowledge and exchange of experience amongst permitting authorities (European Commission, 2016).

3.2.3 European Maritime Safety Agency's (EMSA) role

EMSA actively assists the Commission in the attempt to reduce the maximum permissible Sulphur content of marine fuels inside and outside SECAs and provides technical assistance to the member states during the implementation of air pollution related EU legislation. The measures so far undertaken are expected to have a

significant beneficial impact on the environment and on human health, particularly for those people living in port cities and coastal communities.

More specifically, EMSA's role can be summarized in the following actions:

- It assists member states in the implementation of forthcoming or newly adopted legislation in the field of ship related pollution
- It assists the Commission, member states and the maritime industry in meeting, implementing and monitoring international and European legislation and initiatives on the reduction of SOx and NOx emissions
- It assists the Commission, member states and the maritime industry in the technical developments related to alternate fuels for ships as well as abatement methods
- It assists the Commission, member states and the industry in the implementation of the EU MRV CO2 Regulation as well as in the international context on future policy developments in this area. (http://www.emsa.europa.eu/main/air-pollution/air-pollution.html,1 June 2017)

EMSA also facilitates a harmonized reporting of the implementation and enforcement of the Sulphur directive by the member states. To this end, the agency developed the dedicated European Union information system known as THETIS-S for the recording of the outcome of the verifications on board which are available since 1 January 2015. EMSA also acts as technical secretariat of the European Sustainable Shipping Forum which was conceived in response to the challenges created by the Sulphur directive.

3.3 United Nations' regulations

3.3.1 The United Nations Framework Convention on Climate Change (UN, 2012)

Climate change is a trans-boundary and inter-generational environmental problem which is complex, uncertain and dynamic due to its global scope, long-term perspective and the large number of interacting and inter-relating factors. Global warming already adversely affects and will increasingly affect the environmental, social and vital economic interests of all states.

To address the challenge of global climate change and to limit and reduce global GHG emissions is beyond the capacity of a single country. A comprehensive strategy and collective action of the international community are required. At the United Nations Conference on Environment and Development, 166 countries agreed on the United Nations Framework Convention on Climate Change (UNFCCC), the first international treaty that sets general goals and rules for addressing climate change.

It is the main objective of the UNFCCC to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate change. In order to reach this objective a comprehensive and global climate change strategy is necessary to address climate change jointly across all sectors of the society and the global economic system. Together with its Kyoto Protocol, the UNFCCC established an international legal and institutional framework that initiates, coordinates and regulates joint action to mitigate climate change and adapt to its adverse effects across state borders and economic sectors. GHG emissions from the international maritime transport sector contribute to global climate change. Hence, action to limit and reduce GHG emissions from international maritime transport forms one element of a necessary global climate change strategy.

3.3.2 The Paris agreement

At the Paris climate conference in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The Paris Agreement builds upon the Convention and –for the first time- brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line

with their own national objectives. The Agreement also provides for enhanced transparency of action and support through a more robust transparency framework (http://unfccc.int/paris_agreement/items/9485.php, 3 June 2017).

The Paris Agreement is a bridge between today's policies and climate-neutrality. Before and during the Paris conference, countries submitted comprehensive national climate action plans. These are not yet enough to keep global warming below 2°C, but the agreement traces the way to achieving this target**.**

Also, for the transparency and global stocktake the governments agreed to come together every 5 years to set more ambitious targets as required by science; to report to each other and the public on how well they are doing to implement their targets and to track progress towards the long-term goal through a robust transparency and accountability system.

With reference to adaption, governments agreed to strengthen societies' capacity to deal with impact of climate change and also to provide continued and enhanced international support for adaption to developing countries.

The agreement also recognizes the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change as well as acknowledges the need to cooperate and enhance the understanding, action and support in different areas such as early warning systems, emergency preparedness and risk insurance.

Furthermore, the agreement recognizes the role of non-Party stakeholders in addressing climate change, including cities, other sub national authorities, civil society, the private sectors and others who are invited to scale up their efforts and support actions to reduce emissions, to enhance resilience and decrease vulnerability to the adverse effects of climate change and last to uphold and promote regional and international cooperation.

With regard to support, the EU and other developed countries will continue to support climate action to reduce emissions and build resilience to climate change impacts in developing countries; other countries are encouraged to provide or continue to provide or continue to provide such support voluntarily and the developed countries intend to continue their existing collective goal to mobilize USD 100 billion per year by 2020 and extend this until 2025 (https://ec.europa.eu/clima/policies/international/negotiations/paris_en, 3 June 2017)

3.4 Areas affected by the regulations

3.4.1 Emission Control Areas

ECAs are sea areas in which stricter controls were established to minimize airborne emissions (Sox, NOx, ODS, VOC) from ships as defined By Annex VI of the 1997 MARPOL Protocol. Annex VI contains provisions for two sets of emissions and fuel quality requirements regarding Sox and PM, or NOx, a global requirement and more stringent controls in special ECAs. These regulations stemmed from concerns about the contribution of the shipping industry to "local and global air pollution and environmental problems." By July 2010 a revised more stringent Annex VI was enforced with significantly tightened emissions limits.
(http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Default.aspx , 4 March 2017)

Table 3.1 Outside/Inside an ECA established to limit SOx and particulate matter emissions

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

Source:http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Sulphur-oxides-(SOx)-%E2%80%93-Regulation-14.aspx

Existing Emission Control Areas include:

- ✓ Baltic Sea (SOx: adopted 1997/entered into force 2005; 2016/2021)
- ✓ North Sea (SOx :2005/2006; NOx : 2016/2021)
- ✓ North American ECA, including most of US and Canadian coast (NOx & SOx: 2010/2012).
- ✓ US Caribbean ECA, including Puerto Rico and the US Virgin Islands (NOx & SOx: 2011/2014).

- ✓ China domestic ECAs – sea water areas of Pearl river Delta, Yangtze river Delta and Bohai sea water area (NOx, SOx:2015)

In September 2015, China's Ministry of Transport released its Ship and Port Pollution Prevention Special Action Plan (2015-2020), a five – year program that aims to reduce Sulphur and nitrogen oxide emissions by up to 65 per cent in some of China's major ports. The subsequent publication of Chinese regulation designating the Pearl River and Yangtze River Deltas, and Bohai-rim Waters as domestic ECAs places a cap on the Sulphur content of fuel oil in the ECAs at 0.50 per cent and it is considered as an important step to achieve these pollution prevention goals.

The Chinese regulation applies to all ships navigating, anchoring and operating within the ECAs with the exception of military ships, fishing boats and ships/boats used for sporting purposes. Also, eleven ports within the ECAs are designed as "key ports" :

- ✓ Shenzhen, Guangzhou and Zhuhai in the Pearl River Delta
- ✓ Shanghai, Ningbo-Zhoushan, Suzhou and Nantong in the Yangtze River Delta
- ✓ Tianjin, Quihuangdao, Tangshan and Huanghua in the Bohai-rim Waters

The applicable area at all ports within Zhejiang ECA area which is a part of Yangtze River ECA is:

1. Seawater area: the sea area within the lines connecting
    a) 12 nautical miles away from the shoreline junction point of Zhejiang province and Shanghai city
    b) 12 nautical miles away from the shoreline junction point of Taizhou city and Wenzhou city

Jiaxing port, Ningbo-Zhoushan port and Taizhou port are included in the above seawater area.

2. Inland water areas: navigable waters under the administrative jurisdiction of 6 cities including Hangzhou, Jiaxing, Huzhou, Shaoxing Ningbo and Taizhou.

Inland water ships and river- to- sea ships are required to use diesel oil that meets with relevant standard. Ocean ships are required to satisfy relevant standard in accordance with international treaties which China entered into as well as the implementation details issued by Zhejiang authorities. However, ships are allowed to

take alternative measures with equivalent effect such as connecting shore power, using clean energy, arranging after-treatment of exhaust (London P&I, 2017).

Most ships which operate both outside and inside these ECA will therefore operate on different fuel oils in order to comply with the respective limits. In such cases, prior to entry into the ECA it is required to have fully changed –over to using the ECA compliant fuel oil, and to have onboard implemented written procedures as to how this is to be undertaken. Similarly change-over from using the ECA compliant fuel oil is not to commence until after exiting the ECA. At each change-over it is required that the quantities of the ECA compliant fuel oils onboard are recorded, together with the date, time and position of the ship when either completing the change –over prior to entry or commencing change – over after exit from such areas. These records are to be made in a logbook as prescribed by the ship's flag State, in the absence of any specific requirement in this regard the record could be made, for example in the ships Annex I Oil Record Book.

The first level of control in this respect is therefore on the actual Sulphur content of the fuel oil as bunkered. This value is to be stated by the fuel oil supplier on the bunker delivery note and hence this, together with other related aspects, is directly linked to the fuel oil quality requirements as covered under regulation. Thereafter it is for the ship's crew to ensure, in respect of the ECA compliant fuel oils, that through avoiding loading into otherwise past filled storage, setting or service tanks, or in the course of transfer operations, that such fuel oils do not become mixed with other, higher Sulphur content fuel oils, so that the fuel oil as actually used within an ECA exceeds the applicable limit.

Consequently regulations provide both the limit values and means to comply. However, there are other means by with equivalent of SOx and particulate matter emission control, both outside and inside ECA, could be achieved. These may be divided into methods termed primary (in which the formation of the pollutant is avoided) or secondary (in which the pollutant is formed but subsequently removed to some degree prior to discharge of the exhaust gas stream to the atmosphere.) (http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Sulphur-oxides-(SOx)-%E2%80%93-Regulation-14.aspx, 4 March 2017).

Also, the control of diesel engine NOx emissions is achieved through the survey and certification requirements leading to the issue of an Engine International

Air Pollution Prevention (EIAPP) Certificate and the subsequent demonstration of in service compliance in accordance with the requirements of the mandatory.

The NOx control requirements of Annex VI apply to installed marine diesel engines of over 130 kilowatt (kw) output power other than those used solely for emergency purposes irrespective of the tonnage of the ship onto which such engines are installed. Different levels (Tiers) of control apply based on the ship construction date and within any particular Tier the actual limit value is determined from the engine's rated speed:

Table 3.2 Different levels (Tiers) of control apply based on the ship construction date and within any particular Tier the actual limit value is determined from the engines

Tier	Ship construction date on or after	Total weighted cycle emission limit (g/kWh) n = engine's rated speed (rpm)		
		n < 130	n = 130 - 1999	n ≥ 2000
I	1 January 2000	17.0	$45 \cdot n^{(-0.2)}$ e.g., 720 rpm – 12.1	9.8
II	1 January 2011	14.4	$44 \cdot n^{(-0.23)}$ e.g., 720 rpm – 9.7	7.7
III	1 January 2016*	3.4	$9 \cdot n^{(-0.2)}$ e.g., 720 rpm – 2.4	2.0

Source:***http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Nitrogen-oxides-(NOx)-%E2%80%93-Regulation-13.aspx***

The Tier III controls apply only to the specified ships while operating in ECA established to limit NOx emissions, outside such areas the Tier II controls apply. In accordance with regulation 13 certain small ships would not be required to install Tier III engines. A marine diesel engine that is installed on as ship constructed on or after January 2016 and operating in the North American ECA and the United Caribbean Sea ECA shall comply with the Tier III NOx standards.

The emission value for a diesel engine is to be determined in accordance with NOx Technical Code 2008 in the case of Tier II and Tier III limits. Most Tier I engines have been certified to the earlier 1997 version of the NOx Technical Code which, in accordance MEPC.1/Circ.679, may continue to be used in certain cases until

January 2011. Certification issued in accordance with the 1997 NOx Technical Code would still remain valid over the service life of such engines.
(http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Nitrogen-oxides-(NOx)-%E2%80%93-Regulation-13.aspx, 4 March 2017)

3.4.2 Particularly Sensitive Sea Areas

Special Areas under MARPOL are areas where stricter provisions apply for the control of pollution from regular running operations, such as oily bilge water, tank/deck wash water, sewage, garbage, cargo residues and emissions to air. Special Area provisions do not include additional measures for the prevention of acute pollution (spills) from accidents.

Different areas have been designated as Special Areas under the different Annexes to MARPOL, based on their characteristics, ship traffic and the particular need for protection from the pollution aspect controlled by the respective Annex. In special areas, a limited set of predefined stricter regulations applies, as set out under the respective annex and as can be seen in the below table. Thus, Special Area designation does not, as PSSAs, enabling for selecting between different suitable measures.

Special Areas and their additional requirements under relevant annexes to MARPOL include the following:

Table 3.3 Special Areas and their additional requirements under relevant annexes to MARPOL

Table 11: *Special Areas and their additional requirements under relevant annexes to MARPOL*[20]	
Pollution aspect; Annex to MARPOL	***Additional Special Area (incl. ECAs) provisions***
Oil; Annex I (10 adopted Special Areas)	*Discharges oil and oily mixtures from machinery spaces (bilge water):* Both inside and outside Special Areas, discharges are prohibited, except when the oil concentration in the effluent does not exceed 15 ppm after passing through approved oil filtering equipment. For ships above 10 000 GT, the equipment shall have concentration alarm and automatic stopping functionality. **In Special Areas, the alarm/stopping device is also required for ships between 400 and 10 000 GT. In the Antarctic Special Area, effluents are not permitted for discharge, regardless of concentration and equipment in use.** *Discharges from oil and oily mixtures from cargo spaces of oil tankers (wash water/slop):* Outside Special Areas, discharges are prohibited, except when having in operation an oil discharge and monitoring system securing sufficiently low concentrations and rates. **In Special Areas, effluents from cargo areas are not permitted for discharge, regardless of concentration and equipment in use.**
Noxious Liquid Substances in bulk; Annex II (1 adopted Special Area - Antarctica)	Outside Special areas, discharge of residues of classified substances, such as in tank wash water, is prohibited, except when in line with given operational requirements and discharge standards, i.e. at very low concentrations and rates. **In Special Areas, Noxious Liquid substances are not permitted for discharge, regardless of concentration and operational procedure in use.**
Sewage; Annex IV (1 adopted Special Area – Baltic Sea)	Both outside and inside Special Areas, all ships must have in use either an approved sewage treatment system, a comminuting and disinfection system, or a holding tank for retention of all sewage. Discharge of sewage is prohibited, except when: • the distance to land is more than 12 nautical miles, or • the sewage has been comminuted and disinfected in an approved system, and the distance to land is more than 3 nautical miles, or • the sewage has been through an approved sewage treatment plant, and the effluents does not produce visible floating solids nor discoloration **The additional requirement in Special Areas is only relevant for passenger ships, for which discharges will only be permitted from a sewage treatment plant that also removes nitrogen and phosphor (ref the particular challenges with eutrophication in the Baltic Sea SA)**
Garbage; Annex V (8 adopted Special Areas)	In the recently revised Annex V, similar strict regulation of garbage applies both inside and outside special areas. Basically any discharge of garbage is prohibited, except from grinded food waste and limited fractions of non-harmful cargo residues and cleaning agents in wash water, which can be discharged according to given criteria. **In Special Areas, certain additional requirements should be fulfilled before grinded food waste and non-harmful cargo residues and cleaning agents in wash water can be discharged.**
Emissions to air; Annex VI Special Areas = Emission Control Areas (ECA)	Outside ECAs (global requirements): SO_x: - Maximum 3,5% sulphur in fuel. - From 2020/25*: Maximum 0,5% sulphur in fuel

2 adopted ECAs for SO_x only. 2 adopted ECAs for both SO_x** and NO_x	(Exhaust gas cleaning accepted as an alternative to low sulfur fuel) NO_x: - Tier II emission level for machinery installed on ships after 2011 **Inside ECAs:** **SO_x:** - **Maximum 1% sulphur in fuel** - **From 2015: Maximum 0.1% sulphur in fuel** **(Exhaust gas cleaning accepted as an alternative to low sulfur fuel)** **NO_x:** - **Tier III emission level (80% reduction from tier II) for machinery installed on ships after 2016***.**
*Date TBD pending 2018 review, but 2020 will apply in EU waters **PM emissions are indirectly covered through the regulation of SO_x. ***May be delayed, pending on IMO discussions	

Source: "***Specially Designated Marine Areas in the Arctic High Seas"***, Det Norske Veritas, Report for Norwegian Environment Agency, 2014

As Special Areas, PSSAs are areas that based on their conditions and exposure to ship traffic and need additional protective measures under IMO. However, an important difference is that PSSA is not a measure under MARPOL, where a particular set of stricter standards apply for equipment and operational discharges. Rather, when approved as a PSSA, specific measures can be used to control the maritime activities in that area, including discharge and equipment requirements for ships of the type required in an SA and other measures such as routing measures and ship reporting systems.

The toolbox is thus wider and more flexible in PSSAs and depends on the particular conditions and threats from ship traffic in the area. Most importantly maybe, in contrast to Special Areas, PSSAs are not limited only to provisions for regular operational discharges, but also enables measures for prevention of acute pollution and disturbance.

The criteria for the identification of PSSAs and the criteria for the designation of Special Areas are not mutually exclusive. In many cases a Particularly Sensitive Sea Area may be indentified within a Special Area and vice versa (Det Norske Veritas, 2014).

CHAPTER 4 METHODS OF COMPLIANCE FOR THE TANKER INDUSTRY

The herebelow chapter describes in depth the available methods with which shipowners are able to comply with the new sulfur regulations of 2020. The factors that may affect shipowners' decisions are also referred.

4.1 Factors to be taken into consideration by ship owner

4.1.1 The operating life of the vessel

The various options of installing a scrubber, retrofitting the engine to handle alternative fuels such as LNG, or usage of compliant MGO are all expected to involve additional investment and/or operating costs come 2020. Depending on market conditions, these added costs may not be recoverable on older units with ten years or less of operating life, increasing the incentive to scrap older vessels in the coming years.

4.1.2 Trading areas of the vessel

Certain countries may prohibit the discharge of wash waters from open loop scrubbers, thus limiting the vessel to use the more expensive closed loop or hybrid scrubbers, or other methods of compliance. Depending on how the refining industry and bunkering markets adapt, the availability of compliant fuels may also differ in each region.

4.1.3 View on the spread between HSFO and compliant fuel options

Depending on the actions of refiners and state of shipping market come 2020, the spread between HSFO and compliant fuels options may change from what we have seen historically. Thus, shipowners may need to form their own houseview on the price spread between such fuels in 2020, in order to decide whether to use MGO, install scrubbers or to retrofit engines to use alternative fuels.

4.1.4 Split incentive between ship owner and charterer (depending on the type of charter)

Depending on the type of charter between shipowners and charterers, the responsibility for fuel costs may or may not lie with the shipowner. Unless shipowners operate their own ships or have long term agreements with charterers, they may not wish to invest in such technology due to inability to recoup their investment (Banchero Costa, 2016).

4.1.5 Economic situation of the shipowner

Shipowners will need to have a clear view of their finances, to see if they can access the credit for a scrubber or whether they will be in a position to take a cut in profits from higher fuel bills in 2020 or pass the cost on to their customers.

4.1.6 Competition

Shipowners will also need to look at what their competitors are doing, as those who find the least painful of method of coping with the sulfur cap will be able to offer the lowest freight rates and take market share from rivals (S&P Global Platts, 2017).

4.2 Methods of compliance

4.2.1 Use of bunkers with Low-Sulphur content (Lloyds Register Marine, 2015)

Several low-Sulphur fuels are available including low-Sulphur distillate oil, 'hybrid' fuel oil, liquefied natural gas (LNG), liquefied petroleum gas (LPG), biofuels, dimethyl ether (DME), ethane and methanol. Residual fuel oil (RFO) can also be de-sulphurised.

Due to the nature of crude oil and refinery operations, RFO meeting the 0.15 Sulphur limit is not expected to be widely available. So it is anticipated that low Sulphur distillate oil (LSDO) will generally be used to comply with the new regulations. It is also the simplest way to comply. LSDO will normally consist of MDO or MGO. Both of them are distillates and therefore do not require heating before injection, whereas RFO, whatever the grade, does require heating.

4.2.2 Use of scrubbers

Another solution for shipowners to meet the new requirements is to continue to use fuel types which exceed the 0.5% sulfur limit, but in combination with an

approved Exhaust Gas Cleaning System, also known as scrubbers, to remove sulfur from exhaust. There are two technologies available today: dry systems that use a dry chemical and wet systems that use water (seawater or fresh water) as the scrubbing medium. The wet systems are by far the most predominant. Within the wet systems there are three alternatives: open loop, closed loop and a hybrid system. Additionally, one can choose between multi-inlet scrubbers, allowing for exhaust from more than one emission source or a single-inlet scrubber that serve only one engine. The technology is suitable in most cases for retrofitting vessels as well as for newbuildings.

The optimal scrubber type for a given ship depends on the machinery configuration, operational profile and the routes of the vessel, such as time spent inside/outside areas and ports with restrictions against wash water discharge. There are also weight and space considerations that have to be taken into consideration, especially for retrofitting on existing ships (DNV-GL).

When choosing a scrubber system, there are a number of factors which should be taken into consideration. The capital expenditure (CAPEX) for the unit itself as well as varying operational expenditures (OPEX) can significantly affect the total cost and value of the unit to the ship owner.

The value of a scrubber and its potential to ensure compliance with an economic advantage is influenced by an array of variables. Therefore, the following factors should be taken into consideration for each scrubber application:

- The initial cost of the scrubbing unit, including the raw materials costs and the labor costs associated with installation (CAPEX).
- The price of fuel and the differential between low-Sulphur and heavy fuel oil
- Operational profile of the ship.
- Maintenance and repair including: The type of fuel used as it will affect the maintenance of components such as the pipes and the replacement of components.
- Crew training
- Costs associated with documentation, e.g. if the scrubber fails to function correctly then documentation will need to be provided to prove that non-compliance was due to a technical fault.
- Uncertainly and sensitivity factors –some factors cannot be predicted or controlled, such as future fuel prices, inflation, regulatory uncertainty

regarding ECAs and the influence this will have on the quantity of LSF or HFO consumed. The baseline or ship route can be altered in order to reduce voyage length but there is a high uncertainty regarding the impact this will have on scrubbers and their life cycle cost.

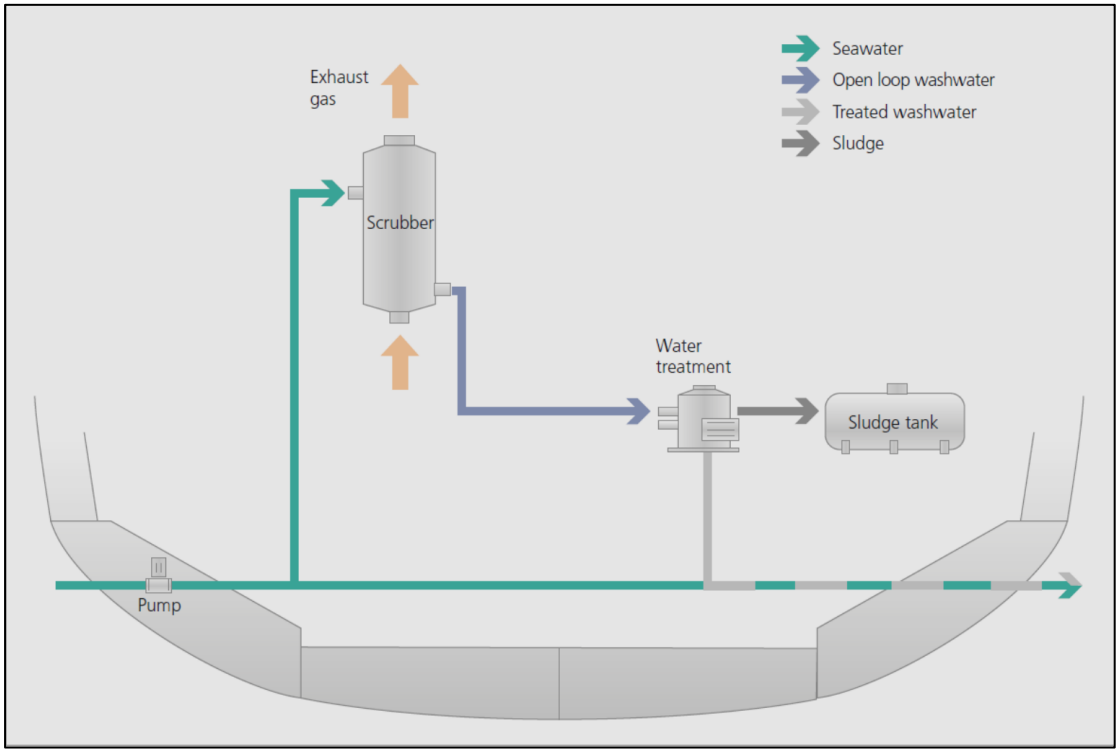
- The return on Investment which is directly related to the price differential between HFO and LSF.
- The downtime of the ship during installation.
- The disposal of the unit once its lifetime comes to an end
- Current ship design, including existing freshwater capacity, ship design layout, tank arrangement and available space (Fathom, 2015).

The use of scrubbers has substantial social and environmental benefits as they can reduce SOx emissions by at least 95% and PM by at least 80%. Scrubbers can also reduce NOx emissions, although there is no consensus as to by how much. Through this significant reduction in non GHG –related emissions, the widespread use of ship scrubbers can benefit populations by avoiding for example some diseases and can also benefit the environment by avoiding for instance acid rain. Moreover, scrubbers can also help reduce GHG emissions to some extent.

4.2.2.1 Open loop scrubbers

If an open loop scrubber is installed, seawater, which is naturally alkaline, is taken in to spray exhaust gas that enters the scrubber. The wash water is then treated before being discharged into the sea. The resulting waste water must meet MARPOL requirements before being discharged. However, if a vessel occasionally sails through waters with a slightly more acidic pH level, such as rivers or brackish waters, a hybrid (open/closed loop) solution could be considered. Another disadvantage of open loop only systems is that several ports in Europe and the port of New Haven in the US presently prohibit the release of open-loop water. Other ports may implement similar regulations in the future (DNV-GL).

Figure 4.1 Open loop scrubber

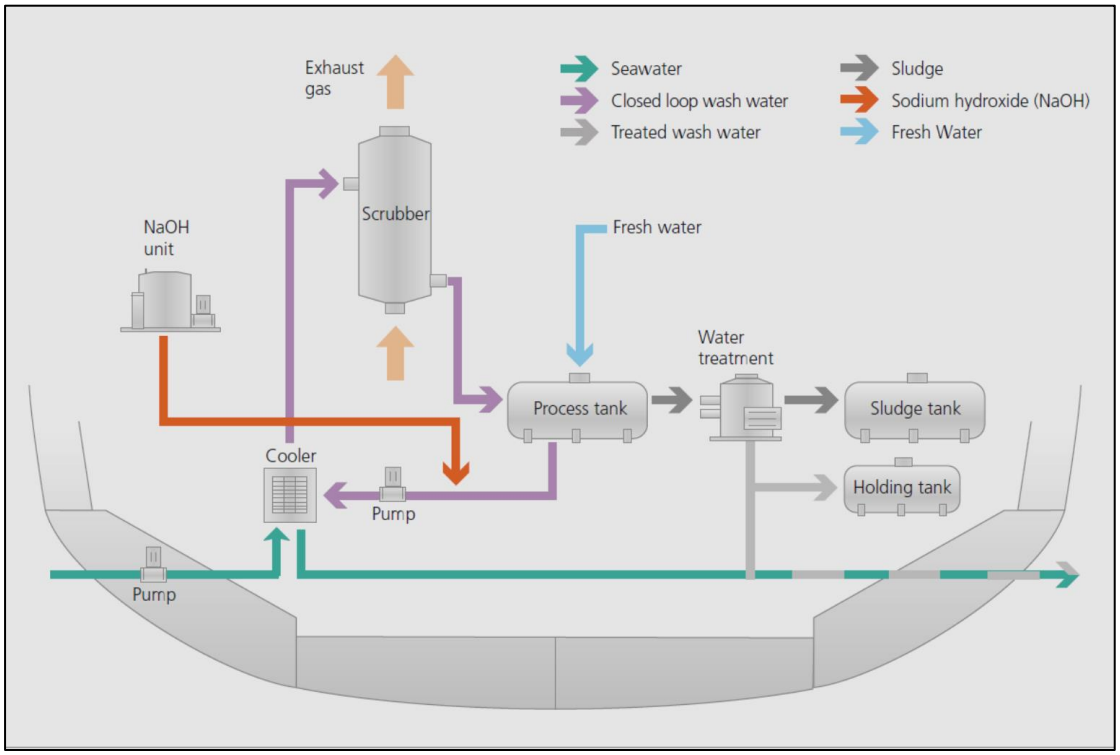


Source: ***"Your options for emissions compliance – Guidance for shipowners and operators on the Annex VI SOx and NOx regulations",*** Lloyds Register Marine, 2015

4.2.2.2 Closed loop scrubbers

For vessels operating inside areas where discharge to sea is restricted, closed loop or hybrid systems are necessary. In case of a closed loop scrubber, wash water is mixed with chemicals, such as caustic soda before being used to spray exhaust gas that enters the scrubber in order to boost the alkalinity of the wash water, neutralizing the SOx. The water can be recirculated with only a small amount released into the sea and can be partially purged. If no discharge is allowed, the wash water can be stored in a holding tank temporarily. Closed loop scrubbers are generally more expensive that open loop ones, as they require additional equipment and are installed on ships sailing mainly in fresh water or low-alkalinity areas, such as the Greatest Lakes in the United States.

Figure 4.2 Closed loop scrubber

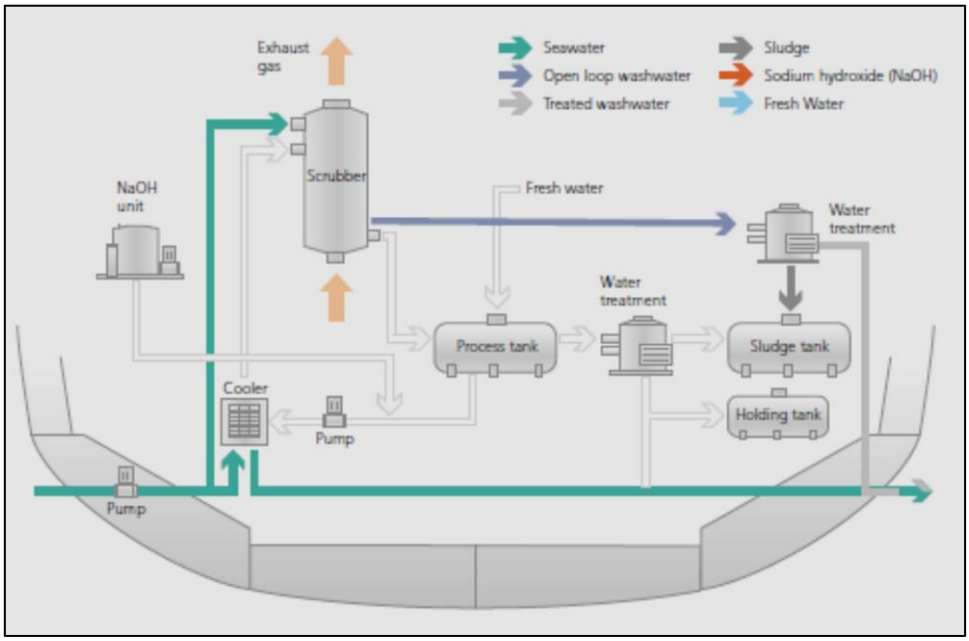


Source: ***"Your options for emissions compliance – Guidance for shipowners and operators on the Annex VI SOx and NOx regulations",*** Lloyds Register Marine, 2015

4.2.2.3 Hybrid scrubbers

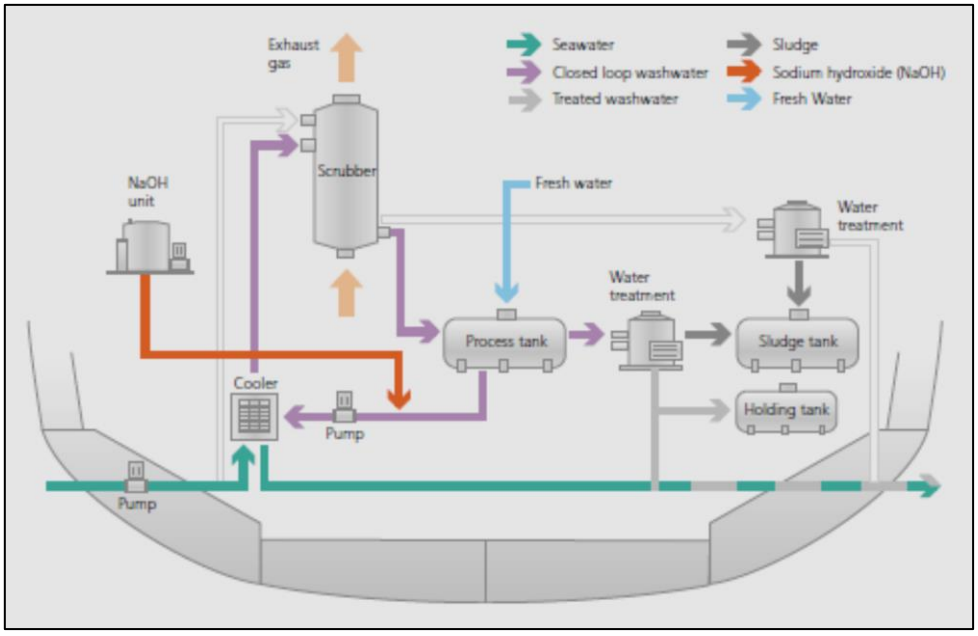
Hybrid scrubbers can operate in either open loop or closed loop mode. This provides the flexibility to operate in closed loop mode where the water alkalinity is insufficient or where there is sensitivity to, or regulation of, washwater discharge and in open loop mode without consuming sodium hydroxide at all other times. This offers advantages as the sodium hydroxide is only used when necessary, reducing handling, storage and associated costs. Freshwater consumption is also reduced. There are also hybrid systems that can operate in open and closed loop mode simultaneously. However, in general, hybrid scrubbers are the most expensive and complex (Lloyds Register Marine, 2015).

Figure 4.3 A hybrid scrubber operating in open loop mode



Source: ***"Your options for emissions compliance – Guidance for shipowners and operators on the Annex VI SOx and NOx regulations",*** Lloyds Register Marine, 2015

Figure 4.4 A hybrid scrubber operating in closed loop mode



Source: ***"Your options for emissions compliance – Guidance for shipowners and operators on the Annex VI SOx and NOx regulations",*** Lloyds Register Marine, 2015

Table 4.1 "Comparison of SOx scrubber technologies"

	Wet scrubber, open loop	Wet scrubber, closed loop	Wet scrubber, hybrid	Dry scrubber
Main system components	– Scrubber – Washwater piping – Washwater pumps – Washwater treatment equipment – Sludge handling equipment	– Scrubber – Washwater piping – Washwater pumps – Washwater processing tank – Washwater holding tank – Sodium hydroxide storage tank – Washwater treatment equipment – Sludge handling equipment	– Scrubber – Washwater piping – Washwater pumps – Washwater processing tank – Washwater holding tank – Sodium hydroxide storage tank – Washwater treatment equipment – Sludge handling equipment	– Absorber – Fresh granulate hopper – Used granulate hopper – Granulate transport system – Additional granulate – storage (new and used granules)
Operation in fresh water	✗	✓	✓ (only when operating in closed loop mode)	✓
Operation without discharge to sea	✗	For a limited time depending on the size of the washwater holding tank	For a limited time depending on the size of the washwater holding tank	✓
Weight Based on typical values for a 20MW SO_x scrubber	30-55t (Excluding washwater system and treatment equipment)	30-55t (Excluding washwater system, treatment equipment, washwater processing tank and washwater holding tank)	30-55t (Excluding washwater system, treatment equipment, washwater processing tank and washwater	≈200t (Including granules stored adjacent to the absorber but excluding additional granulate storage)
Power consumption (% of max. scrubbed engine power)	1-2%	0.5-1%	0.5-2% (depending on whether it is operating in open or closed loop mode)	0.15-0.20%
Scrubbing chemical consumable	✗	Sodium hydroxide solution (≈6 l/MWh·%S)	Sodium hydroxide solution (only when operating in closed loop mode) (≈6 l/MWh·%S)	Calcium hydroxide granules (≈10 kg/MWh·%S)
Compatibility with waste heat recovery system	Yes, provided the scrubber is installed after the waste heat recovery system	Yes, provided the scrubber is installed after the waste heat recovery system	Yes, provided the scrubber is installed after the waste heat recovery system	Yes. Can be placed before or after the waste heat recovery system
Compatibility with SCR system	No, unless a reheater is fitted after the wet scrubber to raise the exhaust gas temperature	No, unless a reheater is fitted after the wet scrubber to raise the exhaust gas temperature	No, unless a reheater is fitted after the wet scrubber to raise the exhaust gas temperature	✓
Compatibility with EGR system	✓	✓	✓	✓
Particulate matter removal	✓	✓	✓	✓

Source: ***"Your options for emissions compliance – Guidance for shipowners and operators on the Annex VI SOx and NOx regulations",*** Lloyds Register Marine, 2015

4.2.3 Use of alternative fuels (LNG, LPG, Methanol etc)

Besides the commercial aspects, the main argument for choosing LNG as a ship fuel and in the replacement of conventional oil-based fuels by LNG is the significant reduction in local air pollution – ranging from emissions of SOx and NOx to particulates (PM). The complete removal of SOx and PM emissions and a reduction of NOx emissions of up to 85% by using LNG is a strong argument for the use of LNG, especially in the ECAs. But only when burnt in low-pressure internal combustion engines. LNG is non-compliant to Tier III requirements when burnt in high pressure engines where its NOx advantage falls to 40%. In addition, LNG can to some extent reduce CO2 emissions, up to 25%, but only if used in high pressure engines. In low pressure engines unburnt LNG escapes into the exhaust (methane slip), which is 20 times more polluting than CO2. This reduces LNG's CO2 advantage to 7% below fuel oil. As a fueling option, LNG offers multiple advantages to human health and the environment. It also has a positive impact on EEDI of the ship.

Another advantage is the lack of potential compatibility issues, as a fairly consistent specification of the fuel should be available at all ports with LNG bunkering facilities. Additionally, dual-fuel engines capable of burning MGO as well as LNG are widely available, meaning that shipowner can switch fuels if LNG becomes more expensive (S&P Global Platts, 2017).

Methanol has also come up as a replacement for marine fuel, although its viability is currently limited to short sea shipping where emission controls may be mandated by the government. Retrofitting engines for methanol consumption is also estimated to cost at least 20% less compared with LNG, according to Lloyd's Register. Methanol has similar environmental advantages to LNG, with lower sulfur, nitrogen, particulate matter and carbon emissions than gasoil-based fuels. It should also be cheaper than 0.5% sulfur bunkers under most circumstances and its properties as a liquid fuel are easier for shipping crews to work with than those of LNG. Conversions of marine vessels to methanol are significantly less costly than conversions to LNG because of the simplicity of the storage system for methanol. Although methanol itself is slightly more costly than LNG, the trade-off between methanol and LNG involves the complexity of the fuel system versus the cost of the fuel. However, Methanol increases the risk of corrosion, which must be met with

sufficient upgrading of fuel tanks, etc., and the low energy content per cubic meter of methanol means that it takes up cargo space on the ship.

Other compliant fuels include LPG, Dimethyl Ether and Biofuels. These are considered to have very little impact on the market as a whole, but are alternatives that can be considered where supply is readily available. Apart from some of the biofuels, changing to these types of fuel will need special adaptive engines and fuel treatment systems. These alternative fuels are usable for most engine configurations but the specific fuel cost is unknown. They are not in the market – there is no track record and their availability is uncertain. Another drawback is that they may create operational issues due to off-spec fuel or incompatibility.

LPG is mentioned from time to time as a potential marine fuels candidate. However, there seems to be very limited material available on LPG'S viability as a marine fuel. The general view around the globe seems to be that LPG is a premium product and, as such, is priced accordingly and is too expensive compared to other alternative fuel options. So, although the supply is there, its current markets are in automotive transportation and domestic heating and cooking, markets that have a different price reference than shipping. In terms of safety, LPG is heavier than air and thus presents an explosive safety hazard if it were to accumulate in the bilges or low sections of a ship's engine room in the event of a leak in the fuel system; it is not considered safe for shipboard use (McGill & Remley & Winther, 2013)

CHAPTER 5 COMPARISON BETWEEN THE AVAILABLE METHODS OF COMPLIANCE

Chapter 5 analyses the implications of each method of compliance and the problems that may arise from their practical implementation and of which shipowners should be aware of.

Table 5.1 "Comparison of compliance alternatives"

Option	Pros	Cons	Issues/questions
Low Sulphur diesel	– Simple, technical mature, low CAPEX – Reduce SO_x and PM – Global availability – Competence is proven	– Expensive fuel – Issues with fuel switch – IMO Tier III after 2016 need SCR or EGR	– Global availability – Fuel quality – Future higher prices?
HFO + Scrubber	– Low cost fuel (HFO) – Lower CAPEX than LNG – Easier conversions – Process is mature – Global availability	– Space req. installation – Waste disposal, consumables (closed/hybrid) – Maintenance, complexity – IMO Tier III after 2016 need SCR or EGR	– Flag approval – Reliability/corrosion – Load dependence – Compatibility with SCR redundancy
LNG	– Low cost of natural gas – technical mature – Reduce SO_x, PM, NO_x, CO_2 – Favourable CAPEX for smaller vessel than scrubber – Environmental profile	– Engine, tank and system costs – Space for LNG tank – Range on gas could be limited – Lack of LNG bunkering infrastructure – Risk and safety challenges – IMO, international and national regulations are in progress	– Flag approval – LNG pricing – Global LNG bunker availability – LNG fuel quality standards – GHG (methane slip/emissions)

Source: ***"Studies on the feasibility and use of LNG as a fuel for shipping",*** IMO, 2016

Based on the above table it can be seen that LNG provides the greatest environmental benefits with respect to the reduction of SOx, NOx, PM and CO2 emissions but the fleetwide adoption of LNG will depend on the availability, financial considerations and clear regulatory guidance.

5.1 Implications of the use of low sulfur bunkers (Lloyds Register Marine, 2015)

LSDO is traditionally considered a trouble-free fuel but it is not entirely without risk. There are some technical challenges, particularly if converting existing ships from residual fuel. Equipment and systems will need to be suitable for use with

LSDO and may need to be modified. However, these engineering modifications are minor compared to those needed for other SOx compliance options.

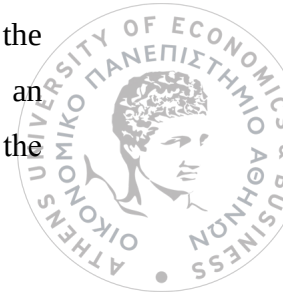
Additionally, the 0.1% Sulphur limit means that low-Sulphur distillates could easily become non-compliant if contaminated with higher Sulphur fuels. Therefore, it is essential to strictly segregate low-Sulphur and other fuels. Moreover, since distillates generally have low viscosities, fuel transfer and supply pumps, fuel valves and other parts of the fuel oil system should be checked to ensure they can operate with fuels at lower viscosities, as they can all be affected on diesel engines.

Furthermore, distillates are more likely to have lower lubricity than residual fuel oils. Therefore, they may not provide the required boundary lubricating performance. High-pressure fuel pumps and other equipment should be checked to see if they have any minimum lubricity requirements for the fuel being used.

Also, converting RFO systems to LSDO may result in seepage of fuel from pipe flanges, equipment seams and other fittings (such as pressure gauges and other sensors) because of the 'searching' nature of LSDO. This may only become apparent after a period of time as accumulated material is removed by the cleaning action of the distillate.

Switch between different fuels according to whether or not the ship is in an ECA-SOx, there is a risk that incompatible fuels will result in the formation of excessive quantities of sludge. This can disrupt the combustion process and the functioning of fuel oil treatment, service systems and associated equipment. Mixing of significant quantities of fuel should be avoided. During fuel change-over between residual fuel and distillate, the fuel system, including fuel pumps, will be subject to a significant change in temperature as a result of the need to heat the residual fuel to maintain viscosity at the correct levels for the engine. This temperature change will be approximately 100°C, therefore the change-over procedure is critical to prevent machinery seizure, machinery wear, micro-seizure and loss of performance.

In addition, RFO and LSDO have different ignition and combustion characteristics. An engine set up for RFO can experience a number of issues if operated on LSDO: Firstly, deposition may be caused within the cylinder and inlet/exhaust valves. This reduces the life expectancy of piston rings, liners and valves. Secondly, fuel valves may require increased maintenance to counter the effects of using LSDO. In some cases, fuel valves may need to be changed to an alternative material specification based on the manufacturer's advice. Thirdly, the



reduced viscosity of distillates may result in worn high-pressure fuel pumps being unable to deliver sufficient fuel to the fuel valves to maintain engine power output. This may result in excessive fuel leakage and engine failure and may also present difficulties in starting the engine. Fourthly, on two-stroke engines, the lower Sulphur content of LSDO will reduce the rate of acidic corrosion of the cylinder liner. Finally, the cylinder oil base number must be suitable for the fuel in use: If the cylinder oi base number is too high relative to the acidity of fuel, there is a risk of hard alkaline deposition to cylinder liners, which can cause polishing and accelerated year. If it is too low, the rate of acidic corrosion of the liner may be too high, resulting in accelerated wear.

5.2 Implications of the use of scrubbers

5.2.1 Technical and operational challenges

The installation of scrubbers on existing ships may come with technical and operational challenges. Firstly, scrubbers require space onboard the ship, which in turn limits space available for cargo. Secondly, they have an impact on the vessel's stability, as scrubber towers add top weight. Additional tanks are required, consuming hull volume and increasing deadweight, increasing fairway dues and reducing overall ship efficiency. Engine room flooding can occur if a pipe fails. However, there is no risk of flooding or reverse flow with dry systems. Moreover, they have an impact on power requirements, as smaller vessels may have insufficient power generation capacity. There are also operational expenses related to increased power consumption, need for chemical consumables and sludge handling. Another important issue is the compatibility of scrubbers with Tier III NOx emission requirements. Another element of concern is the scrubber's end-of-life management and the production of the scrubber system itself which might be energy intensive.

Furthermore, dry scrubbers have no discharges to sea. Given, the uncertainty surrounding the acceptability of discharging washwater to sea, this is a critical consideration. More specifically, there is some concern regarding the sulphates being discharged into the sea as they change the acidity of water. This change is acidity could have an impact on seawater biodiversity, especially among fish species. Then, the dry SOx scrubber is heavier compared to wet scrubbers. However, the overall weight of wet and dry systems may be similar once the washwater systems, such as the processing tank, holding tank and chemical storage, are taken into account. In

addition, the washwater flow rate in an open loop scrubber is higher that a closed loop scrubber because the buffering capacity of seawater is less that the buffering capacity of fresh water dosed with sodium hydroxide. Consequently, open loop scrubbers require larger pumps and have higher power requirements. The power requirement of dry scrubbers is mainly associated with a screw conveyor that moves the calcium hydroxide granules through the scrubber unit. The power required is therefore significantly less than for wet SOx scrubbers. Finally, all SOx scrubbers reduce the black carbon and ash from the exhaust but wet scrubbers may increase the water vapor content in the exhaust stream, resulting in a highly visible white plume unless the exhaust is kept well above the dew point.

5.2.2 Economic challenges

If the operator owns the ship and pays for bunker fuel, investing in a scrubber is the most economical option. Ship owners can recover investment costs sooner or later, but if the prices of IMO compliant fuels go through the roof in early 2020 and the world is awash with HFSO, it will be a matter of months before a scrubber investment is recouped. Ship owners' concern will be the upfront cost of around $3-$4 million with no guarantee that it will be needed in case the spread between marine gasoil and HSFO stays very narrow (S&P Global Platts, 2017).

Fitting a scrubber will allow a shipowner to continue burning high-sulfur fuel oil from 2020 while still complying with the new 0.5% limit. But retrofitting a vessel with this technology can cost between $3 and $6 million, as well as some time at a shipyard in most cases. However, there is significant cost for taking the vessel to dry dock for about a month to install the equipment and since the global fleet is currently also gradually being retrofitted with ballast water management systems to comply with new regulations, a lack of shipyard space worldwide may limit the uptake of scrubbers before 2020.

To determine the profitability of fitting a scrubber, shipowners need to take a view on the price spread between 3.5% and 0.5% sulfur bunker fuel in 2020. If they believe 3.5% prices will plummet and 0.5% prices will climb as the demand shifts, the upfront capital cost of the equipment may appear a sensible investment. But if there is a significant uptick in shipowners fit scrubbers, the more high sulfur fuel oil demand will be preserved and the price spread between the two fuels may be narrower than

they expect. Space at shipyards may also run short over the next few years if a large percentage of the global fleet requires scrubber retrofit work.

The cost-effectiveness of a scrubber is also a function of how long a vessel will spend in an ECA zone and its remaining lifetime. Once sulfur is capped globally, all vessels will have an incentive to install one, but it will still make less financial sense for a vessel with ten years or less of operational life (S&P Global Platts, 2016).

Furthermore, for vessels with smaller engines, retrofitting the vessel with scrubbers may not be cost effective. In the study by CE Delft, assuming a price difference of USD 129/metric ton between conventional fuels and low sulfur fuels, they found that for engines up to about 5 MW, retrofitted scrubbers are rarely cost effective. The cost-effectiveness improves for engines between 5 and 20 MW, while for most ships with over 20 MW of engine power scrubbers are a cost-effective option to comply with the sulfur limit. For new buildings, the share of ships for which scrubbers are cost-effective is higher.

The investment and operational cost estimates from CE Delft for open loop and hybrid scrubbers have been listed below. Other estimates from industry bodies suggest the cost could range from $3-10 million (Banchero Costa, 2016).

Table 5.2 "Investment and operational costs for open loop and hybrid scrubbers"

Scrubber Type	Time of fitting	Fixed Investment costs (USD mln)	Variable investment cost (USD per kW of installed engine power)	Operational Costs
Open loop	Retrofit	2,3	55	1% additional fuel + $13,000 +0,4 x Pm.e. (Kw)
	Newbuild	1,9	38	1% additional fuel + $13,000 +0,4 x Pm.e. (Kw)
Hybrid	Retrofit	2,8	58	0,5% additional fuel + $25,000 + 0,4 x Pm.e. (Kw)
	Newbuild	2,4	44	0,5% additional fuel + $25,000 + 0,4 x Pm.e. (Kw)
Note: Pm.e. (Kw) Iis the power of the main engine in kilowatt				

Source: ***"0.5% Global Sulfur Cap – Impact on refineries and shipping markets",*** Banchero Costa, December 2016

5.3 Consequences of the use of LNG

5.3.1 Technical and operational implications

Moreover, the supporting infrastructure for LNG bunkering currently remains limited globally. LNG requires cryogenics for bunker storage tanks, which would reduce available onboard cargo space and the amount of money the ship is able to generate. LNG capacity is around 1.6-2 times greater than that of conventional fuel and with the necessary equipment the actual loss is even greater and could be as high as 3-4 times. Furthermore, LNG may have higher calorific value than fuel oil but is also less dense. Meaning the same value of fuel will equate to higher mile range. Being less dense means an LNG fueled ship with the same size fuel tank as a fuel oil ship travels a much shorter distance.

LNG has the main problem of limited availability at ports. So if you trade an aframax tanker, you are not going to cut yourself off from the possibility of bunkering at most ports in the world.

Moreover, the tankage and other systems needed to contain and consume LNG as a fuel are more complex and larger than traditional bunker fuel engines. Another disadvantage of LNG is the 'methane slip' issue. While burning LNG will produce much less carbon dioxide than a gasoil-based bunker fuel, if we include the natural gas that can escape while bunkering, the GHG emissions can be higher. Methane slip will be present, especially on four-stroke, dual-fuel engines, partly from the scavenging process in the cylinder and partly from the ventilation from the crank case, which is being led to the atmosphere. In addition, there is some uncertainty as to whether future regulations will allow LNG tanks to be situated directly below the outfitting/accommodation of the ship. If not, this constraint could cause difficulties in retrofitting certain ships.

Another concern with LNG is the possibility for de-bunkering (or emptying the fuel tanks). This step is necessary when a ship is to be anchored for an extended period of time. Unless special LNG de-bunkering facilities are available in the port, the gas would boil off, causing huge methane losses to the atmosphere. In case of grounding accidents, a technique for de-bunkering would also be necessary. Another concern is pressure increase when consumption occurs below the natural boil-off rate,

which will happen if there is no re-liquefaction plan available onboard (McGill & Remley & Winther, 2013).

5.3.2 Economic implications

Most will respond initially by buying a gasoil-based fuel for their vessels, but LNG could be a cheaper alternative. As well as being compliant with the sulfur cap, LNG will also work with future regulations on nitrogen and particulate matter emissions from shipping likely to emerge in the next few years.

The vessel would save about $1 million per year compared with a similar ship running on 0.5% sulfur gasoil. However, the first problem facing LNG bunkering is the upfront capital expenditure needed – while most ships are already capable of burning 0.5% sulfur gasoil, they would need a new engine to run on LNG. As the cost of retrofitting vessels is likely to be prohibitively expensive in most cases, that will mean ship owners cannot make the change until they order new ships.

The take-up of LNG bunkering will in part be determined by how large a price spread emerges between fuel oil and 0.5% sulfur bunkers in the run-up to 2020. At the moment, the potential rise in fuel costs has not been enough to prompt shipowners to invest in new LNG fueled vessels.

The infrastructure needed for liquefaction of the gas and storage are the primary contributors to the high cost of retrofitting a ship. There are additional costs that are not related to infrastructure, such as crew training or the time lost during the engine conversion process which shipowners should also take into account (S&P Global Platts, 2017).

5.3.3 Implications on ports

The main obstacle for LNG bunkering at present is the lack of infrastructure for it. While LNG itself is readily available near most of the world's busiest bunkering ports, the means of delivering it efficiently to ships has not been built yet. In Europe the majority of LNG bunkering at the moment is done by small short-sea ferries around Scandinavia, with the fuel being delivered by truck at berth. This method works well for vessels of a small size, but would be far too slow for big oil tankers looking to take on large quantities of fuel without waiting days for its delivery. For the owners of larger vessels to view LNG bunkering as an option they will need delivery to be available by ship-to-ship transfer from a barge.

The use of LNG for bunkering in the US maritime industry will take some time as shipowners and suppliers consider the costs of building infrastructure and assess the risks. Most companies will not even look at that type of project unless the return on investment is at least 10% and depending on the capital leverage the return on investment may need to be closer to 18-20%. The return on investment is largely determined by the cost of capital leverage.

More specifically, the estimated cost of building an onshore regasification LNG unit is around 1$ billion. In the US there is one facility in operation designed for LNG bunkering, the facility in port Fourchon, Louisiana.

CHAPTER 6 TOOLS IN ORDER TO CHOOSE THE OPTIMAL SOLUTION FROM THE SHIPOWNERS' PERSPECTIVE

In this chapter a practical evaluation of the available methods of compliance is performed. To that end, a cost comparison between the alternatives, a swot analysis and an investment comparison calculator are being developed.

6.1 Accumulated cost of alternative methods of compliance compared to HFO baseline

A cost comparison between a scrubber, LNG and a range of compliant fuel alternatives is shown for three tankers with different characteristics. The scenarios are general, and the conclusions will vary depending on the assumptions that are used. The cost comparisons are based on the difference between HFO and the alternatives, where the HFO is the base case and set here at $300. Running on HFO with a hybrid scrubber is shown with an investment for installing the scrubber and increased operating costs. The compliant fuel is shown as a range, where the lower side represents an increase in fuel cost of 30% or $90 above the HFO price and the upper end represents 80% or $240 above the HFO price. It should be noted that the absolute price spread of the alternative fuels will vary with variations of HFO prices. For operation within ECAs a 0.1% ECA compliant fuel is used with a high price estimate 100% or $300 above the HFO price. The LNG alternative has an investment cost and a running cost based on an assumed LNG price. The LNG price is set differently for the different ship types due to the amount of LNG needed. For tankers is set at 10%. It is also expected that larger amounts of LNG ordered will result to lower prices (DNV-GL).

Table 6.1 Three tankers with different characteristics

	Tanker 1	Tanker 2	Tanker 3
Age	3	13	To be built
Operating profile	High speed (15 knots)	Low speed (11 knots)	High speed (15 knots)
ECA exposure	Medium	Low	High
TC/Spot (…who pays for fuel?)	TC (long term)	Spot	TC (long term)
North America trade?	No	No	Yes

Source: ***"Global Sulphur cap 2020 – Know the different choices and challenges for on-time compliance",*** DNV-GL

Table 6.2 Choice of method depending on the characteristics of each tanker

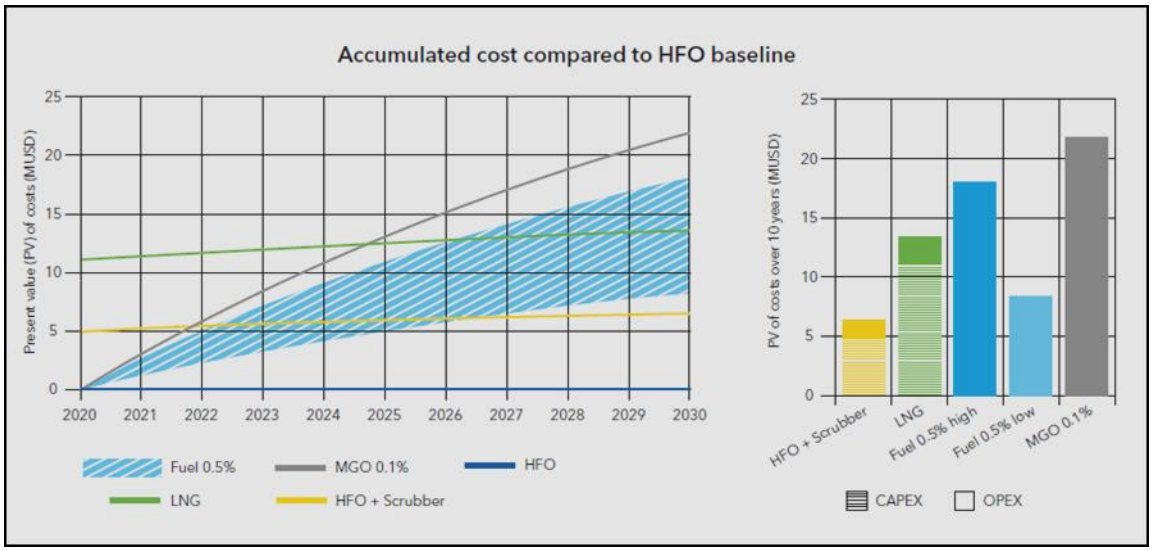
	Tanker 1	Tanker 2	Tanker 3
Solution 1	**Hybrid Fuel :** 0,5% outside ECA - 0,1% in ECA	**Hybrid Fuel** : 0,5% outside ECA - 0,1% in ECA	**Hybrid Fuel** : 0,5% outside ECA - 0,15% in ECA + EGR/SR (Tier III)
Solution 2	**HFO + Scrubber :** 0,5% outside ECA, Scrubber 0,1% in ECA	**HFO + Scrubber :** 0,5% outside ECA, Scrubber 0,1% in ECA	**HFO + Scrubber :** 0,5% outside ECA, Scrubber 0,1% in ECA + EGR/SCR (Tier III)
Solution 3			**LNG** + EGR/SCR (Tier III)

Source: ***"Global Sulphur cap 2020 – Know the different choices and challenges for on-time compliance",*** DNV-GL

Furthermore, the below graph shows a comparison between today's situation, running on traditional HFO and a future case where a scrubber, LNG or compliant fuel is used. A newly built Aframax tanker running on conventional non-compliant HFO with a scrubber will need an extra initial investment for the scrubber system of around $5 million. Compared to using a compliant fuel, the payback time, depending on how the compliant fuel cost varies, will be from 2.5 to 6 years. Similarly, if an LNG alternative is chosen, the initial investment will be about $11 million and the payback time may vary from 6 to well beyond 10 years.

With the payback times estimated, the scrubber alternative should be feasible both for newbuildings and retrofits. One must expect a somewhat higher initial cost when retrofitting a scrubber system on an existing vessel, while the LNG alternative appears to be less interesting both for new and existing vessels.

Figure 6.1 Accumulated cost compared to HFO baseline



Source: ***"Global sulphur cap 2020 – Know the different choices and challenges for on-time compliance",*** DNV-GL

6.2 SWOT Analysis

Another way to compare the available methods of compliance is through a SWOT analysis, showing the advantages, the disadvantages, the opportunities and the threats of each option.

Table 6.3 "Solutions SWOT"

Scrubbers	
Strength	**Weakness**
1. Comply with EU & IMO regulations	1. Prices can range from USD 1.3 million to USD 9 million
2. Continue using cheap high sulfur fuel	2. USD 395,000 to USD 6.59 million loss of revenue
	3. Insifficiently proven technology
	4. Not aplicable for all vessels due to age or availability of space
	5. Stability of vessel compromises
Opportunity	**Threat**
1. Scrubbers fare better than other technologies economically or technically	1. Price spread between high and low sulfur fuel
2. Price spread between high and low shulfur fuel	2. Difficulty forecasting maintenance costs
	3. Tighteining of regulations making technology non compliant
	4. Scrubbers fare worse than other technologies economically or technically
LNG	
Strength	**Weakness**
1. Comply with EU & IMO regulations	1. Lack of available supply chain and instrastructure
2. Least harmful to the environment	2. High flammability and toxicity
3. Most economically feasible in the long term	3. Additional investment of 10-50% for new vessels
Opportunity	**Threat**
1. LNG fares better thatn other technologies economically or technically	1. Infrastructure does not develop easily
2. Stricter regulations come in place	2. LNG fares worse than other technologies economically or technically
Low - Sulfur Fuel	
Strength	**Weakness**
1. Comply with EU & IMO regulations	1.High price
2. Investment costs are considered negligible	
3. Already technically feasible	
Opportunity	**Threat**
1. Low sulfur fuel fares better than other technologies economically or technically	1. Insuffient supply of LSFO
	2. LSFO fares worse than other technologies economically or technically

Source: ***"Emissions reduction in the shipping industry: Regulations, exposure and solutions"***, J.F. Helfre – P.A.C. Boot, 2013

Scrubbers are generally regarded as a good short-term investment to comply with regulations and are considered cheaper that LSFO in the long term. By using a scrubber the ship can continue to burn the cheaper HFO as the scrubber uses sea water and chemicals to remove sulfur from engine exhaust gas. In addition, the use of scrubbers has substantial social and environmental benefits as they can reduce SOx and PM emissions to a significant extent. However, the use of scrubbers presents

some risk for shipping companies. First of all, scrubbers have a high upfront cost which can be found in the market with variations. Also, since there is not significant previous experience they can be considered as an unproven technology. It should also be noted that scrubbers would not be a solution for all vessels, which is a major weakness of this method. Another weakness is the impact of scrubbers on the stability of the vessel and the loss of revenue that may occur due to loss of cargo space which is occupied by the scrubber installation and the offhire period during which the scrubber is installed at the shipyard. A vital factor which can be proven either an opportunity or a threat is the price spread between high and low sulfur fuels and will determine the rate of adoption of the scrubber technology. Finally, the difficulty in forecasting maintenance costs and future stricter regulations with which scrubbers may not be compliant, are threats that have to be taken into consideration from shipowners.

LNG is another method of compliance with the regulations of 2020 and offers substantial social and environmental benefits, since the burning of LNG results in no SOx and negligible NOx and PM emissions. Furthermore, LNG has a higher hydrogen-to-carbon ratio, which makes it less CO2 intensive than oil. A significant strength, is its economic feasibility for the long term, especially for newbuildings. However, there are significant safety issues due to its high flammability and toxicity. Another weakness is the lack of available infrastructure and additional investment they require on new vessels, which ranges from 10 to 50%. The main opportunity of LNG is that it will be compliant even if stricter regulations will be adopted, whereas its main threat is the difficulty in developing its infrastructure.

Another option for shipping companies trying to reduce their sulfur emissions would be to opt for low-sulfur fuel. Compared to scrubbers and LNG, LSFO investments costs are considered negligible since most ships' engines can run on both HFO and LSFO. However, the cost of refining fuel and converting it into LSFO represents a significant cost for oil companies. These costs will surely be passed on to shipping companies. Finally, the potential increase in demand for LSFOs may pose an important threat since supply may be insufficient.

6.3 Development of a comparison calculator between two alternative investments

Until the global sulfur cap is enforced many ships may not call at ECA ports. Many other ships may have limited time sailing through ECAs and calling at ECA ports.

Shipowners of the latter category, particularly of existing vessels, may need to assess the cost effectiveness of the alternatives in complying with the ECA SOx emissions requirements. To that end we developed a calculator to assist ship owners in doing a cost-benefit analysis of installing a scrubber versus using ULSFs in the ECAs. The model calculates the payback period in the number of years over which a ship can pay a premium for use of MGO until it equals the CAPEX for retrofitting a scrubber in order to comply with SOx emissions limitations in ECAs. We have adapted this model to our thesis' requirements. More specifically, an aframax tanker of 110,000 dwt is being used with the following input data:

- CAPEX
- WACC / Depreciation rate (%)
- Daily fuel consumption in tons
- Days at sea per year
- Voyages per year
- Fuel consumption for discharge of cargo
- Days at sea in ECAs per year (as a percentage of the total days at sea per year)
- HFO cost

The cost (or CAPEX) includes the price of scrubbers, the costs of installation, the cost to classification society and the off-hire cost. The model accounts for daily consumption at sea and consumption for a discharge but ignores variable lower consumption for maneuvering, waiting and idling.. MGO daily consumption is considered to be 95% of daily HFO consumption to discount the higher calorific value of the MGO, the higher consumption of HFO for running scrubbers and the less MGO needed as there is no need for fuel treatment/heating. It should be noted that the model does not take into account operating and maintenance costs of scrubbers.

However, this model provides an approximation or an indication – not necessarily an answer on whether the use of MGO is a viable alternative as compared with installing scrubbers, at least for existing vessels, since future availability, prices and price gap between low sulfur and residual fuels, future trade patterns and changed in regulations affecting the viability of scrubber solutions installed are all vital to the decision that shipowner makes.

The payback period is given at a variety of premium values paid for use of 0.1% MGO and for varying times used by each ship in ECAs as a percentage of the total trading days per year. More specifically, the payback period is calculated as a function of both the premium paid for the MGO and the time spent in ECAs out of the total trading time, including discharges.

In the model created for our thesis we take two different cases depending on the days a ship spend at ECAS. In the first case we assume that the vessel spends at ECAs 80% of its trading life. The data included in the model are the following:

- CAPEX: $5,840,000
- WACC / Depreciation rate (%): 9%
- Daily fuel consumption: 37.6 metric tons
- Days at sea per year : 335
- Voyages per year : 30
- Fuel consumption for discharge of cargo: 60 metric tons
- Days at sea in ECAs per year (as a percentage of the total days at sea per year) : 80%
- HFO cost: $380
- Premium of MGO over HFO: $200
- MGO consumption is 95% of HFO consumption

If a scrubber is installed, the vessel continues to burn HFO all over the world including ECAs. In such a case, the consumption of the vessel is calculated as follows: Daily consumption * days at sea * HFO cost + (Voyages per year * Fuel consumption for cargo discharge) * HFO cost, namely: 37.6 * 335 * 380 + (30 * 60) *380 = $5,470,480 which is the same every year.

If a scrubber is not installed, the vessel burns MGO at ECAs and HFO together with the use of a scrubber in all other areas. In such a case, the ECA consumption is calculated as follows: (Daily consumption * Days at sea in ECA per year + Voyages per year * Fuel consumption for cargo discharge * Share of days at sea in ECA) * (HFO cost + MGO premium over HFO) * 0.95 = (37.6 * 268 + 30 * 60 * 80%) * (380 + 200) * 95% = $6,345,757 which is the same every year. No ECA consumption is calculated in the following way: [Daily consumption * (Days at sea pear year – Days at sea in ECAs) + Voyages per year

* Fuel consumption for cargo discharge * (1-Share of days in ECA)] * HFO cost = [37.6 * (335 – 268) + 30 * 60 * (1-0.8)] * 380 = $1,094,096 which is the same for all years. As a result, the total consumption is the sum of consumption at ECAs and consumption outside ECAs, namely $6,345,757 + $1,094,096 = $7,439,853, which remains the same every year.

The difference between the two alternative methods of compliance represents the savings of installing a scrubber and is calculated as follows: $7,439,853 - $5,470,480 = $1,969,373, remaining the same during all years of the study. Then, we present the discounted savings to arrive at a present value estimate, which is used to evaluate the potential for investment. Discounted savings are calculated in the following way: savings / $(1+wacc)^{\text{ι}}$ = 1,969,373 / $(1+9\%)^{1}$ = 1,806,764 for the first year, 1,969,373 / $(1+9\%)^{2}$ = 1,657,582 for the second year and the method of calculation is the same for every year. Finally, we calculate the cumulative discounted savings. For the first year the cumulative discounted savings are the same with the discounted savings of the first year, namely 1,806,764. For the second year we take 3,464,346 by adding the cumulative discounted savings of the first year to the discounted savings of the second year and the calculation continues in the same way for the rest of the years.

As a result, it can be concluded that if a ships spends 80% of its time in ECAs and if the premium for the MGO over HFO is $200, the investment of scrubbers would have been depreciated in the fourth year. In other words, the investment on scrubbers will be equalized by the premium in MGO in four years.

Table 6.4 Vessel spends 80% of its trading life in ECAs

A	B	C	D	E	F	G	H	I
Cost (US)			$5,840,000					
WACC			9%					
Daily Consumption (tonnes)			37.6					
Days in Sea/year			335					
Share of days in sea in ECA			80%					
Days in Sea in ECA/year			268					
Voyages/year			30					
Fuel/discharge (tonnes)			60					
HFO cost			$380					
Premium MGO vs HFO			$200					
MGO consumption is 95% of HFO								
Scrubber								
Time	0	1	2	3	4	5	6	7
Consumption		$5,470,480	$5,470,480	$5,470,480	$5,470,480	$5,470,480	$5,470,480	$5,470,480
No Scrubber								
ECA Consumption		$6,345,757	$6,345,757	$6,345,757	$6,345,757	$6,345,757	$6,345,757	$6,345,757
No ECA Consumption		$1,094,096	$1,094,096	$1,094,096	$1,094,096	$1,094,096	$1,094,096	$1,094,096
Total		$7,439,853	$7,439,853	$7,439,853	$7,439,853	$7,439,853	$7,439,853	$7,439,853
Difference		$1,969,373	$1,969,373	$1,969,373	$1,969,373	$1,969,373	$1,969,373	$1,969,373
		$1,806,764	$1,657,582	$1,520,717	$1,395,153	$1,279,957	$1,174,273	$1,077,314
		$1,806,764	$3,464,346	$4,985,063	$6,380,216	$7,660,173	$8,834,446	$9,911,760
Outflow	$5,840,000							

In the second case we assume that the vessel spends at ECAs 30% of its trading life.

The data included in the model are the following:

- CAPEX: $5,840,000
- WACC / Depreciation rate (%): 9%
- Daily fuel consumption: 37.6 metric tons
- Days at sea per year : 335
- Voyages per year : 30
- Fuel consumption for discharge of cargo: 60 metric tons
- Days at sea in ECAs per year (as a percentage of the total days at sea per year) : 30%
- HFO cost: $380
- Premium of MGO over HFO: $200
- MGO consumption is 95% of HFO consumption

In such a case by applying the same formulas as above, the investment on scrubber is depreciated after fifteen years. In other words, the ship can use MGO for some fifteen years until it would equal the investment into scrubber as a means of compliance.

Table 6.5 Vessel spends 30% of its trading life in ECAs

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Cost (US)			$5.840.000													
WACC			9%													
Daily Consumption (tonnes)			37,6													
Days in Sea/year			335													
Share of days in sea in ECA			30%													
Days in Sea in ECA/year			100,5													
Voyages/year			30													
Fuel/discharge (tonnes)			60													
HFO cost			$380													
Premium MGO vs HFO			$200													
MGO consumption is 95% of HFO																
Scrubber																
Time	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Consumption		$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480	$5.470.480
No Scrubber																
ECA Consumption		$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659	$2.379.659
No ECA Consumption		$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336	$3.829.336
Total		$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995	$6.208.995
Difference		$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515	$738.515
		$677.537	$621.593	$570.269	$523.183	$479.984	$440.352	$403.993	$370.636	$340.033	$311.957	$286.199	$262.568	$240.888	$220.998	$202.750
		$677.537	$1.299.130	$1.869.399	$2.392.581	$2.872.565	$3.312.917	$3.716.910	$4.087.546	$4.427.579	$4.739.535	$5.025.734	$5.288.302	$5.529.189	$5.750.187	$5.952.938
Outflow	$5.840.000															

From the above research carried out it can be concluded that the highest the percentage of days per year a ship travels at ECAs the more attractive the investment in scrubbers becomes. In other words, as time spent in ECAs increases, the investment in scrubbers is depreciated more quickly. However, in practice, the decision of

whether to install a scrubber or opt for MGO will also depend on the price differential between HFO and MGO. More specifically, if the MGO trades at a high premium over HFO then investing in a scrubber would be preferable. On the other hand, if the price differential between HFO and MGO stays narrow, then shipowners would probably opt for compliant fuels. Moreover, the findings of this research depend on the assumption that the upfront cost of the scrubber amounts to $5,840,000. However, if CAPEX are increased then it would be more difficult to depreciate the investment and the payback period would be bigger. The results are also affected if we change the WACC. In other words, by increasing for example the depreciation rate the investment is depreciated after a longer time period and vice versa.

In addition, the study carried out refers to an aframax tanker, with this type of tanker, trading most of its time at the ECAs of the Baltic and the North sea. For instance, one main route of an aframax is loading from Russia and discharging to UK Continent or Mediterranean. In this voyage the ship spends very high percentage on the ECAs. On the other hand, a suezmax or a VLCC spend less of their trading life in ECAS and as result in their case the scrubber may not be the most appropriate method of compliance. For example, most VLCCs load from west Africa or Persian Gulf and discharge to the east (India, Indonesia, Singapore, Japan, Korea, China etcetera). In such a trade, only China has established an ECA area.

CHAPTER 7 CONCLUSION

7.1 Implications

Oil is the one of the most useful commodities and is being transported by sea at large quantities. Oil can be divided into crude oil and oil products, which are the result of the refining process. Marpol, one of the most important conventions in the sector of marine pollution prevention, has established four categories of noxious and liquid substances, depending on the magnitude of the hazards they represent for the marine environment and human health. As a result, the prohibition or the allowance of the disposal as well as the possible limits of the disposal of each substance into the marine environment depend on the category into which each substance falls.

Crude oil is being transported by sea via the biggest tankers, namely Panamaxes, Aframaxes, Suezmaxes and VLCCs, whereas oil products are being transported with smaller product carriers, which can be characterized as dirty or clean product tankers, depending on the grade being carried. However, due to the great quantities and the high frequency with which oil is being transported worldwide, marine pollution is a major problem since decades, and has been addressed several times by the global shipping community. In general, marine pollution is divided into accidental pollution, pollution from operational activities and pollution from emissions.

Air pollution from ships results from the necessity of shipping companies to burn fossil fuel in order to conduct their operations. However, the combustion of fossil fuel results to the production of greenhouse and non greenhouse gas emissions. From the research we have carried out we found out that shipping emissions have peaked during the last decades and have contributed to major environmental problems, such as climate change and acid rain. This is especially relevant for the deposition of Sulphur and nitrogen compounds. In that context, a number of conventions and regulations have been adopted in order to prevent and minimize air pollution.

Marpol and more specifically Annex VI is of outmost importance as it sets limits on SOx and NOx emissions from ships and separates such limit to a global cap that is being enforced to all sea areas worldwide and a lower limit that applies to ECAs. In addition, IMO trough amendments to Marpol has required fuel oil

consumption data collection, data analysis and reporting requirements in order to enhance ships' energy efficiency.

Under the auspices of the EU, directive 1999/32/EC and its amendments have been adopted with the aim to specify the limits of the sulfur content of certain liquid fuels and further aiming at reducing emissions of sulfur dioxides from bunker fuels. It should be noted, that this Directive introduced the concept of ECAs within the EU and set stricter rules regarding the sulfur content on EU ports and EU member states. Also, the EU from 2009 has presented a maritime transport strategy till 2018 related to five different sectors from which we focus on the area of environmental sustainability and decarbonisation which belong to the long-term objective of "zero waste, zero emission".

EMSA actively assists the Commission in the attempt to reduce the maximum permissible Sulphur content of marine fuels inside and outside SECAs and provides technical assistance to the member states during the implementation of air pollution related EU legislation. In the context of UN, the UNFCCC was the first treaty that set general goals and rules for addressing climate change.

In practice, from 2010 stricter Sulfur requirements have been introduced to some sea areas, which are known as ECAs and PSSAs. In 2020, despite the 0.5% global sulfur cap, these areas will be subject to 0.1% sulfur limit. In 2015 the ECA of China was the last addition to the existing ECAs and continues to impose stricter and stricter regulations and guidelines for compliance. Generally, regulations provide both the limit values and means to comply outside and inside ECAs.

In addition, different levels (Tiers) of control apply based on the ship construction date and within any particular Tier the actual limit value is determined from the engine's rated speed. The methods of compliance with the new bunker regulations can be divided into primary or secondary solutions, depending on the formation or not of the pollutant.

Shipowners when considering which option is most suitable for their fleet, they should take into account the operating life of the vessel and its trading areas, the spread between HFO and compliant fuel options, the split incentive between shipowner and charterer depending on the type of the charter, the economic situation of the shipowner and the competition.

In practice shipowners can choose between various methods of compliance, the most popular of which are LSFOs, scrubbers, LNG and biofuels and on these

methods we focused during our research. In order to find out the optimal method we have initially presented the case studies of three tankers with different characteristics regarding the accumulated cost of alternative methods of compliance compared to HFO baseline. The results of this research depend on the characteristics of the tankers, namely, their age, their operating profile, their ECA exposure and the type of charter. It is concluded that scrubbers are considered a viable investment both for existing and newbuilings. However, the upfront cost is higher for retrofitting a scrubber on an existing vessel. Also, since LNG has the highest investment cost, it is suggested only for newbuildings.

A swot analysis is also prepared as a tool to compare the available methods. By performing this analysis we have concluded that from an environmental and social perspective LNG would be suggested as it reduces apart from SOx, also NOx, PM and CO2 emissions and complies with current and possible future stricter regulations. Then, by considering the initial investment costs, compliant fuels would be the most suitable method of compliance since their upfront cost is negligible. When taking into account feasibility, shipowners should opt for LNG in case of newbuldings, whereas in case of existing vessels scrubbers or LSFOs are easier to be adopted. The price spread between HFO and LSFOs will wither result to be a threat or an opportunity for scrubbers: if the price spread is big scrubbers would be preferred and vice versa.

Finally, we have created an ECA calculator from which we have concluded that the scrubber investment becomes preferable as the share of time a ship spends at ECAs increases and when a substantial price differential exists between HFO and MGO. On the other hand, when the upfront cost of installing a scrubber and the WACC increase, the scrubber will be depreciated after a longer time period and in such a case shipowners should opt for MGO.

However, in practice each vessel should be examined as a different case and in most instances a combination of the available methods should be applied to a shipowner's fleet depending on the fleet's characteristcs.

According to Intertanko if a ship is running on 50 metric tons per day and is on sea 200 days per year, while the LSFs' premium to HSFO is $200 per metric ton, the extra cost of fuel for the ship owner will be $2 million per year. Depending on the price one pays to retrofit a scrubber, but assuming it to be $2-$4 million, the owner can recover it within one or two years of operations.

LNG as fuel is also an option but not a cheap one – retrofitting a ship to use LNG may not be economically viable today. Currently, one a minuscule number of ships, around 100 out of the global merchant fleet population of more than 85,000 are running on LNG, though newbuilding orders are on the rise and may rise exponentially over the next decade. The lifespan of a ship is typically 20-30 years. Shipowners prefer to wait out the life of the ship rather than invest in retrofitting as the return on investment would outlast the ship's life. Many sources believe that meaningful LNG bunkering demand will come from newly built ships.

On the other hand, there are also challenges in disposing of solid waste ashore if closed-loop scrubbers are used and they may be a preferred option only for a small and perhaps specialized, portion of the fleet, unless the LSFs are in shortage and very costly.

The main stumbling block preventing shipowners from taking on scrubbers in high numbers is the up-front capital investment required. Shipping companies in many cases are struggling to access credit for the daily costs and most are unlikely to find banks willing to loan them several million dollars to retrofit. But credit may be available from other sources. With a relatively short time over which the savings a scrubber enables overtake the initial cost, most shipowners could be expected to repay their loans promptly. Furthermore, there is significant cost for taking the vessel to dry dock for about a month to install the equipment and since the global fleet is currently also gradually being retrofitted with ballast water management systems to comply with new regulations, a lack of shipyard space worldwide may limit the uptake of scrubbers before 2020. The length of payback time, along with the time needed in dry dock, mean that scrubber retrofits would not be cost effective for any vessel likely to be scrapped within a few years.

Also, the availability of fuel oil after 2020 may prove to be a problem for some shipowners using scrubbers. The shift to 0.5% sulfur fuels in 2020 will make conventional fuel oil much more of a niche product and at smaller ports many suppliers may give up on keeping fuel oil in storage. If a situation emerges where a single supplier has a monopoly on fuel oil bunkering for vessels with scrubbers at some ports, that supplier is likely to charge much more for the product – paring back the ship owner's potential savings.

Shipowners looking at scrubbers will also need to consider which type is most suitable for their needs. Closed loop scrubbers come with a much higher operating

cost, with the expense both of the caustic soda constantly being added and of the discharge disposal. Open loop scrubbers also tend to be considerably cheaper to install, with a price tag as much as $800,000 lower than closed loop versions in some cases. However, open loop systems come with a regulatory risk as lawmakers concerned about ocean acidification may seek to prevent shipowners from simply removing the sulfur from their emissions and then dumping it in the sea. There is also a wider regulatory risk with all types of scrubbers, in that they are not designed to cope with all of the environmental regulations likely to be imposed on shipping over the next decade.

LNG as fuel is especially expected to increase for vessels frequently operating in the North American and North European waters with existing or upcoming NOx requirements. An increase in compliant fuel prices relative to LNG will encourage operators to invest in LNG. Alternative fuels, such as methanol and biofuels are expected to only be able to serve a minor share of the market. They will be an alternative in some local areas, where the supply fits trading patterns for vessels.

On the other hand, installation costs of a small methanol bunkering station have been estimated at around €400,000, while a bunker barge could be converted to carry methanol for around €1.5 million. That compares with a bill of about €50 million to build an LNG terminal and €30 million to build a new LNG bunker barge. But methanol also has the same problem of requiring huge capital expenditure up front. While it can be cost effective to retrofit a vessel to use methanol, the cost of doing so and of taking a vessel to dry dock is still high. Methanol bunkers also have the disadvantage of not being reliably available at all major ports.

Other compliant fuels include LPG, Dimethyl Ether and Biofuels. These are considered to have very little impact on the market as a whole, but are alternatives that can be considered where supply is readily available

As a result a blend option is suggested. It would be cheaper to operate the open-loop scrubber on high seas and switch to LSFs in specific waters where their use is restricted. Ship owners can reconfigure the fuel system of ships so that the operations of LSFs and HSFO are segregated and the fuel switch is managed to maximize the use of scrubbers and minimize that of expensive IMO-compliant fuels.

Experience from the ECA areas that came into force in 2015 show that the majority of operators have opted for the fuel switch from HFO to MGO, with just a small percentage having chosen to use HFO with exhaust gas cleaning or LNG as

fuel. This is also expected for the 2020 regulations, as scrubbers require a costly retrofit and the industry has questions regarding technological maturity and operational limitations, and LNG is mostly relevant for newbuilds. In particular, larger vessels, such the ones examined at the dissertation, do not spend a significant amount of time in ECAs to justify an expensive investment. In addition, where charterers are paying for the fuel, there is no or little incentive for an owner to invest in equipment for running on cheaper fuel as he will see no return on the investment.

Nevertheless, as the production of low Sulphur-blend hybrid fuels (0.5% S) is gradually introduced, we may observe the prices of distillates eventually levelling off. However, if a substantial price differential between the traditional HFO and the compliant fuels persists over time, the alternative solutions, such as scrubbers or using LNG as fuel, may prove to be the preferred solution.

There is no one-size-fits-all solution and the best option very much depends on vessel type, size of vessel, operational patterns and which fuels are available in the short and long term. For options requiring a retrofit, it is also important to consider the complexity of installation, possible off-hire and the remaining lifetime of the ship.

7.2 Limitation of analysis

The ECA calculator we have developed has limited our analysis as it performs a comparison between LSFOs and scrubbers and it does not take into consideration other alternative methods. Also, in our thesis we have analyzed only the main alternatives of compliance. However, there are others, less popular methods such as advanced fuel injection, fuel emulsification, high-pressure supercharging, use of non-thermal plasma and others.

7.3 Further research

One source for further research on this topic should include all the available methods of compliance and should take into account the possible future regulations that may come in place after 2020, connecting this with the energy outlook of the following decades.

Another suggestion for further research would be to study the implications of the new bunkers' regulations on the refinery industry and the ways with which refineries could meet the increased demand that may result due to 2020 requirements.

Further research on this topic could also focus on the practical implementation of the regulations and the methods to check and control compliance. More specifically, one study could investigate what actions should be undertaken by ports and flag states in order to ensure compliance, especially in the high seas, where compliance and checking of compliance are more difficult. Such study could also be connected with the jurisdiction and the rights that prevail to high seas according to the law of the sea.

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APPENDICES

APPENDIX A COUNCIL DIRECTIVE 1999/32/EC OF 26 APRIL 1999 RELATING TO A REDUCTION IN THE SULFUR CONTENT OF CERTAIN LIQUID FUELS AND AMENDING DIRECTIVE 93/12/EEC

THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 130s(1) thereof,

Having regard to the proposal from the Commission(1),

Having regard to the opinion of the Economic and Social Committee(2),

Acting in accordance with the procedure laid down in Article 189c of the Treaty(3),

(1) Whereas the objectives and principles of the Community's environmental policy as set out in the action programmes on the environment and in particular the Fifth Environmental Action Programme(4) on the basis of principles enshrined in Article 130r of the Treaty, aim in particular to ensure the effective protection of all people from the recognised risks from sulphur dioxide emissions and to protect the environment by preventing sulphur deposition exceeding critical loads and levels;

(2) Whereas Article 129 of the Treaty provides that health protection requirements are to form a constituent part of the Community's other policies; whereas Article 3(o) of the Treaty also provides that the activities of the Community should include a contribution to the attainment of a high level of health protection;

(3) Whereas emissions of sulphur dioxide contribute significantly to the problem of acidification in the Community; whereas sulphur dioxide also has a direct effect on human health and on the environment;

(4) Whereas acidification and atmospheric sulphur dioxide damage sensitive ecosystems, reduce biodiversity and reduce amenity value as well as detrimentally affecting crop production and the growth of forests; whereas acid rain falling in cities may cause significant damage to buildings and the architectural heritage; whereas sulphur dioxide pollution may also have a significant effect upon human health, particularly among those sectors of the population suffering from respiratory diseases;

(5) Whereas acidification is a transboundary phenomenon requiring Community as well as national or local solutions;

(6) Whereas emissions of sulphur dioxide contribute to the formation of particulate matter in the atmosphere;

(7) Whereas the Community and the individual Member States are Contracting Parties to the UN-ECE Convention on Long-Range Transboundary Air Pollution; whereas the second UN-ECE Protocol on transboundary pollution by sulphur dioxide foresees that the Contracting Parties should reduce sulphur dioxide emissions in line with or beyond the 30 % reduction specified in the first Protocol and whereas the second UN-ECE Protocol is based on the premise that critical loads and levels will continue to be exceeded in some sensitive areas; whereas further measures to reduce sulphur dioxide emissions will still be required if the objectives in the Fifth Environmental Action Programme are to be respected; whereas the Contracting Parties should therefore make further significant reductions in emissions of sulphur dioxide;

(8) Whereas sulphur which is naturally present in small quantities in oil and coal has for decades been recognised as the dominant source of sulphur dioxide emissions which are one of the main causes of "acid rain" and one of the major causes of the air pollution experienced in many urban and industrial areas;

(9) Whereas the Commission has recently published a communication on a cost-effective strategy to combat acidification in the Community; whereas the control of sulphur dioxide emissions originating from the combustion of certain liquid fuels was identified as being an integral component of this cost-effective strategy; whereas the Community recognises the need for measures regarding all other fuels;

(10) Whereas studies have shown that benefits from reducing sulphur emissions by reductions in the sulphur content of fuels will often be considerably greater than the estimated costs to industry in this Directive and whereas the technology exists and is well established for reducing the sulphur level of liquid fuels;

(11) Whereas, in conformity with the principle of subsidiarity and the principle of proportionality referred to in Article 3b of the Treaty, the objective of reducing the emissions of sulphur dioxide arising from the combustion of certain types of liquid fuels cannot be achieved effectively by Member States acting individually; whereas unconcerted action offers no guarantee of achieving the desired objective, is potentially counterproductive and will result in considerable uncertainty in the market for the fuel products affected; whereas, in view of the need to reduce sulphur dioxide emissions across the Community, it is therefore more effective to take action at the level of the Community; whereas this Directive limits itself to the minimum requirements necessary to achieve the desired objective;

(12) Whereas in Council Directive 93/12/EEC of 23 March 1993 relating to the sulphur content of certain liquid fuels(5) the Commission was asked to submit to the Council a proposal prescribing lower limits for the sulphur content in gas oil and new limits for aviation kerosene; whereas it would be appropriate to lay down limits for the sulphur content of other liquid fuels, in particular heavy fuel oils, bunker fuel oils, marine gas oils and gas oils, on the basis of cost effectiveness studies;

(13) Whereas, in accordance with Article 130t of the Treaty, this Directive should not prevent any Member State from maintaining or introducing more stringent protective measures; whereas such measures must be compatible with the Treaty and should be notified to the Commission;

(14) Whereas a Member State, before introducing new, more stringent protective measures, should notify the draft measures to the Commission in accordance with Council Directive 83/189/EEC of 28 March 1983 laying down a procedure for the provision of information in the field of technical standards and regulations(6);

(15) Whereas, with regard to the limit on the sulphur content of heavy fuel oil, it is appropriate to provide for derogations in Member States and regions where the environmental conditions allow;

(16) Whereas, with regard to the limit on the sulphur content of heavy fuel oil, it is also appropriate to provide for derogations for their use in combustion plants which comply with the emission limit values laid down in Council Directive 88/609/EEC of 24 November 1988(7) on the limitation of emissions of certain pollutants into the air from large combustion plants; whereas in the light of the forthcoming revision of Directive 88/609/EEC, it may be necessary to review and, if appropriate, to revise certain provisions of this Directive;

(17) Whereas for refinery combustion plants excluded from the scope of Article 3(3)(i)(c) of this Directive the emissions of sulphur dioxide averaged over such plants should not exceed the limits set out in Directive 88/609/EEC or any future revision of that Directive; whereas, in the application of this Directive, Member States should bear in mind that substitution by fuels other than those pursuant to Article 2 should not produce an increase in emissions of acidifying pollutants;

(18) Whereas a limit value of 0,2 % for the sulphur content of gas oils has already been established pursuant to Directive 93/12/EEC; whereas that limit value should be changed to 0,1 % until 1 January 2008;

(19) Whereas, in accordance with the 1994 Act of Accession, Austria and Finland have a derogation for a period of four years from the date of accession regarding the provisions in Directive 93/12/EEC concerning the sulphur content of gas oil;

(20) Whereas the limit values of 0,2 % (from the year 2000) and of 0,1 % (from the year 2008) for the sulphur content of gas oils intended for marine use in sea-going ships may present technical and economic problems for Greece throughout its territory, for Spain with regard to the Canary Islands, for France with regard to the French Overseas Departments, and for Portugal with regard to the archipelagoes of Madeira and Azores; whereas a derogation for Greece, the Canary Islands, the French Overseas Departments and the Archipelagoes of Madeira and Azores should not have a negative effect upon the market in gas oil intended for marine use and given that exports of gas oil for marine use from Greece, the Canary Islands, the French Overseas Departments and the Archipelagoes of Madeira and Azores to other Member States should satisfy the requirements in force in the importing Member State;

whereas Greece, the Canary Islands, the French Overseas Departments and the Archipelagoes of Madeira and Azores should therefore be afforded a derogation from the limit values of sulphur by weight for gas oil used for marine purposes;

(21) Whereas sulphur emissions from shipping due to the combustion of bunker fuels with a high sulphur content contribute to sulphur dioxide pollution and problems of acidification; whereas the Community will be advocating more effective protection of areas sensitive to SOx emissions and a reduction in the normal limit value for bunker fuel oil (from the present 4,5 %) at the continuing and future negotiations on the MARPOL Convention within the International Maritime Organisation (IMO); whereas the Community initiatives to have the North Sea/Channel declared a special low SOx emission control area should be continued;

(22) Whereas more profound research into the effects of acidification on ecosystems and the human body is needed; whereas the Community is assisting such research under the Fifth Framework Research Programme(8);

(23) Whereas in the case of a disruption in the supply of crude oil, petroleum products or other hydrocarbons, the Commission may authorise application of a higher limit within a Member State's territory;

(24) Whereas Member States should establish the appropriate mechanisms for monitoring compliance with the provisions of this Directive; whereas reports on the sulphur content of liquid fuels should be submitted to the Commission;

(25) Whereas, for reasons of clarity, it will be necessary to amend Directive 93/12/EEC,

HAS ADOPTED THIS DIRECTIVE:

Article 1

Purpose and scope

1. The purpose of this Directive 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.

2. Reductions in the 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 the territory of the Member States.

The limitations on the sulphur content of certain petroleum-derived liquid fuels as laid down in this Directive shall not, however, apply to:

(a) - petroleum derived liquid fuels used by seagoing ships, except those fuels falling within the definition in Article 2(3),

- marine gas oil used by ships crossing a frontier between a third country and a Member State;

(b) fuels intended for processing prior to final combustion;

(c) fuels to be processed in the refining industry.

Article 2

Definitions

For the purpose of this Directive:

1. heavy fuel oil means:

- any petroleum-derived liquid fuel falling within CN code 2710 00 71 to 2710 00 78, or

- any petroleum-derived liquid fuel, other than gas oil as defined in points 2 and 3, which, by reason of its distillation limits, falls within the category of heavy oils intended for use as fuel and of which less than 65 % by volume (including losses) distils at 250 °C by the ASTM D86 method. If the distillation cannot be determined by the ASTM D86 method, the petroleum product is likewise categorised as a heavy fuel oil;

2. gas oil means:

- any petroleum-derived liquid fuel falling within CN code 2710 00 67 or 2710 00 68, or

- any petroleum-derived liquid fuel which, by reason of its distillation limits, falls within the category of middle distillates intended for use as fuel and of which at least 85 % by volume (including losses) distils at 350 °C by the ASTM D86 method.

Diesel fuels as defined in Article 2(2) of Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC(9) are excluded from this definition. Fuels used in non-road mobile machinery and agricultural tractors are also excluded from this definition;

3. marine gas oil means fuels intended for marine use which meet the definition in point 2 or which have a viscosity or density falling within the ranges of viscosity or density defined for marine distillates in Table I of ISO 8217 (1996);

4. ASTM method means the methods laid down by the American Society for Testing and Materials in the 1976 edition of standard definitions and specifications for petroleum and lubricating products;

5. combustion plant means any technical apparatus in which fuels are oxidised in order to use the heat generated;

6. critical load means a quantitative estimate of exposure to one or more pollutants below which significant harmful effects on sensitive elements of the environment do not occur according to current knowledge.

Article 3

Maximum sulphur content of heavy fuel oil

1. Member States shall take all necessary steps to ensure that as from 1 January 2003 within their territory heavy fuel oils are not used if their sulphur content exceeds 1,00 % by mass.

2. Provided that the air quality standards for sulphur dioxide laid down in Directive 80/779/EEC(10) or in any Community legislation which repeals and replaces these standards and other relevant Community provisions are respected and the emissions do not contribute to critical loads being exceeded in any Member State, a Member State may authorise heavy fuel oils with a sulphur content of between 1,00 and 3,00 % by mass to be used in part or the whole of its territory. Such authorisation shall apply only while emissions from a Member State do not contribute to critical loads being exceeded in any Member State.

3. (i) Subject to appropriate monitoring of emissions by competent authorities paragraphs 1 and 2 shall not apply to heavy fuel oils used:

(a) in combustion plants which fall within the scope of Directive 88/609/EEC, which are considered new plants in accordance with the definition given in Article 2(9) of that Directive and which comply with the sulphur dioxide emission limits for such plants set out in Article 4 of and Annex IV to that Directive;

(b) in other combustion plants, which do not fall under the scope of (a), where the emissions of sulphur dioxide from the plant are less than or equal to 1700 mg/Nm3 at an oxygen content in the flue gas of 3 % by volume on a dry basis;

(c) for combustion in refineries, where the monthly average of emissions of sulphur dioxide averaged over all plants in the refinery (excluding combustion plants which fall under the scope of (a)), irrespective of the type of fuel or fuel combination used, are within a limit to be set by each Member State, which shall not exceed 1700 mg/Nm3.

(ii) Member States shall take the necessary measures to ensure that any combustion plant using heavy fuel oil with a sulphur concentration greater than that referred to in paragraph 1 shall not be operated without a permit issued by a competent authority, which specifies the emission limits.

4. The provisions of paragraph 3 shall be reviewed and, if appropriate, revised in the light of any future revision of Directive 88/609/EEC.

5. If a Member State avails itself of the possibilities referred to in paragraph 2, it shall, at least 12 months beforehand, inform the Commission and the public. The Commission shall be given sufficient information to assess whether the criteria mentioned in paragraph 2 are met. The Commission shall inform the other Member States.

Within six months of the date on which it receives the information from the Member State, the Commission shall examine the measures envisaged and, in accordance with the procedure set out in Article 9, take a decision which it shall communicate to the Member States. This decision shall be reviewed every eight years on the basis of information to be provided to the Commission by the Member States concerned in accordance with the procedure set out in Article 9.

Article 4

Maximum sulphur content in gas oil

1. Member States shall take all necessary steps to ensure that gas oils, including marine gas oils, are not used within their territory as from:

- July 2000 if their sulphur content exceeds 0,20 % by mass,

- 1 January 2008 if their sulphur content exceeds 0,10 % by mass.

2. By way of derogation from paragraph 1, Spain, for the Canary Islands, France, for the French Overseas Departments, Greece, for the whole or part of its territory, and Portugal, for the archipelagoes of Madeira and Azores may authorise the use of gas oils for marine use with a sulphur content in excess of the limits set out in paragraph 1.

3. Provided that the air quality standards for sulphur dioxide laid down in Directive 80/779/EEC or in any Community legislation which repeals and replaces these standards and other relevant Community provisions are respected and the emissions do not contribute to critical loads being exceeded in any Member State, a Member State may authorise gas oil with a sulphur content between 0,10 and 0,20 % by mass to be used in part or the whole of its territory. Such authorisation shall apply only while emissions from a Member State do not contribute to critical loads being exceeded in any Member State and shall not extend beyond 1 January 2013.

4. If a Member State avails itself of the possibilities referred to in paragraph 3, it shall, at least 12 months beforehand, inform the Commission and the public. The Commission shall be given sufficient information to assess whether the criteria mentioned in paragraph 3 are met. The Commission shall inform the other Member States.

Within six months of the date on which it receives the information from the Member State, the Commission shall examine the measures envisaged and, in accordance with the procedure set out in Article 9, take a decision which it shall communicate to the Member States.

Article 5

Change in the supply of fuels

If, as a result of a sudden change in the supply of crude oil, petroleum products or other hydrocarbons, it becomes difficult for a Member State to apply the limits on the maximum sulphur content referred to in Articles 3 and 4, that Member State shall inform the Commission thereof. The Commission may authorise a higher limit to be applicable within the territory of that Member State for a period not exceeding six months; it shall notify its decision to the Council and the Member States. Any Member State may refer that decision to the Council within one month. The Council, acting by a qualified majority, may adopt a different decision within two months.

Article 6

Sampling and analysis

1. Member States shall take all necessary measures to check by sampling that the sulphur content of fuels used complies with Articles 3 and 4. The sampling shall commence within six months of the date on which the relevant limit for maximum sulphur content in the fuel comes into force. It shall be

carried out with sufficient frequency and in such a way that the samples are representative of the fuel examined.

2. The reference method adopted for determining the sulphur content shall be that defined by:

(a) ISO method 8754 (1992) and PrEN ISO 14596 for heavy fuel oil and marine gas oil;

(b) EN method 24260 (1987), ISO 8754 (1992) and PrEN ISO 14596 for gas oil.

The arbitration method will be PrEN ISO 14596. The statistical interpretation of the verification of the sulphur content of the gas oils used shall be carried out in accordance with ISO standard 4259 (1992).

Article 7

Reporting and review

1. On the basis of the results of the sampling and analysis carried out in accordance with Article 6, Member States shall by 30 June of each year supply the Commission with a short report on the sulphur content of the liquid fuels falling within the scope of this Directive and used within their territory during the preceding calendar year. This report shall include a summary of derogations granted pursuant to Article 3(3).

2. On the basis inter alia of the annual reports submitted in accordance with paragraph 1 and the observed trends in air quality and acidification, the Commission shall, by 31 December 2006, submit a report to the European Parliament and to the Council. The Commission may submit with its report proposals aimed at revising this Directive and in particular the limit values laid down for each fuel category and the exceptions and derogations provided for in Article 3(2) and (3), and Article 4(2) and (3).

3. The Commission shall consider which measures could be taken to reduce the contribution to acidification of the combustion of marine fuels other than those specified in Article 2(3) and, if appropriate, make a proposal by the end of 2000.

Article 8

Amendments to Directive 93/12/EEC

1. Directive 93/12/EEC is amended as follows:

(a) in Article 1, paragraph 1(a) and paragraph 2 are deleted;

(b) in Article 2, the first subparagraph of paragraph 2 and paragraph 3 are deleted;

(c) Articles 3 and 4 are deleted.

2. Paragraph 1 shall apply as from 1 July 2000.

Article 9

Advisory Committee

The Commission shall be assisted by a committee of an advisory nature composed of the representatives of the Member States and chaired by the representative of the Commission.

The representative of the Commission shall submit to the committee a draft of the measures to be taken. The committee shall deliver its opinion on the draft, within a time limit which the chairman may lay down according to the urgency of the matter, if necessary by taking a vote.

The opinion shall be recorded in the minutes; in addition, each Member State shall have the right to ask to have its position recorded in the minutes.

The Commission shall take the utmost account of the opinion delivered by the committee. It shall inform the committee of the manner in which its opinion has been taken into account.

Article 10

Transposition

Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive before 1 July 2000. They shall immediately inform the Commission thereof.

When Member States adopt these provisions, these shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The procedure for such reference shall be adopted by Member States.

Member States shall communicate to the Commission the text of the provisions of national law which they adopt in the field covered by this Directive.

Article 11

Penalties

Member States shall determine the penalties applicable to breaches of the national provisions adopted pursuant to this Directive. The penalties determined must be effective, proportionate and dissuasive.

Article 12

Entry into force

This Directive shall enter into force on the day of its publication in the Official Journal of the European Communities.

Article 13

Addressees

This Directive is addressed to the Member States.

Done at Luxembourg, 26 April 1999.

For the Council

The President

<u>APPENDIX B</u> DIRECTIVE 2012/33/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 21 NOVEMBER 2012 AMENDING COUNCIL DIRECTIVE 1999/32/EC AS REGARDS THE SULFUR CONTENT OF MARINE FUELS

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 192(1) thereof,

Having regard to the proposal from the European Commission,

After transmission of the draft legislative act to the national parliaments,
Having regard to the opinion of the European Economic and Social Committee ([1]),

After consulting the Committee of the Regions,
Acting in accordance with the ordinary legislative procedure ([2]),

Whereas:

(1) The environmental policy of the Union, as set out in the action programmes on the environment, and in particular in the Sixth Environmental Action Programme adopted by Decision No 1600/2002/EC of the European Parliament and of the Council ([3]), has as one of its objectives to achieve levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment.

(2) Article 191(2) of the Treaty on the Functioning of the European Union (TFEU) provides that Union policy on the environment is to aim at a high level of protection, taking into account the diversity of situations in the various regions of the Union.

(3) Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels ([4]) lays down the maximum permitted sulphur content of heavy fuel oil, gas oil, marine gas oil and marine diesel oil used in the Union.

(4) Emissions from shipping due to the combustion of marine fuels with a high sulphur content contribute to air pollution in the form of sulphur dioxide and particulate matter, which harm human health and the environment and contribute to acid deposition. Without the measures set out in this Directive, emissions from shipping would soon have been higher than emissions from all land-based sources.

(5) Air pollution caused by ships at berth is a major concern for many harbour cities

when it comes to their efforts to meet the Union's air quality limit values.

(6) Member States should encourage the use of shore-side electricity, as the electricity for present-day ships is usually provided by auxiliary engines.

(7) Under Directive 1999/32/EC, the Commission is to report to the European Parliament and the Council on the implementation of that Directive and may submit with its report proposals for amending it, in particular as regards the reduction of sulphur limits for marine fuel in SOx Emission Control Areas (SECAs), in accordance with the work of the International Maritime Organisation (IMO).

(8) In 2008, the IMO adopted a resolution to amend Annex VI 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 (MARPOL), containing regulations for the prevention of air pollution from ships. The revised Annex VI to MARPOL entered into force on 1 July 2010.

(9) The revised Annex VI to MARPOL introduces, inter alia, stricter sulphur limits for marine fuel in SECAs (1,00 % as of 1 July 2010 and 0,10 % as of 1 January 2015) as well as in sea areas outside SECAs (3,50 % as of 1 January 2012 and, in principle, 0,50 % as of 1 January 2020). Most Member States are obliged, in accordance with their international commitments, to require ships to use fuel with a maximum sulphur content of 1,00 % in SECAs as of 1 July 2010. In order to ensure coherence with international law as well as to secure proper enforcement of new globally established sulphur standards in the Union, Directive 1999/32/EC should be aligned with the revised Annex VI to MARPOL. In order to ensure a minimum quality of fuel used by ships either for fuel-based or technology-based compliance, marine fuel the sulphur content of which exceeds the general standard of 3,50 % by mass should not be allowed for use in the Union, except for fuels supplied to ships using emission abatement methods operating in closed mode.

(10) Amendments to Annex VI to MARPOL regarding SECAs are possible under IMO procedures. In the event that further changes, including exemptions, are introduced with regard to the application of SECA limits in Annex VI to MARPOL, the Commission should consider any such changes and, where appropriate, without delay make the necessary proposal in accordance with the TFEU to fully align Directive 1999/32/EC with the IMO rules regarding SECAs.

(11) The introduction of any new emission control areas should be subject to the IMO process under Annex VI to MARPOL and should be underpinned by a well-founded case based on environmental and economic grounds and supported by scientific data.

(12) In accordance with regulation 18 of the revised Annex VI to MARPOL, Member

States should endeavour to ensure the availability of marine fuels which comply with this Directive.

(13) In view of the global dimension of environmental politics and shipping emissions, ambitious emission standards should be set at a global level.

(14) Passenger ships operate mostly in ports or close to coastal areas and their impacts on human health and the environment are significant. In order to improve air quality around ports and coasts, those ships are required to use marine fuel with a maximum sulphur content of 1,50 % until stricter sulphur standards apply to all ships in territorial seas, exclusive economic zones and pollution control zones of Member States.

(15) In accordance with Article 193 TFEU, this Directive should not prevent any Member State from maintaining or introducing more stringent protective measures in order to encourage early implementation with respect to the maximum sulphur content of marine fuels, for instance using emission abatement methods outside SECAs.

(16) In order to facilitate the transition to new engine technologies with the potential for significant further emission reductions in the maritime sector, the Commission should further explore opportunities to enable and encourage the uptake of gas-powered engines in ships.

(17) Proper enforcement of the obligations with regard to the sulphur content of marine fuels is necessary in order to achieve the aims of Directive 1999/32/EC. The experience from the implementation of Directive 1999/32/EC has shown that there is a need for a stronger monitoring and enforcement regime in order to ensure the proper implementation of that Directive. To that end, it is necessary that Member States ensure sufficiently frequent and accurate sampling of marine fuel placed on the market or used on board ship as well as regular verification of ships' log books and bunker delivery notes. It is also necessary for Member States to establish a system of effective, proportionate and dissuasive penalties for non-compliance with the provisions of Directive 1999/32/EC. In order to ensure more transparency of information, it is also appropriate to provide that the register of local suppliers of marine fuel be made publicly available.

(18) Reporting by Member States under Directive 1999/32/EC has proved insufficient for the purpose of verification of compliance with that Directive due to the lack of harmonised and sufficiently precise provisions on the content and the format of the Member States' reports. Therefore, more detailed indications as regards the content and the format of the report are necessary to ensure more harmonised reporting.

(19) Following the adoption of Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) ([5]), which recasts the Union legislation on

industrial emissions, it is necessary to amend the provisions of Directive 1999/32/EC relating to maximum sulphur content of heavy fuel oil accordingly.

(20) Complying with the low sulphur limits for marine fuels, particularly in SECAs, can result in a significant increase in the price of such fuels, at least in the short term, and can have a negative effect on the competitiveness of short sea shipping in comparison with other transport modes, as well as on the competitiveness of the industries in the countries bordering SECAs. Suitable solutions are necessary in order to reduce compliance costs for the affected industries, such as allowing for alternative, more cost-effective methods of compliance than fuel-based compliance and providing support, where necessary. The Commission will, based inter alia on reports from Member States, closely monitor the impacts of the shipping sector's compliance with the new fuel quality standards, particularly with respect to possible modal shift from sea to land-based transport and will, if appropriate, propose proper measures to counteract such a trend.

(21) Limiting modal shift from sea to land-based transport is important given that an increasing share of goods being transported by road would in many cases run counter to the Union's climate change objectives and increase congestion.

(22) The costs of the new requirements to reduce sulphur dioxide emissions could result in modal shift from sea to land-based transport and could have negative effects on the competitiveness of the industries. The Commission should make full use of instruments such as Marco Polo and the trans-European transport network to provide targeted assistance so as to minimise the risk of modal shift. Member States may consider it necessary to provide support to operators affected by this Directive in accordance with the applicable State aid rules.

(23) In accordance with existing guidelines on State aid for environmental protection, and without prejudice to future changes thereto, Member States may provide State aid in favour of operators affected by this Directive, including aid for retrofitting operations of existing vessels, if such aid measures are deemed to be compatible with the internal market in accordance with Articles 107 and 108 TFEU, in particular in light of the applicable guidelines on State aid for environmental protection. In this context, the Commission may take into account that the use of some emission abatement methods go beyond the requirements of this Directive by reducing not only the sulphur dioxide emissions but also other emissions.

(24) Access to emission abatement methods should be facilitated. Those methods can provide emission reductions at least equivalent to, or even greater than, those achievable using low sulphur fuel, provided that they have no significant negative impacts on the environment, such as marine ecosystems, and that they are developed subject to appropriate approval and control mechanisms. The already known alternative methods, such as the use of on-board exhaust gas cleaning systems, the mixture of fuel and liquefied natural gas (LNG) or the use

of biofuels should be recognised in the Union. It is important to promote the testing and development of new emission abatement methods in order, among other reasons, to limit modal shift from sea to land-based transport.

(25) Emission abatement methods hold the potential for significant emission reductions. The Commission should therefore promote the testing and development of these technologies, inter alia by considering the establishment of a co-financed joint programme with industry, based on principles from similar programmes, such as the Clean Sky Programme.

(26) The Commission, in cooperation with Member States and stakeholders, should further develop measures identified in the Commission's staff working paper of 16 September 2011 entitled ·Pollutant emission reduction from maritime transport and the sustainable waterborne transport toolbox·.

(27) Alternative emission abatement methods such as some types of scrubbers could generate waste that should be handled properly and not be discharged into the sea. Pending the revision of Directive 2000/59/EC of the European Parliament and of the Council of 27 November 2000 on port reception facilities for ship-generated waste and cargo residues ([6]), Member States should ensure, in accordance with their international commitments, the availability of port reception facilities adequate to meet the needs of ships using exhaust gas cleaning systems. In the revision of Directive 2000/59/EC, the Commission should consider the inclusion of waste from exhaust gas cleaning systems under the principle of no special fee applying to port fees for ship-generated waste provided for in that Directive.

(28) The Commission should, as part of its air quality policy review in 2013, consider the possibility of reducing air pollution, including in the territorial seas of Member States.

(29) Effective, proportionate and dissuasive penalties are important for the implementation of Directive 1999/32/EC. Member States should include in those penalties fines calculated in such a way as to ensure that the fines at least deprive those responsible of the economic benefits derived from their infringement and that those fines gradually increase for repeated infringements. Member States should notify the provisions on penalties to the Commission.

(30) The power to adopt acts in accordance with Article 290 TFEU should be delegated to the Commission in respect of the amendment of the equivalent emission values for and the criteria for the use of emission abatement methods in order to adapt the provisions of Directive 1999/32/EC to scientific and technical progress and in such a way as to ensure strict consistency with the relevant instruments of the IMO and in respect of the amendment of points 1, 2, 3, 3a, 3b and 4 of Article 2, point (b) of Article 6(1a) and Article 6(2) of Directive 1999/32/EC in order to adapt the provisions of that Directive to scientific and

technical progress. It is of particular importance that the Commission carry out appropriate consultations during its preparatory work, including at expert level. The Commission, when preparing and drawing up delegated acts, should ensure a simultaneous, timely and appropriate transmission of relevant documents to the European Parliament and to the Council.

(31) In order to ensure uniform conditions for the implementation of Directive 1999/32/EC, implementing powers should be conferred on the Commission. Those powers should be exercised in accordance with Regulation (EU) No 182/2011 of the European Parliament and of the Council of 16 February 2011 laying down the rules and general principles concerning mechanisms for control by Member States of the Commission's exercise of implementing powers ([7]).

(32) It is appropriate for the Committee on Safe Seas and the Prevention of Pollution from Ships established by Regulation (EC) No 2099/2002 of the European Parliament and of the Council of 5 November 2002 establishing a Committee on Safe Seas and the Prevention of Pollution from Ships (COSS) ([8]) to assist the Commission in the approval of the emission abatement methods which are not covered by Council Directive 96/98/EC of 20 December 1996 on marine equipment ([9]).

(33) In accordance with the Joint Political Declaration of 28 September 2011 of Member States and the Commission on explanatory documents ([10]), Member States have undertaken to accompany, in justified cases, the notification of their transposition measures with one or more documents explaining the relationship between the components of a directive and the corresponding parts of national transposition instruments. With regard to this Directive, the legislator considers the transmission of such documents to be justified.

(34) Directive 1999/32/EC should therefore be amended accordingly,

HAVE ADOPTED THIS DIRECTIVE:

Article 1

Amendments to Directive 1999/32/EC

Directive 1999/32/EC is amended as follows:

(1) in Article 1(2), point (h) is replaced by the following:

'(h) without prejudice to Article 3a, fuels used on board vessels employing emission abatement methods in accordance with Articles 4c and 4e.';

(2) Article 2 is amended as follows:

(a) points 1 and 2 are replaced by the following:

'(1) *heavy fuel oil* means:

— any petroleum-derived liquid fuel, excluding marine fuel, falling within CN code 2710 19 51 to 2710 19 68, 2710 20 31, 2710 20 35, 2710 20 39, or

— any petroleum-derived liquid fuel, other than gas oil as defined in points 2 and 3, which, by reason of its distillation limits, falls within the category of heavy oils intended for use as fuel and of which less than 65 % by volume (including losses) distils at 250 °C by the ASTM D86 method. If the distillation cannot be determined by the ASTM D86 method, the petroleum product is likewise categorised as a heavy fuel oil;

(2) *gas oil* means:

— any petroleum-derived liquid fuel, excluding marine fuel, falling within CN code 2710 19 25, 2710 19 29, 2710 19 47, 2710 19 48, 2710 20 17 or 2710 20 19, or

— any petroleum-derived liquid fuel, excluding marine fuel, of which less than 65 % by volume (including losses) distils at 250 °C and of which at least 85 % by volume (including losses) distils at 350 °C by the ASTM D86 method.

Diesel fuels as defined in point 2 of Article 2 of Directive 98/70/EC of the European Parliament and of the Council of 13 October 1998 relating to the quality of petrol and diesel fuels ([11]) are excluded from this definition. Fuels used in non-road mobile machinery and agricultural tractors are also excluded from this definition;

(b) points 3a and 3b are replaced by the following:

·(3a) marine diesel oil means any marine fuel as defined for DMB grade in Table I of ISO 8217 with the exception of the reference to the sulphur content;

(3b) marine gas oil means any marine fuel as defined for DMX, DMA and DMZ grades in Table I of ISO 8217 with the exception of the reference to the sulphur content;·;

(c) point 3m is replaced by the following:

·(3m) emission abatement method means any fitting, material, appliance or apparatus to be fitted in a ship or other procedure, alternative fuel, or compliance method, used as an alternative to low sulphur marine fuel meeting the requirements set out in this Directive, that is verifiable, quantifiable and enforceable;·;

(3) Article 3 is amended as follows:

(a) paragraphs 1 and 2 are replaced by the following:

·1. Member States shall ensure that heavy fuel oils are not used within their territory if their sulphur content exceeds 1 % by mass.

2. Until 31 December 2015, subject to appropriate monitoring of emissions by competent authorities, paragraph 1 shall not apply to heavy fuel oils used:

(a) in combustion plants which fall within the scope of Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants ([12]), which are subject to Article 4(1) or (2) or Article 4(3)(a) of that Directive and which comply with the emission limits for sulphur dioxide for such plants as set out in that Directive;

(b) in combustion plants which fall within the scope of Directive 2001/80/EC, which are subject to Article 4(3)(b) and Article 4(6) of that Directive and the monthly average sulphur dioxide emissions of which do not exceed 1 700 mg/Nm^3 at an oxygen content in the flue gas of 3 % by volume on a dry basis;

(c) in combustion plants which do not fall under points (a) or (b), and the monthly average sulphur dioxide emissions of which do not exceed 1 700 mg/Nm^3 at an oxygen content in the flue gas of 3 % by volume on a dry basis;

(d) for combustion in refineries, where the monthly average of emissions of sulphur dioxide averaged over all combustion plants in the refinery, irrespective of the type of fuel or fuel combination used, but excluding plants which fall under points (a) and (b), gas turbines and gas engines, do not exceed 1 700 mg/Nm^3 at an oxygen content in the flue gas of 3 % by volume on a dry basis.

3. As from 1 January 2016, subject to appropriate monitoring of emissions by competent authorities, paragraph 1 shall not apply to heavy fuel oils used:

(a) in combustion plants which fall within the scope of Chapter III of Directive 2010/75/EU of the European Parliament and of the Council ([13]), and which comply with the emission limits for sulphur dioxide for such plants as set out in Annex V to that Directive or, where those emission limit values are not applicable according to that Directive, for which the monthly average sulphur dioxide emissions do not exceed 1 700 mg/Nm^3 at an oxygen content in the flue gas of 3 % by volume on a dry basis;

(b) in combustion plants which do not fall under point (a), and the monthly average sulphur dioxide emissions of which do not exceed 1 700

mg/Nm^3 at an oxygen content in the flue gas of 3 % by volume on a dry basis;

(c) for combustion in refineries, where the monthly average of emissions of sulphur dioxide averaged over all combustion plants in the refinery, irrespective of the type of fuel or fuel combination used, but excluding plants falling under point (a), gas turbines and gas engines, do not exceed 1 700 mg/Nm^3 at an oxygen content in the flue gas of 3 % by volume on a dry basis.

Member States shall take the necessary measures to ensure that no combustion plant using heavy fuel oil with a sulphur concentration greater than that referred to in paragraph 1 is operated without a permit issued by a competent authority, which specifies the emission limits.

(b) paragraph 3 is deleted;

(4) the following Article is inserted:

·Article 3a

Maximum sulphur content in marine fuel

Member States shall ensure that marine fuels are not used within their territory if their sulphur content exceeds 3,50 % by mass, except for fuels supplied to ships using emission abatement methods subject to Article 4c operating in closed mode.·;

(5) in Article 4, paragraph 1 is replaced by the following:

·1. Member States shall ensure that gas oils are not used within their territory if their sulphur content exceeds 0,10 % by mass.·;

(6) Article 4a is amended as follows:

(a) the title is replaced by the following:
·Maximum sulphur content of marine fuels used in territorial seas, exclusive economic zones and pollution control zones of Member States, including SOx Emission Control Areas and by passenger ships operating on regular services to or from Union ports·;

(b) paragraph 1 is replaced by the following:

·1. Member States shall take all necessary measures to ensure that marine fuels are not used in the areas of their territorial seas, exclusive economic zones and pollution control zones falling within SOx Emission Control Areas if the sulphur content of those fuels by mass exceeds:

(a) 1,00 % until 31 December 2014;

(b) 0,10 % as from 1 January 2015.

This paragraph shall apply to all vessels of all flags, including vessels whose journey began outside the Union. The Commission shall have due regard to any future changes to the requirements pursuant to Annex VI to MARPOL applicable within SOx Emission Control Areas, and, where appropriate, without undue delay make any relevant proposals with a view to amending this Directive accordingly.·;

(c) the following paragraph is inserted:

·1a. Member States shall take all necessary measures to ensure that marine fuels are not used in the areas of their territorial seas, exclusive economic zones and pollution control zones if the sulphur content of those fuels by mass exceeds:

(a) 3,50 % as from 18 June 2014;

(b) 0,50 % as from 1 January 2020.

This paragraph shall apply to all vessels of all flags, including vessels whose journey began outside of the Union, without prejudice to paragraphs 1 and 4 of this Article and Article 4b.·;

(d) paragraphs 4, 5, 6 and 7 are replaced by the following:

·4. Member States shall take all necessary measures to ensure that marine fuels are not used in their 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.

Member States shall be responsible for the enforcement of this requirement at least in respect of vessels flying their flag and vessels of all flags while in their ports.

5. Member States shall require the correct completion of ships' logbooks, including fuel-changeover operations.

5a. Member States shall endeavour to ensure the availability of marine fuels which comply with this Directive and inform the Commission of the availability of such marine fuels in its ports and terminals.

5b. If a ship is found by a Member State not to be in compliance with the standards for marine fuels which comply with this Directive, the competent authority of the Member State is entitled to require the ship to:

(a) present a record of the actions taken to attempt to achieve compliance; and

(b) provide evidence that it attempted to purchase marine fuel which complies with this Directive in accordance with its voyage plan and, if it was not made available where planned, that attempts were made to locate alternative sources for such marine fuel and that, despite best efforts to obtain marine fuel which complies with this Directive, no such marine fuel was made available for purchase.

The ship shall not be required to deviate from its intended voyage or to delay unduly the voyage in order to achieve compliance.

If a ship provides the information referred to in the first subparagraph, the Member State concerned shall take into account all relevant circumstances and the evidence presented to determine the appropriate action to take, including not taking control measures.

A ship shall notify its flag State, and the competent authority of the relevant port of destination, when it cannot purchase marine fuel which complies with this Directive.

A port State shall notify the Commission when a ship has presented evidence of the non-availability of marine fuels which comply with this Directive.

6. Member States shall, in accordance with regulation 18 of Annex VI to MARPOL:

(a) maintain a publicly available register of local suppliers of marine fuel;

(b) ensure that the sulphur content of all marine fuels sold in their territory is documented by the supplier on a bunker delivery note, accompanied by a sealed sample signed by the representative of the receiving ship;

(c) take action against marine fuel suppliers that have been found to deliver fuel that does not comply with the specification stated on the bunker delivery note;

(d) ensure that remedial action is taken to bring any non-compliant marine fuel discovered into compliance.

7. Member States shall ensure that marine diesel oils are not placed on the market in their territory if the sulphur content of those marine diesel oils exceeds 1,50 % by mass.·;

(e) paragraph 8 is deleted;

(7) Articles 4b and 4c are replaced by the following:

·Article 4b

Maximum sulphur content of marine fuels used by ships at berth in Union ports

1. Member States shall take all necessary measures to ensure that ships at berth in Union ports do not use marine fuels with a sulphur content exceeding 0,10 % by mass, allowing sufficient time 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.

Member States shall require the time of any fuel-changeover operation to be recorded in ships' logbooks.

2. Paragraph 1 shall not apply:

(a) whenever, according to published timetables, ships are due to be at berth for less than two hours;

(b) to ships which switch off all engines and use shore-side electricity while at berth in ports.

3. Member States shall ensure that marine gas oils are not placed on the market in their territory if the sulphur content of those marine gas oils exceeds 0,10 % by mass.

Article 4c

Emission abatement methods

1. Member States shall allow the use of emission abatement methods by ships of all flags in their ports, territorial seas, exclusive economic zones and pollution control zones, as an alternative to using marine fuels that meet the requirements of Articles 4a and 4b, subject to paragraphs 2 and 3 of this Article.

2. Ships using the emission abatement methods referred to in paragraph 1 shall continuously achieve reductions of sulphur dioxide emissions that are at least equivalent to the reductions that would be achieved by using marine fuels that meet the requirements of Articles 4a and 4b. Equivalent emission values shall be determined in accordance with Annex I.

2a. Member States shall, as an alternative solution for reducing emissions, encourage the use of onshore power supply systems by docked vessels.

3. The emission abatement methods referred to in paragraph 1 shall comply with the criteria specified in the instruments referred to in Annex II.

4. Where justified in the light of scientific and technical progress regarding alternative emission abatement methods and in such a way as to ensure strict consistency with the relevant instruments and standards adopted by the IMO, the

Commission shall:

(a) be empowered to adopt delegated acts in accordance with Article 9a amending Annexes I and II;

(b) adopt implementing acts laying down the detailed requirements for monitoring of emissions, where appropriate. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 9(2).·;

(8) the following Articles are inserted:

·Article 4d

Approval of emission abatement methods for use on board ships flying the flag of a Member State

1. Emission abatement methods falling within the scope of Council Directive 96/98/EC ([14]) shall be approved in accordance with that Directive.
2. Emission abatement methods not covered by paragraph 1 of this Article shall be approved in accordance with the procedure referred to in Article 3(2) of Regulation (EC) No 2099/2002 of the European Parliament and of the Council of 5 November 2002 establishing a Committee on Safe Seas and the Prevention of Pollution from Ships (COSS) ([15]), taking into account:

(a) guidelines developed by the IMO;

(b) the results of any trials conducted under Article 4e;

(c) effects on the environment, including achievable emission reductions, and impacts on ecosystems in enclosed ports, harbours and estuaries; and

(d) the feasibility of monitoring and verification.

Article 4e

Trials of new emission abatement methods

Member States may, in cooperation with other Member States, as appropriate, approve trials of ship emission abatement methods on vessels flying their flag, or in sea areas within their jurisdiction. During those trials, the use of marine fuels meeting the requirements of Articles 4a and 4b shall not be mandatory, provided that all of the following conditions are fulfilled:

(a) the Commission and any port State concerned are notified in writing at least six months before trials begin;

(b) permits for trials do not exceed 18 months in duration;

(c) all ships involved install tamper-proof equipment for the continuous monitoring of funnel gas emissions and use it throughout the trial period;

(d) all ships involved achieve emission reductions which are at least equivalent to those which would be achieved through the sulphur limits for fuels specified in this Directive;

(e) there are proper waste management systems in place for any waste generated by the emission abatement methods throughout the trial period;

(f) there is an assessment of impacts on the marine environment, particularly ecosystems in enclosed ports, harbours and estuaries throughout the trial period; and

(g) full results are provided to the Commission, and made publicly available, within six months of the end of the trials.

Article 4f

Financial measures

Member States may adopt financial measures in favour of operators affected by this Directive where such financial measures are in accordance with State aid rules applicable and to be adopted in this area.

(9) Article 6 is replaced by the following:

·Article 6

Sampling and analysis

1. Member States shall take all necessary measures to check by sampling that the sulphur content of fuels used complies with Articles 3, 3a, 4, 4a and 4b. The sampling shall commence on the date on which the relevant limit for maximum sulphur content in the fuel comes into force. It shall be carried out periodically with sufficient frequency and quantities in such a way that the samples are representative of the fuel examined, and in the case of marine fuel, of the fuel being used by vessels while in relevant sea areas and ports. The samples shall be analysed without undue delay.

1a. The following means of sampling, analysis and inspection of marine fuel shall be used:

(a) inspection of ships' log books and bunker delivery notes;

and, as appropriate, the following means of sampling and analysis:

(b) sampling of the marine fuel for on-board combustion while being delivered to ships, in accordance with the Guidelines for the sampling of fuel oil for

determination of compliance with the revised MARPOL Annex VI adopted on 17 July 2009 by Resolution 182(59) of the Marine Environment Protection Committee (MEPC) of the IMO, and analysis of its sulphur content; or

(c) sampling and analysis of the sulphur content of marine fuel for on-board combustion contained in tanks, where technically and economically feasible, and in sealed bunker samples on board ships.

1b. The Commission shall be empowered to adopt implementing acts concerning:

(a) the frequency of sampling;

(b) the sampling methods;

(c) the definition of a sample representative of the fuel examined.

Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 9(2).

2. The reference method adopted for determining the sulphur content shall be ISO method 8754 (2003) or PrEN ISO 14596 (2007).

In order to determine whether marine fuel delivered to and used on board ships is compliant with the sulphur limits required by Articles 3a, 4, 4a and 4b the fuel verification procedure set out in Appendix VI to Annex VI to MARPOL shall be used.·;

(10) Article 7 is amended as follows:

(a) paragraph 1 is replaced by the following:

·1. Each year by 30 June, Member States shall, on the basis of the results of the sampling, analysis and inspections carried out in accordance with Article 6, submit a report to the Commission on the compliance with the sulphur standards set out in this Directive for the preceding year.

On the basis of the reports received in accordance with the first subparagraph of this paragraph and the notifications regarding the non-availability of marine fuel which complies with this Directive submitted by Member States in accordance with the fifth subparagraph of Article 4a(5b), the Commission shall, within 12 months from the date referred to in the first subparagraph of this paragraph, draw up and publish a report on the implementation of this Directive. The Commission shall evaluate the need for further strengthening the relevant provisions of this Directive and make any appropriate legislative proposals to that effect.·;

(b) the following paragraph is inserted:

·1a. The Commission may adopt implementing acts concerning the information to be included in the report and the format of the report. Those implementing acts shall be adopted in accordance with the examination procedure referred to in Article 9(2).·;

(c) paragraphs 2 and 3 are replaced by the following:

·2. By 31 December 2013 the Commission shall submit a report to the European Parliament and to the Council which shall be accompanied, if appropriate, by legislative proposals. The Commission shall consider in its report the potential for reducing air pollution taking into account, inter alia: annual reports submitted in accordance with paragraphs 1 and 1a; observed air quality and acidification; fuel costs; potential economic impact and observed modal shift; and progress in reducing emissions from ships.

3. The Commission shall, in cooperation with Member States and stakeholders, by 31 December 2012, develop appropriate measures, including those identified in the Commission's staff working paper of 16 September 2011 entitled "Pollutant emission reduction from maritime transport and the sustainable waterborne transport toolbox" promoting compliance with the environmental standards of this Directive, and minimising the possible negative impacts.·;

(d) paragraph 4 is replaced by the following:

·4. The Commission shall be empowered to adopt delegated acts in accordance with Article 9a concerning the adaptations of Article 2, points 1, 2, 3, 3a, 3b and 4, point (b) of Article 6(1a) and Article 6(2) to scientific and technical progress. Such adaptations shall not result in any direct changes to the scope of this Directive or to sulphur limits for fuels specified in this Directive.·;

(11) Article 8 is deleted;

(12) Article 9 is replaced by the following:

·Article 9

Committee procedure

1. The Commission shall be assisted by a committee. That committee shall be a committee within the meaning of Regulation (EU) No 182/2011 of the European Parliament and of the Council of 16 February 2011 laying down the rules and general principles concerning mechanisms for control by Member States of the Commission's exercise of implementing powers ([16]).

2. Where reference is made to this paragraph, Article 5 of Regulation (EU) No 182/2011 shall apply.

Where the committee delivers no opinion, the Commission shall not adopt the draft implementing act and the third subparagraph of Article 5(4) of Regulation (EU) No 182/2011 shall apply.

(13) the following Article is inserted:

·Article 9a

Exercise of the delegation

1. The power to adopt delegated acts is conferred on the Commission subject to the conditions laid down in this Article.

2. The power to adopt delegated acts referred to in Article 4c(4) and Article 7(4) shall be conferred on the Commission for a period of five years from 17 December 2012. The Commission shall draw up a report in respect of the delegation of power not later than nine months before the end of the five-year period. The delegation of power shall be tacitly extended for periods of an identical duration, unless the European Parliament or the Council opposes such extension not later than three months before the end of each period.

3. The delegation of power referred to in Article 4c(4) and Article 7(4) may be revoked at any time by the European Parliament or by the Council. A decision to revoke shall put an end to the delegation of the powers specified in that decision. It shall take effect the day following the publication of the decision in the *Official Journal of the European Union* or at a later date specified therein. It shall not affect the validity of any delegated acts already in force.

4. As soon as it adopts a delegated act, the Commission shall notify it simultaneously to the European Parliament and to the Council.

5. A delegated act adopted pursuant to Article 4c(4) and Article 7(4) shall enter into force only if no objection has been expressed either by the European Parliament or the Council within a period of three months of notification of that act to the European Parliament and the Council or if, before the expiry of that period, the European Parliament and the Council have both informed the Commission that they will not object. That period shall be extended by three months at the initiative of the European Parliament or of the Council.·;

(14) Article 11 is replaced by the following:

·Article 11

Penalties

1. Member States shall determine the penalties applicable to breaches of the national provisions adopted pursuant to this Directive.

2. The penalties determined must be effective, proportionate and dissuasive and may include fines calculated in such a way as to ensure that the fines at least

deprive those responsible of the economic benefits derived from their infringement and that those fines gradually increase for repeated infringements.·;

(15) the Annex to Directive 1999/32/EC is replaced by the Annex to this Directive.

Article 2

Transposition

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 18 June 2014. They shall forthwith communicate to the Commission the text of those provisions.

When Member States adopt those provisions, they shall contain a reference to this Directive or be accompanied by such a reference on the occasion of their official publication. The methods of making such reference shall be laid down by Member States.

2. Member States shall communicate to the Commission the text of the main provisions of national law which they adopt in the field covered by this Directive.

Article 3

Entry into force

This Directive shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

Article 4

Addressees

This Directive is addressed to the Member States.
Done at Strasbourg, 21 November 2012.

APPENDIX C FINAL COMMISSION STAFF WORKING DOCUMENT ON THE IMPLEMENTATION OF THE EU MARITIME TRANSPORT STRATEGY 2009-2018

1. INTRODUCTION

1. The European Commission presented in January 2009 a Communication on the strategic goals and recommendations for the EU's maritime transport policy until 20181 ("2009 Communication"). Set in the broader context of the EU Transport Policy2 and the EU Integrated Maritime Policy3, it defined the main strategic objectives of the European maritime transport policy until 2018 and recommended actions in several areas4 pertaining to maritime transport.

2. Since then, several developments have affected the maritime sector. The decade that preceded the 2009 Communication saw a rapid growth of the world economy, a rapid development of globalisation and widespread outsourcing of production. As 80% of global trade in terms of tonnage is transported by sea, the demand for maritime transport services expanded beyond any expectation, placing huge pressure on available capacities: in 2008, freight rates reached historical peaks and world shipyards received record orders. Only one year later, however, the market outlook was very different.

3. The crisis that hit the economy in 2009 brought about a drastic reduction of transport volumes5 at a time when a wave of newly built vessels was beginning to enter the market. In just a few years, a large overcapacity built up, intensifying the already strong competition in the market and triggering a process of concentration and vertical integration of operators. Nowadays, ports and the maritime industry compete as part of entire supply chains. To strengthen their position, a great number of top container shipping companies are integrating vertically with port terminals, hinterland logistic operators, and shipping agencies6.

4. Larger vessels are being built to reap economies of scale and profit for technological advances7; horizontal alliances and agreements are being formed to better exploit them. The handling of bigger ships, together with other trends such as the need for 'greener operations leads to new investments in port infrastructure, which, in turn, calls for a regulatory framework that guarantees legal certainty for investors, transparency of public funding to ensure fair competition and efficient use, and non-discriminatory access to services.

5. More concentrated volumes of cargo, as well as the need to remain competitive vis à vis other modes of transport, also necessitate speedier execution of formalities and better coordination of logistic operations8. Digitalisation is considered by the majority of respondents to the consultation on a Mid-Term Review of the EU Maritime Transport Strategy9 ("the public consultation") to be crucial in simplifying administrative processes, enabling efficient management of freight flows through exchange of information on cargo, infrastructure and equipment.

6. The economic crisis has also reduced the resources of public administrations with responsibilities in the field of maritime safety and security. Modernisation of

procedures and sharing of assets and information can help all actors involved in gaining efficiency while maintaining high standards.

7. Increased pressure on environmental resources has already required corrective actionto contribute to the "greening" of shipping. By way of example, reference may be made to recent legislation on sulphur emissions. Such measures have to be seen against the background of current low oil prices, which lower the incentives for industry to invest into alternative energies and new technologies.

8. The patterns of global trade are changing, with larger volumes being transported between emerging economies. New intercontinental routes influence the competitive position of ports and carriers. A 2015 Study on the Analysis and Evolution of International and EU Shipping10 underlines that the presence of the EU shipping industries in new markets must be encouraged and supported.

9. As a result of new vessel technology, crews are becoming smaller and must acquire new skills. Social partners11 have emphasized the need to attract and train a sufficient number of EU seafarers to avoid the EU maritime cluster being deprived of staff with the right mix of skills and competences.

10. All these developments are relatively new, and may represent challenges for policy makers and market operators. In the public consultation, recurrent themes raised by stakeholders and national maritime administrations are: ensuring effective competition and choice for shippers, while avoiding that the search for efficiency and fewer resources are to the detriment of safety, quality shipping and working conditions for the crew; directing infrastructure investments where they add most value for the EU transport system; boosting efficiency through digitalisation and administrative simplification; promoting green technologies and decarbonisation of EU shipping; retaining and creating new jobs, decent working conditions and skills in the EU; and gaining better access to third countries' markets.

11. Since 2009, a number of legislative and non-legislative initiatives have been adopted with a number of ongoing actions. Others may be needed to address current challenges. However, the intention of this staff working document is to set out and report on developments in the EU's Maritime Transport Strategy of 2009, following a number of preparatory studies and consultations12.

2. SAFETY & SECURITY: A PRIORITY CONCERN

2.1. Objectives & Accomplishments

12. The 2009 Communication highlighted the need to give priority to the enforcement of existing EU and international rules and to speedy implementation of measures introduced with the 3rd Maritime Safety Package. It also aimed at the revision of the mandate and functioning of the European Maritime Safety Agency (EMSA) to further enhance its technical and scientific assistance capability.

13. The mandate of **EMSA** was revised in 201313 enhancing existing tasks and adding new ones. In particular, EMSA was mandated to assist countries applying for

accession to the Union and neighbourhood states as well as to extend the coverage of its anti-pollution means from shipping activities to oil and gas installations. A new multi-annual envelope of €160.5 million was decided in 2014 for the response to pollution caused by ships and offshore oil and gas installations.

14. With the 3rd Maritime Safety Package adopted in 2009, the EU now has one of the world's most stringent legislative frameworks covering the entire chain of responsibility in the maritime sector. One of the pillars of this framework is the reinforcement of **flag State compliance** to ensure that Member States effectively and consistently discharge their obligations as flag States, making the voluntary IMO flag State audit scheme mandatory for all EU Member States since 2009, and requiring all flag administrations to implement and maintain a quality management system, certified in accordance with international standards. In situations where Member States delegate work to **recognised organisations (classification societies),** this includes the key aspect of monitoring the performance of their work. The Commission, through the inspection programme carried out by EMSA, periodically assesses the major existing classification societies, which classify and control safety of more than 90% of the world's cargo carrying tonnage and are recognised at EU level against the stringent safety-oriented quality criteria provided in EU legislation.

15. Another pillar of the EU framework for maritime safety is **Port State Control**. Since 2009, the Commission has assisted the Member States in the implementation of a new risk-based approach to inspections. Persistently substandard vessels can be banned from European waters14. EMSA provides all Member States (as well as Norway, Russia and Canada as members of the Paris Memorandum of Understanding on Port State Control) with technical support on the new inspection regime and operates the system for targeting vessels and reporting of results (THETIS database).

16. As for the responsibilities of coastal states, the **Union Maritime Information and Exchange System (SafeSeaNet)** is today fully operational and covers all European coastal waters, tracks 12,000 ships/day and receives and records 100,000,000 ship (AIS) positions per month. This enables early identification of high-risk vessels, earlier precautionary actions, and improved emergency response to incidents or pollution, including search and rescue operations and places of refuges for ships in need of assistance. Following the changes brought in 201415, there is today an operational integrated information management system in place operated by EMSA – the Integrated Maritime System and Services (based on SafeSeaNet, LRIT, AIS and SAT-AIS and CleanSeaNet)16 which is also used by other EU Agencies.

17. Following the accident of the MSC Flaminia container vessel in 2012, the Commission, with the assistance of EMSA, has been particularly active in facilitating a constructive dialogue, including table top exercises, with national authorities and industry stakeholders, this led to the adoption by the relevant expert group of the "EU Guidelines on **Places of Refuge**", in November 201517

This process has also been met with considerable interest at international level with a view to improving the respective IMO Guidelines18 following the EU model of cooperation.

18. For **accidents investigations**, the focus has been on making sure that EU legislation has been properly implemented, checking whether Member States have established an independent investigative body; provided for a system of safety-focused investigation systems; drawn up commonly structured investigation reports; and encode the necessary information in the **European Marine Casualty Information Database** hosted in EMSA. This database is a powerful instrument to draw lessons from maritime accidents and to derive policy proposals based on empirical evidence.

19. On **passenger ship safety**, the focus has been on improving the effectiveness, efficiency and proportionality of some of the regulatory requirements. In this respect, the Commission adopted on 6 June 2016 a number of legislative proposals19 to simplify and improve the common rules on safety of ships carrying passengers in EU waters. The review is a response to lessons learnt, including from accidents, and technological developments. It aims, inter-alia, at allowing immediate access of competent authorities to relevant data in case of emergency, ensuring that search and rescue operations are performed more effectively.

20. Regarding **liability and compensation for damages by shipping activities**, the Commission has published in March 2016 a report20 on the application of Directive 2009/20/EC21 on the insurance of ship-owners for maritime claims, which makes it mandatory for any ship registered in an EU Member State or ships entering EU ports to have adequate insurance. In addition, the Commission is presently evaluating22 the application of Regulation (EC) No 392/2009 on the liability of carriers of passengers by sea in the event of accidents. In the international context, since 2009, the Commission has continuously promoted the ratification of all IMO Conventions on liability and compensation for damages related to shipping activities. There has been important progress, in particular with the entry into force of the 2002 Protocol to the Athens Convention on the liability of carriers of passengers by sea23, and the 2007 Nairobi Wreck Removal Convention24. However, there are still steps for Member States to take to complete ratification of all relevant instruments25.

21. Regarding **marine equipment**, EU legislation was revised in 201426 by replacing the annual amendments to the Directive containing the list of the applicable performance and testing standards, which have to be transposed by each of the EU Member States into their national legislation, with directly applicable implementing regulations. The revision also strengthens the requirements for the notification and control of conformity assessment bodies and enhances market surveillance.

22. As regards **security**, SOLAS Chapter XI-2 and part A as well as certain parts of part B of the International Ship and Port Facility Security (ISPS) Code were added to the ‘acquis communautaire’ by means of Regulation (EC) No 725/2004 on enhancing ship and port facility security27. The regime is complemented by Directive 2005/65/EC on enhancing port security28 that addresses elements of port security not covered by the Regulation. The Commission was given powers to perform inspections to verify the effectiveness of national quality control systems and maritime security measures, procedures and structures. More than 870 maritime security inspections have been conducted by the European Commission since 2005, with the technical assistance of EMSA, in order to ensure a harmonised implementation throughout the EU of the maritime security provisions, whilst also contributing to keeping high the

level of vigilance in this domain. The procedures for conducting Commission inspections are provided by a relevant Commission Regulation29.

23. **Piracy and armed robbery at sea** remains an endemic problem in South East Asia and also in the Gulf of Guinea. And while piracy off the coast of Somalia has declined, the fears of resurgence are very real. In combating piracy and armed robbery, collaboration of the Navies30 and use of armed guards has proved to be effective as has been repeatedly underlined by the Contact Group on Piracy off the Coast of Somalia31. The Commission also adopted a Recommendation on Best Management Practices32, to make ships harder to hijack.

2.2. Outlook

24. Efforts will be pursued so that the EU retains one of the world's most stringent legislative frameworks to prevent and respond adequately to maritime accidents. Experience has shown that even if they are parties to the same IMO conventions, differences between Member States in terms of safety legislation and implementation of international rules can be significant.

25. On **passenger ship safety**, the focus is on further enhancing the level of safety and facilitating the internal market. The Union has submitted proposals to the IMO33 for the upgrade of international damage stability standards for passenger ships. The results of the international debate in the course of 2016 will form the background of any further EU action in this respect. The Commission, supported by EMSA and in cooperation with Member States and stakeholders, will also follow-up on the remaining recommendations of the REFIT fitness check on EU passenger ship safety legislation34. Further actions could include the development of guidelines or a code for small vessels built in non-steel or equivalent materials, based on functional requirements35.

26. The constant evolution of the sector poses new challenges (e.g. ultra large container vessels, mega-cruise ships, safety concerns in relation to LNG bunkering, etc.) and offers opportunities for innovative technological solutions. Thus, although the Union's maritime safety and environment protection *acquis* has largely been developed in the past fifteen years, existing rules and systems need to be regularly reviewed to ensure they continue to meet their objectives effectively, are adapted to new circumstances and international developments, while not imposing a greater burden than necessary on the industry. A significant fraction of the EU legislation in the area of maritime safety will thus be evaluated in order to verify if it continues to be **fit for purpose**36. This will concern, inter alia, the areas of vessel traffic monitoring, port State control, flag State responsibilities and accident investigation.

27. **Effective enforcement** is also vital: support can be given to Member States' maritime administrations through EMSA as a competence centre on which national administrations can draw, for example in using the EMSA hosted systems and applications37. This can support them in their roles as port state or coastal state. EMSA's visits and inspections programme of the EU maritime safety *acquis* helps in identifying shortcomings and improvement opportunities38. EMSA's role could evolve to provide further support to national authorities responsible for **Coast Guard functions** for safety, security, environmental protection, law enforcement and

maritime border and fisheries control39, as agreed by the co-legislators within the European Border and Coast Guard package.

28. Establishing a comprehensive framework of **security measures** based on prevention, reaction capacity and resilience is a continuing objective. As specified in the 2009 Communication40, such a framework should lead to a genuine 'security culture' becoming an integral part of quality shipping and port operations, while not compromising unnecessarily the performance of shipping and the quality of life of seafarers and passengers.

29. **Terrorist threats** need continued careful consideration. The 2009 Communication states that the Commission and Member States should continue supporting the implementation of international security measures commensurate with the prevailing security threat and based on appropriate risk analysis methodologies. Flag states and ship owners need to cooperate closely and seafarers need to receive the appropriate basic and continuous training.

30. As specified in the proposal for a Directive on Network and Information Security (NIS)41, cyber **security** needs to be extended to a number of sectors not yet covered by appropriate rules, among which transport, including maritime transport.

3. DIGITALISATION AND SIMPLIFICATION FOR MORE EFFICIENT WATERBORNE TRANSPORT

3.1. Objectives & Accomplishments

31. One of the goals of the 2009 Communication was to establish a true 'European maritime transport space without barriers', removing unnecessary **administrative obstacles** to maritime transport within the Internal Market. The associated action plan42 proposed to simplify customs formalities and administrative procedures, improve electronic transmission by creating "e-maritime" systems and rationalise relevant EU regulations.

32. **SafeSeaNet** has been a useful tool which has developed into the Union Maritime Information and Exchange system. Apart from enhancing maritime safety, port and maritime security, environmental protection and pollution preparedness, this allows for the exchange, in accordance with Union legislation, of additional information aiming at facilitating efficient maritime traffic and maritime transport43.

33. Since 2009, initiatives were undertaken to streamline information requests by authorities, facilitate data exchange between administrations ('reporting once principle'), and achieve more efficient monitoring of maritime traffic. The **Reporting Formalities Directive**44 required that by 1 June 2015, a selected list of documents – that ships have to present to port and other authorities – are reported only once in electronic format to harmonised National Single Windows (NSW). Harmonised guidelines45 were developed in consultation with experts from the national administrations and the industry.

34. A **Blue Belt initiative**46 was also launched in 2013 to relieve EU goods transported between EU seaports from the administrative and customs formalities that apply to goods arriving from overseas. Simplified formalities for regular shipping services have been in place since 1st March 201447. In addition, transportation of Union goods which have been brought from one point to another within the customs territory of the Union and temporarily leave that territory by sea will be facilitated by customs legislation on the "Customs Goods Manifest", a simplified data set which will permit the identification of EU goods and exempt them from custom formalities48.

35. Along with administrative simplification, the 2009 Communication called for framework conditions that are more attractive for **investment** in the port sector and in the connection between ports and hinterland. The use of funding programmes such as the **Trans-European Network Transport projects** was advocated to assist in those developments and promote the use of waterborne transport.

36. In 2013, the Commission adopted the Communication "**Ports: an engine for growth**"49 envisaging legislative and non-legislative measures to improve the competitiveness of the TEN-T ports and their environmental performance. As follow up, the Commission presented in 2013 a proposal for a Regulation establishing a framework on market access to port services and financial transparency of ports50. The European Parliament and the Council reached an agreement on 27 June 2016, and plan to adopt it by the end of the year. It would contribute to high quality port services, notably by facilitating access to the market of port services and improving the training of personnel. It will also provide transparency in public funding and port charging and improve the governance of ports so as to make the other rules of the scheme more effective.

37. In the field of the Trans-European Networks (TEN-T), the Commission has appointed 'European coordinators' with, inter alia, the task of better integrating ports in the TEN-T Corridors and the Motorways of the Sea. Furthermore, the Commission has undertaken actions to promote a good social climate in ports and improve the health, safety and training of port workers and support the work of the Committee for European Social Dialogue established by the port social partners in June 2013. Finally, the Commission has investigated ports practices in the EU on the basis of Article 49 TFUE (freedom of establishment), as interpreted by the Court of Justice. Reference is made in particular to the Court's judgment of 11 December 2014, which clarified that requirements concerning the mandatory employment of identified staff may infringe Art 49 TFEU (Case C-576/13).

38. A comprehensive approach towards investments in the maritime transport was also developed. Besides the funding available under the framework of regional and cohesion policy, the new **TEN-T guidelines and the Connecting Europe Facility** instrument (CEF)51 boost the creation of a network of multimodal transport corridors featuring modern trans-shipment facilities and advanced technologies. In this context, between 2009 and 2014, around EUR 660 million was allocated to Motorways of the Sea, which form the maritime pillar of TEN-T/CEF and aim at supporting sustainable short-sea routes, maritime corridors, infrastructure development in ports, and sea-based transport services integrated in logistics chains. A Programme Support Action aiming to support the implementation of the TEN-T network relating to maritime

ports and inland waterways was launched in 2016 to examine ways to further improve their integration in the network.

39. In the field of **Research and Innovation**, the 2009 Communication stressed the influence of RTD initiatives on the competitiveness of Europe's maritime industry, and on its ability to meet the environmental, energy and safety challenges. In this context, EUR 353 million was allocated for Research and Innovation in the area of maritime transport during the period 2009-2015 under the framework of Horizon 2020 as well as in EU's previous R&I Framework Programme 7 (FP7).

3.2. Outlook

40. The simplification of administrative formalities for shipping and maritime carriage of goods, as well as the need for a comprehensive electronic document, was the number one concern of the respondents to the public consultation. In particular, with reference to the Reporting Formalities Directive, the shipping industry urges further progress towards full EU harmonisation of reporting requirements and wider coverage of formalities through a **harmonised electronic cargo manifest (e-Manifest)**, which could be implemented through a European maritime single window, ensuring an EU-wide 'reporting-once' principle as specified in the relevant EU legislation52. The legislative framework will be
evaluated in 201653 to identify possible shortcomings and possible ways of further reducing administrative burden, including in respect of the central role of the Union Maritime Information and Exchange system hosted by EMSA.

41. Additional aspects of administrative simplification, optimisation of cargo flows, and better use of existing infrastructure through the use of digital technologies, will be addressed in the recently established **Digital Transport & Logistics Forum**54. The forum gathers representatives of national administrations and transport operators to promote use of electronic documents and information exchange. Sharing of data on traffic conditions, cargo positioning, and availability of infrastructure and equipment will be explored with a view to optimising corridor logistics. Synergies with TEN-T policy will be sought in this context. Better coordination of maritime and inland waterways operations with ports and hinterland connections can be pursued, inter alia, through the integration of ICT tools (Union Maritime Information and Exchange system SafeSeaNet, River Information Service).

42. On the EU ports policy, the Commission has initiated work to modernise the application of the **State Aid rules to the public financing of port infrastructures**. In the context of the review of the General Block Exemption Regulation, it envisages the possibility to exempt certain port investments from the requirement of notification under state aid rules55.

4. ENVIRONMENTAL SUSTAINABILITY & DECARBONISATION

4.1. Objectives and Accomplishments

43. Improving the environmental record of maritime transport was among the prime aims of the 2009 Communication which invited the Commission, the Member States and the European maritime industry to work together towards the long-term objective of 'zero-waste, zero emission' maritime transport.

44. Maritime transport is widely recognised as the most environmentally sustainable and energy efficient way of moving large quantities of cargo. Even so, the volume of the shipping activity is so large that it produces a substantial amount of emissions that are harmful for human health and the environment. The need for cleaner shipping has thus come into focus in relation to both emissions having a global impact – namely greenhouse gas (GHG) (2.5% of global CO2 emissions) – and emissions of substances that are particularly harmful at regional level and notably close to coastal areas and port cities (for example, sulphur, particulate matter and nitrogen-oxides).

45. With regard to **GHG emissions**, progress has been made since 2009. The Commission and the EU Member States actively supported the adoption by the IMO, in July 2011, of a mandatory limit on the Energy Efficiency Design Index (EEDI) for ships built as of 2013. A Ship Energy Efficiency Management Plan was also made compulsory for all ships.

46. In June 2013, the Commission set out a strategy to integrate maritime emissions into the EU's policy for reducing domestic greenhouse gas emissions56. The strategy consists of three consecutive steps: **Monitoring, reporting and verification** (MRV) of CO2 emissions from large ships using EU ports; setting up GHG reduction targets for the maritime transport sector; and further measures, including market based measures, in the medium to long term. The first step has been achieved with the adoption of the Regulation (EU) 2015/757 of the European Parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport (MRV Regulation) that applies to ships above 5000 gross tonnage, regardless of their flag, calling at EU ports, as of 1st of January 2018.

47. With regard to the EU legislation on **port reception facilities** for ship generated waste and cargo residues57, the Commission has undertaken several actions. It has incorporated changes from the related international provisions in the MARPOL Convention58. With the assistance of EMSA it has facilitated and streamlined the electronic reporting and works on the implementation of an information and monitoring system set up under Directive 2000/59/EC which is expected to expedite port handling and facilitate enforcement by competent authorities. Finally, it has adopted interpretative Guidelines59 which should result in a more harmonised application and a level playing field for port users. A thorough REFIT Evaluation was also finalised in May60.

48. Global shipping mostly uses heavy fuel oil with high sulphur content of up to 3.5%. New **sulphur emission limits** were globally adopted in IMO in 2008 and included in Directive 2012/33/EU of the European Parliament and of the Council of 21 November 2012 amending Council Directive 1999/32/EC as regards the sulphur content of marine fuels: they impose 0.1% sulphur fuels as of 1 January 2015 in Sulphur Emission Control Areas (SECA), down from 1.0%. The Directive also reduces sulphur content to 0.5%, as of 2020, in all other EU waters (currently 3.5%).

49. In order to comply with these new limits, operators may use low sulphur fuel; install on-board filters (scrubbers); or adopt alternative fuel technologies. The latter

solution is mainly contemplated for new ships as it would require major modifications.

50. In 2013, the European Commission set up the **European Sustainable Shipping Forum** (ESSF) – gathering representatives of national administrations and of the shipping industry – to facilitate implementation of and compliance with environmental legislation in the maritime sector. The ESSF provides advice and technical expertise to the Commission on the development and implementation of legislation, policies, projects and programmes in the field of maritime transport sustainability and facilitates exchanges of information on initiatives, projects and partnerships dealing with maritime transport sustainability. It has coordinated input into international discussions at IMO and at the International Standardization Organization (ISO).

51. Clean and sustainable shipping will be further promoted with the effective implementation of Directive 2014/94/EU on the **deployment of alternative fuels** infrastructure (especially with the promotion and use of LNG as marine fuel), ensuring the necessary standardization and set up of a basic fuel supply infrastructure before 2025 with EU financial support.

52. The new TEN-T guidelines and their main financing instrument, the Connecting Europe Facility (CEF), support the **promotion of green shipping**. In this context over EUR 185 million (including Motorway of the Sea projects) were allocated in 2014 and 2015 for studies, pilot actions and infrastructure projects to support new technologies and innovation in processes. Furthermore, with a view to mobilize investments from the private and public sectors, a dedicated tool for the shipping sector is being prepared together with the European Investment Bank to reduce the risk of investing in clean maritime technologies.

53. The environmental performance of shipping can also be improved through the promotion of voluntary **'green charging'** schemes by EU ports. In this respect a study on environmental port charging that has been launched by the Commission in December 2014 and is now in the concluding stages will provide input for further reflection.

4.2. Outlook

54. The Paris Agreement is intended to limit global warming well below 2oC, which also implies an adequate contribution of the transport sector.

55. For the shipping sector, the EU has a strong preference for a global approach led by the IMO61. The EU and its Member States strongly support the adoption by the IMO, in 2016, of a mandatory and robust system to collect and report fuel consumption of ships on a global scale, accompanied by a viable verification mechanism to ensure data quality62. Together with a specific emission reduction objective this would support the development of further measures to reduce CO2 emissions from international shipping. In the event that such a global MRV system is finalised and adopted, the EU scheme will be reviewed and if appropriate, revised in order to align it with the international scheme63.

56. Greater use of Short Sea Shipping also depends on a reduction of maritime air pollution. The studies and stakeholders strongly advocate the removal of obstacles to the adoption of cleaner fuels, and, in particular, favour the development of EU-wide guidance for LNG bunkering procedures, harmonization of standards and increased knowledge and exchange of experience amongst permitting authorities. CEF funding for TEN-T priorities and Motorways of the Sea can be used to support the development of 'green' infrastructure, whereas Horizon 2020 co-funds R&I into alternative propulsion systems, including for the gradual electrification of shipping.

57. The process of review64 of Directive 2000/59/EC on port reception facilities for ship generated waste and cargo residues, provides an opportunity for further alignment with the MARPOL Convention, by ensuring consistency between definitions of ship generated waste and cargo residues, as well as data provided for waste notification and reporting. The Common Information and Monitoring system based on existing systems developed and operated by EMSA may be further developed in parallel.

5. A STRONGER GLOBAL PLAYER

5.1. Objectives and Accomplishments

58. The 2009 Communication calls for the achievement of a comprehensive international regulatory framework for shipping, suited for the challenges of the 21st century. Cooperation and **active presence from both Member States and the Commission in IMO and in the International Labour Organisation (ILO)** has allowed achieving significant results both on safety and environmental issues.

59. The shipping sector is confronted with **obstacles to international trade** such as discriminatory or over-demanding administrative procedures; restrictions to feedering, international relay of cargo and cabotage; and restrictions on the movement of empty containers65.

60. **Bilateral and multilateral agreements** on international maritime transport are important to ensure a global level playing field, market access for EU companies and overall predictability. Existing bilateral dialogues and annual meetings with China, Japan, Norway, Brazil and the US have proven very useful in identifying areas for cooperation, seeking improved market conditions for industry and building alliances on issues of common interest at international level. These dialogues also allow the clarification of the permitted scope of operations in third countries, the correct application of national rules and requirements, the finding of the cooperative solutions to minor controversies, and better understanding of private sector needs.

61. The **EU-China maritime transport agreement** is considered as a "best practice" example, as it not only provides a legal framework to operate in, but also foresees a mechanism of regular dialogue and exchange between the parties, as well as with the industry. In that way, it offers an official platform to address any restrictions and obstacles met in practice and a mechanism to further improve market access conditions for EU companies.

62. **Free Trade Agreements** (FTAs) that have strong commitments on international maritime transport are also a very important tool as they provide legal certainty, predictability and clarity and in most cases valuable additional market access. Over the reporting period, this has already been achieved through the FTAs concluded with Colombia, Peru, Korea, Ukraine, Moldova, Georgia whereas FTAs with Singapore, Ecuador, Vietnam and Canada were concluded but not yet published in the Official Journal. Other FTAs are currently been negotiated (e.g. US, Japan). Where appropriate, market access restrictions with third countries on matters related to maritime services are discussed by the Market Access Advisory Committee66, and followed up via the appropriate diplomatic channels.

63. In the last 15 years, the number of vessels registered in EU Member States has significantly increased, mainly due to the introduction of favourable taxation regimes, in line with the **Community Guidelines for State aids for maritime transport**67. According to the majority of the respondents to the public consultation and to the above mentioned Study on the Analysis and Evolution of International and EU Shipping68, these regimes are very important to maintain a global level playing field for EU shipping, avoid de-flagging of vessels away from the EU, and create the conditions in which shipping can effectively contribute to the EU economy.

5.2. Outlook

64. In view of the experiences gathered, maritime transport continues to form part of the EU's ongoing (e.g. Japan, U.S.A.) negotiations on FTAs. Moreover the EU supports the inclusion of an annex on the liberalisation of maritime transport services as well as ambitious market access commitments in the ongoing negotiation of a plurilateral agreement on Trade in Services (TiSA) which the EU is currently negotiating with 22 other WTO members69.

65. Active participation in the work of the international organisations will continue, in particular in the field of international standards.

66. Bilateral regulatory cooperation underpins mutual understanding and helps build trust with third countries. Technical dialogue can be particularly useful, in particular when drawing on the expertise of EMSA.

6. RAISING THE PROFILE & QUALIFICATIONS OF THE SEAFARERS & MARITIME PROFESSIONS

6.1. Objectives and Accomplishments

67. Maintaining high **qualification standards** and decent **working and living conditions** for seafarers on board of ships is important for safety, security and for the protection of the environment in order to maintain a quality EU shipping sector. The 2009 Communication focuses mainly on upgrading and enforcing international standards in the field of working conditions, increasing the **attractiveness of the profession** and on training, which are all essential to ensure the level playing field at global level.

68. With regards to **seafarers' working conditions**, the Union has been very pro-active and achieved significant results since 2009. The ILO Maritime Labour Convention, 2006 (MLC, 2006) has been incorporated in EU legislation70 based on the agreement between the EU social partners in the maritime sector. The EU social

partners are currently negotiating an agreement on the 2014 amendments to the MLC, 2006 addressing, among others, the issue of abandonment of seafarers. The MLC 2006 is enforced by means of two other Directives, which ensure that the Member States concerned effectively discharge their obligations under this Convention, as flag States (with respect to the ships flying their flag), and verify the compliance with these requirements through port State control inspections (irrespective of the flag of the ship)71.

69. In addition, since 2015 EU seafarers have been included in the scope of five EU labour law Directives72, therefore improving the working conditions of seafarers and ensuring that seafarers working on-board EU flagged vessels are now provided with the same **information and consultation rights** as on-shore workers in all 28 EU countries in cases of collective redundancies, transfers of undertakings and employer insolvency.

70. On **maritime employment** and competitiveness, the vast majority of the relevant recommendations made in 2011 by the Task force on Maritime Employment and Competitiveness73 have been implemented regarding the regulatory framework, the legal and administrative treatment of seafarers, working and living conditions and actions to promote the attractiveness of seafarers' professions. Many social partners' projects have been supported by the EU with a view to effectively address important issues such as seafarers' fatigue74 and the guidelines to eliminate workplace bullying and harassment75.

71. Regarding **training standards**, the Manila Amendments to the International Convention on Standards of Training, Certification and Watchkeeping (STCW Convention) were incorporated into EU law by Directive 2012/35/EU of the European Parliament and of the Council amending Directive 2008/106/EC on the minimum level of training of seafarers. Directive 2008/106/EC includes also a common system of recognition of seafarers' certificates issued by non EU countries. The decision on the EU recognition of a third country is based on an assessment of its maritime education, training and certification system for seafarers undertaken by the Commission, assisted by EMSA. Currently there are more than 40 third countries recognised at EU level for this purpose.

72. The current 220.000 EU seafarers represent 18% of the total number of seafarers globally. By allowing reduced rates of contributions for the social protection and reduced rates on income tax for EU seafarers, the Community guidelines on State aid to maritime transport76 have created more favourable conditions for **employment of EU personnel**, especially on board passenger ferries operating intra-Union routes.

73. However, despite the increase of the EU fleet between 2004 and 2012, EU seafarers' employment did not increase in proportion, but lagged behind77. The fact that many modern ships need smaller crews owing to technological advances and automated systems is one of the reasons of the decline of EU seafarers. Nevertheless, modern technologies require more complex and **advanced skills** by maritime professionals. Strengthening the cooperation between the education side and the employment side is crucial in order to fill skills gaps78. In this perspective, the Union has funded various studies and research projects to promote career management and

development, e-training, e-education, as well as the image of the seafaring profession, with a view to create develop high professional skills specialised in greener and safer shipping operations.

6.2. Outlook

74. As mentioned above, the skills required from maritime professionals have become more complex – also due to increasing emphasis on multi-model supply chains. This might contribute to a shortage of skilled EU seafarers.

75. The Commission has launched the evaluations of Directive 2008/106/EC and Directive 2005/45/EC79 to verify whether that legislative framework for training and certification is fit for purpose80. In parallel, the Commission will evaluate existing reporting formalities81, which add to the administrative responsibilities of Masters and Senior Officers.

76. The European shipping industry points out that it is important to strengthen cooperation between the education and the employment sides in order to fill skills gaps. A number of EU funding schemes are available for that purpose, and there is scope for a greater use of such schemes.

77. The Commission encourages and promotes social dialogue which has delivered good results for the maritime sector. The Commission notably supports the work of the relevant European social dialogue committee for maritime transport that is promoting action intended to develop career opportunities and ensure that training, working and safety arrangements are adapted to the new types of jobs in ports. This will help to gain insights into future potentially relevant initiatives.

7. CONCLUDING REMARKS

78. The implementation of the 2009 EU Maritime Transport Strategy has been marked by a rapid evolution of the challenges and by evidence that interaction and cross-dependencies between the different areas of work become ever more relevant. Of particular importance has been the enhanced use of mechanisms and fora to bring stakeholders and national administrations together and facilitate mutual consultation and operational cooperation.

79. The substantial evaluation described in the preceding sections will further investigate the aspects of EU maritime policy that consultations and studies have identified as more critical for the success of EU shipping and more exposed to recent trends. The REFIT exercise and individual evaluations will help assessing whether the current EU maritime transport legislation remains fit for purpose or adjustments have to be made within any of the five focus areas described in this staff working document82.

80. The public consultation has confirmed the relevance of the overall goals for EU Maritime Transport specified in the 2009 Communication: the Union and its Member States continue to have a strong common interest in promoting safe, secure and efficient intra-European and international shipping on clean oceans and seas, safeguarding the long-term competitiveness of European shipping and related maritime industries in world markets, and adapting of the entire seaborne transport system and logistic chain to the challenges of the 21st century.

APPENDIX D UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

The Parties to this Convention,
Acknowledging that change in the Earth's climate and its adverse effects are a common concern of humankind,

Concerned that human activities have been substantially increasing the atmospheric concentrations of greenhouse gases, that these increases enhance the natural greenhouse effect, and that this will result on average in an additional warming of the Earth's surface and atmosphere and may adversely affect natural ecosystems and humankind,

Noting that the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs,

Aware of the role and importance in terrestrial and marine ecosystems of sinks and reservoirs of greenhouse gases,

Noting that there are many uncertainties in predictions of climate change, particularly with regard to the timing, magnitude and regional patterns thereof,

Acknowledging that the global nature of climate change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate international response, in accordance with their common but differentiated responsibilities and respective capabilities and their social and economic conditions,

Recalling the pertinent provisions of the Declaration of the United Nations Conference on the Human Environment, adopted at Stockholm on 16 June 1972,

Recalling also that States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction,

Reaffirming the principle of sovereignty of States in international cooperation to address climate change,

Recognizing that States should enact effective environmental legislation, that environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply, and that standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries,

Recalling the provisions of General Assembly resolution 44/228 of 22 December 1989 on the United Nations Conference on Environment and Development, and resolutions 43/53 of 6 December 1988, 44/207 of 22 December 1989, 45/212 of 21 December 1990 and 46/169 of 19 December 1991 on protection of global climate for present and future generations of mankind,

Recalling also the provisions of General Assembly resolution 44/206 of 22 December 1989 on the possible adverse effects of sea-level rise on islands and coastal areas, particularly low-lying coastal areas and the pertinent provisions of General Assembly resolution 44/172 of 19 December 1989 on the implementation of the Plan of Action to Combat Desertification,

Recalling further the Vienna Convention for the Protection of the Ozone Layer, 1985, and the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, as adjusted and amended on 29 June 1990,

Noting the Ministerial Declaration of the Second World Climate Conference adopted on 7 November 1990,

Conscious of the valuable analytical work being conducted by many States on climate change and of the important contributions of the World Meteorological Organization, the United Nations Environment Programme and other organs, organizations and bodies of the United Nations system, as well as other international and intergovernmental bodies, to the exchange of results of scientific research and the coordination of research,

Recognizing that steps required to understand and address climate change will be environmentally, socially and economically most effective if they are based on relevant scientific, technical and economic considerations and continually re evaluated in the light of new findings in these areas,

Recognizing that various actions to address climate change can be justified economically in their own right and can also help in solving other environmental problems,

Recognizing also the need for developed countries to take immediate action in a flexible manner on the basis of clear priorities, as a first step towards comprehensive response strategies at the global, national and, where agreed, regional levels that take into account all greenhouse gases, with due consideration of their relative contributions to the enhancement of the greenhouse effect,

Recognizing further that low-lying and other small island countries, countries with low-lying coastal, arid and semi-arid areas or areas liable to floods, drought and desertification, and developing countries with fragile mountainous ecosystems are particularly vulnerable to the adverse effects of climate change,

Recognizing the special difficulties of those countries, especially developing countries, whose economies are particularly dependent on fossil fuel production, use and exportation, as a consequence of action taken on limiting greenhouse gas emissions,

Affirming that responses to climate change should be coordinated with social and economic development in an integrated manner with a view to avoiding adverse impacts on the latter, taking into full account the legitimate priority needs of developing countries for the achievement of sustained economic growth and the eradication of poverty,

Recognizing that all countries, especially developing countries, need access to resources required to achieve sustainable social and economic development and that, in order for developing countries to progress towards that goal, their energy consumption will need to grow taking into account the possibilities for achieving greater energy efficiency and for controlling greenhouse gas emissions in general, including through the application of new technologies on terms which make such an application economically and socially beneficial,

Determined to protect the climate system for present and future generations,

Have agreed as follows:

Article 1
DEFINITIONS*

For the purposes of this Convention:

1. "Adverse effects of climate change" means changes in the physical environment or biota resulting from climate change which have significant deleterious effects on the composition, resilience or productivity of natural and managed ecosystems or on the operation of socio-economic systems or on human health and welfare.

2. "Climate change" means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
3. "Climate system" means the totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions.
4. "Emissions" means the release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time.
5. "Greenhouse gases" means those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation.
6. "Regional economic integration organization" means an organization constituted by sovereign States of a given region which has competence in respect of matters governed by this Convention or its protocols and has been duly authorized, in accordance with its internal procedures, to sign, ratify, accept, approve or accede to the instruments concerned.
7. "Reservoir" means a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored.
8. "Sink" means any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.
9. "Source" means any process or activity which releases a greenhouse gas, an aerosol or a precursor of a greenhouse gas into the atmosphere.

Article 2

OBJECTIVE

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

Article 3

PRINCIPLES

In their actions to achieve the objective of the Convention and to implement its provisions, the Parties shall be guided, inter alia, by the following:
1. The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.

2. The specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, and of those Parties, especially developing country Parties, that would have to bear a disproportionate or abnormal burden under the Convention, should be given full consideration.

3. The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost. To achieve this, such policies and measures should take into account different socio-economic contexts, be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors. Efforts to address climate change may be carried out cooperatively by interested Parties.

4. The Parties have a right to, and should, promote sustainable development. Policies and measures to protect the climate system against human-induced change should be appropriate for the specific conditions of each Party and should be integrated with national development programmes, taking into account that economic development is essential for adopting measures to address climate change.

5. The Parties should cooperate to promote a supportive and open international economic system that would lead to sustainable economic growth and development in

all Parties, particularly developing country Parties, thus enabling them better to address the problems of climate change. Measures taken to combat climate change, including unilateral ones, should not constitute a means of arbitrary or unjustifiable discrimination or a disguised restriction on international trade.

Article 4

COMMITMENTS

1. All Parties, taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances, shall:

(a) Develop, periodically update, publish and make available to the Conference of the Parties, in accordance with Article 12, national inventories of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, using comparable methodologies to be agreed upon by the Conference of the Parties;

(b) Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and measures to facilitate adequate adaptation to climate change;

(c) Promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors;

(d) Promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases not controlled by the Montreal Protocol, including biomass, forests and oceans as well as other terrestrial, coastal and marine ecosystems;

(e) Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods;

(f) Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example impact assessments, formulated and determined nationally, with a view to minimizing adverse effects on the economy, on public health and on the quality of the environment, of projects or measures undertaken by them to mitigate or adapt to climate change;

(g) Promote and cooperate in scientific, technological, technical, socio-economic and

other research, systematic observation and development of data archives related to the climate system and intended to further the understanding and to reduce or eliminate the remaining uncertainties regarding the causes, effects, magnitude and timing of climate change and the economic and social consequences of various response strategies;

(h) Promote and cooperate in the full, open and prompt exchange of relevant scientific, technological, technical, socio-economic and legal information related to the climate system and climate change, and to the economic and social consequences of various response strategies;

(i) Promote and cooperate in education, training and public awareness related to climate change and encourage the widest participation in this process, including that of non-governmental organizations; and
(j) Communicate to the Conference of the Parties information related to implementation, in accordance with Article 12.

2. The developed country Parties and other Parties included in Annex I commit themselves specifically as provided for in the following:

(a) Each of these Parties shall adopt national**1** policies and take corresponding measures on the mitigation of climate change, by limiting its anthropogenic emissions of greenhouse gases and protecting and enhancing its greenhouse gas sinks and reservoirs. These policies and measures will demonstrate that developed countries are taking the lead in modifying longer-term trends in anthropogenic emissions consistent with the objective of the Convention, recognizing that the return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol would contribute to such modification, and taking into account the differences in these Parties' starting points and approaches, economic structures and resource bases, the need to maintain strong and sustainable economic growth, available technologies and other individual circumstances, as well as the need for equitable and appropriate contributions by each of these Parties to the global effort regarding that objective. These Parties may implement such policies and measures jointly with other Parties and may assist other Parties in contributing to the achievement of the objective of the Convention and, in particular, that of this subparagraph;

(b) In order to promote progress to this end, each of these Parties shall communicate, within six months of the entry into force of the Convention for it and periodically thereafter, and in accordance with Article 12, detailed information on its policies and measures referred to in subparagraph (a) above, as well as on its resulting projected anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for the period referred to in subparagraph (a), with the aim of returning individually or jointly to their 1990 levels these anthropogenic emissions of carbon dioxide and other greenhouse gases not controlled by the Montreal Protocol. This information will be reviewed by the Conference of the Parties, at its first session and periodically thereafter, in accordance with Article 7;

(c) Calculations of emissions by sources and removals by sinks of greenhouse gases

for the purposes of subparagraph (b) above should take into account the best available scientific knowledge, including of the effective capacity of sinks and the respective contributions of such gases to climate change. The Conference of the Parties shall consider and agree on methodologies for these calculations at its first session and review them regularly thereafter;

(d) The Conference of the Parties shall, at its first session, review the adequacy of subparagraphs (a) and (b) above. Such review shall be carried out in the light of the best available scientific information and assessment on climate change and its impacts, as well as relevant technical, social and economic information. Based on this review, the Conference of the Parties shall take appropriate action, which may include the adoption of amendments to the commitments in subparagraphs (a) and (b) above. The Conference of the Parties, at its first session, shall also take decisions regarding criteria for joint implementation as indicated in subparagraph (a) above. A second review of subparagraphs (a) and (b) shall take place not later than 31 December 1998, and thereafter at regular intervals determined by the Conference of the Parties, until the objective of the Convention is met;

(e) Each of these Parties shall:

(i) coordinate as appropriate with other such Parties, relevant economic and administrative instruments developed to achieve the objective of the Convention; and

(ii) identify and periodically review its own policies and practices which encourage activities that lead to greater levels of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol than would otherwise occur;

(f) The Conference of the Parties shall review, not later than 31 December 1998, available information with a view to taking decisions regarding such amendments to the lists in Annexes I and II as may be appropriate, with the approval of the Party concerned;

(g) Any Party not included in Annex I may, in its instrument of ratification, acceptance, approval or accession, or at any time thereafter, notify the Depositary that it intends to be bound by subparagraphs (a) and (b) above. The Depositary shall inform the other signatories and Parties of any such notification.

3. The developed country Parties and other developed Parties included in Annex II shall provide new and additional financial resources to meet the agreed full costs incurred by developing country Parties in complying with their obligations under Article 12, paragraph 1. They shall also provide such financial resources, including for the transfer of technology, needed by the developing country Parties to meet the agreed full incremental costs of implementing measures that are covered by paragraph 1 of this Article and that are agreed between a developing country Party and the international entity or entities referred to in Article 11, in accordance with that Article. The implementation of these commitments shall take into account the need for adequacy and predictability in the flow of funds and the importance of appropriate burden sharing among the developed country Parties.

4. The developed country Parties and other developed Parties included in Annex II shall also assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects.

5. The developed country Parties and other developed Parties included in Annex II shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention. In this process, the developed country Parties shall support the development and enhancement of endogenous capacities and technologies of developing country Parties. Other Parties and organizations in a position to do so may also assist in facilitating the transfer of such technologies.

6. In the implementation of their commitments under paragraph 2 above, a certain degree of flexibility shall be allowed by the Conference of the Parties to the Parties included in Annex I undergoing the process of transition to a market economy, in order to enhance the ability of these Parties to address climate change, including with regard to the historical level of anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol chosen as a reference.

7. The extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology and will take fully into account that economic and social development and poverty eradication are the first and overriding priorities of the developing country Parties.

8. In the implementation of the commitments in this Article, the Parties shall give full consideration to what actions are necessary under the Convention, including actions related to funding, insurance and the transfer of technology, to meet the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures, especially on:

(a) Small island countries;
(b) Countries with low-lying coastal areas;
(c) Countries with arid and semi-arid areas, forested areas and areas liable to forest decay;
(d) Countries with areas prone to natural disasters;
(e) Countries with areas liable to drought and desertification;
(f) Countries with areas of high urban atmospheric pollution;
(g) Countries with areas with fragile ecosystems, including mountainous ecosystems;
(h) Countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products; and
(i) Landlocked and transit countries.

Further, the Conference of the Parties may take actions, as appropriate, with respect to this paragraph.

9. The Parties shall take full account of the specific needs and special situations of the least developed countries in their actions with regard to funding and transfer of technology.

10. The Parties shall, in accordance with Article 10, take into consideration in the implementation of the commitments of the Convention the situation of Parties, particularly developing country Parties, with economies that are vulnerable to the adverse effects of the implementation of measures to respond to climate change. This applies notably to Parties with economies that are highly dependent on income generated from the production, processing and export, and/or consumption of fossil fuels and associated energy-intensive products and/or the use of fossil fuels for which such Parties have serious difficulties in switching to alternatives.

Article 5

RESEARCH AND SYSTEMATIC OBSERVATION

In carrying out their commitments under Article 4, paragraph 1 (g), the Parties shall:

(a) Support and further develop, as appropriate, international and intergovernmental programmes and networks or organizations aimed at defining, conducting, assessing and financing research, data collection and systematic observation, taking into account the need to minimize duplication of effort;

(b) Support international and intergovernmental efforts to strengthen systematic observation and national scientific and technical research capacities and capabilities, particularly in developing countries, and to promote access to, and the exchange of, data and analyses thereof obtained from areas beyond national jurisdiction; and

(c) Take into account the particular concerns and needs of developing countries and cooperate in improving their endogenous capacities and capabilities to participate in the efforts referred to in subparagraphs (a) and (b) above.

Article 6

EDUCATION, TRAINING AND PUBLIC AWARENESS

In carrying out their commitments under Article 4, paragraph 1 (i), the Parties shall:

(a) Promote and facilitate at the national and, as appropriate, subregional and regional levels, and in accordance with national laws and regulations, and within their respective capacities:

(i) the development and implementation of educational and public awareness programmes on climate change and its effects;
(ii) public access to information on climate change and its effects;
(iii) public participation in addressing climate change and its effects and developing adequate responses; and
(iv) training of scientific, technical and managerial personnel;

(b) Cooperate in and promote, at the international level, and, where appropriate, using existing bodies:

(i) the development and exchange of educational and public awareness material on climate change and its effects; and
(ii) the development and implementation of education and training programmes, including the strengthening of national institutions and the exchange or secondment of personnel to train experts in this field, in particular for developing countries.

Article 7

CONFERENCE OF THE PARTIES

1. A Conference of the Parties is hereby established.

2. The Conference of the Parties, as the supreme body of this Convention, shall keep under regular review the implementation of the Convention and any related legal instruments that the Conference of the Parties may adopt, and shall make, within its mandate, the decisions necessary to promote the effective implementation of the Convention. To this end, it shall:

(a) Periodically examine the obligations of the Parties and the institutional arrangements under the Convention, in the light of the objective of the Convention, the experience gained in its implementation and the evolution of scientific and technological knowledge;

(b) Promote and facilitate the exchange of information on measures adopted by the Parties to address climate change and its effects, taking into account the differing circumstances, responsibilities and capabilities of the Parties and their respective commitments under the Convention;

(c) Facilitate, at the request of two or more Parties, the coordination of measures adopted by them to address climate change and its effects, taking into account the differing circumstances, responsibilities and capabilities of the Parties and their respective commitments under the Convention;

(d) Promote and guide, in accordance with the objective and provisions of the Convention, the development and periodic refinement of comparable methodologies, to be agreed on by the Conference of the Parties, inter alia, for preparing inventories of greenhouse gas emissions by sources and removals by sinks, and for evaluating the effectiveness of measures to limit the emissions and enhance the removals of these gases;

(e) Assess, on the basis of all information made available to it in accordance with the provisions of the Convention, the implementation of the Convention by the Parties, the overall effects of the measures taken pursuant to the Convention, in particular environmental, economic and social effects as well as their cumulative impacts and the extent to which progress towards the objective of the Convention is being achieved;

(f) Consider and adopt regular reports on the implementation of the Convention and ensure their publication;

(g) Make recommendations on any matters necessary for the implementation of the Convention;

(h) Seek to mobilize financial resources in accordance with Article 4, paragraphs 3, 4 and 5, and Article 11;

(i) Establish such subsidiary bodies as are deemed necessary for the implementation of the Convention;

(j) Review reports submitted by its subsidiary bodies and provide guidance to them;

(k) Agree upon and adopt, by consensus, rules of procedure and financial rules for itself and for any subsidiary bodies;

(l) Seek and utilize, where appropriate, the services and cooperation of, and information provided by, competent international organizations and intergovernmental and non-governmental bodies; and

(m) Exercise such other functions as are required for the achievement of the objective of the Convention as well as all other functions assigned to it under the Convention.

3. The Conference of the Parties shall, at its first session, adopt its own rules of procedure as well as those of the subsidiary bodies established by the Convention, which shall include decision-making procedures for matters not already covered by decision-making procedures stipulated in the Convention. Such procedures may include specified majorities required for the adoption of particular decisions.

4. The first session of the Conference of the Parties shall be convened by the interim secretariat referred to in Article 21 and shall take place not later than one year after the date of entry into force of the Convention. Thereafter, ordinary sessions of the Conference of the Parties shall be held every year unless otherwise decided by the Conference of the Parties.

5. Extraordinary sessions of the Conference of the Parties shall be held at such other times as may be deemed necessary by the Conference, or at the written request of any Party, provided that, within six months of the request being communicated to the Parties by the secretariat, it is supported by at least one third of the Parties.

6. The United Nations, its specialized agencies and the International Atomic Energy Agency, as well as any State member thereof or observers thereto not Party to the Convention, may be represented at sessions of the Conference of the Parties as observers. Any body or agency, whether national or international, governmental or non-governmental, which is qualified in matters covered by the Convention, and which has informed the secretariat of its wish to be represented at a session of the Conference of the Parties as an observer, may be so admitted unless at least one third

of the Parties present object. The admission and participation of observers shall be subject to the rules of procedure adopted by the Conference of the Parties.

Article 8

SECRETARIAT

1. A secretariat is hereby established.

2. The functions of the secretariat shall be:

(a) To make arrangements for sessions of the Conference of the Parties and its subsidiary bodies established under the Convention and to provide them with services asrequired;

(b) To compile and transmit reports submitted to it;

(c) To facilitate assistance to the Parties, particularly developing country Parties, on request, in the compilation and communication of information required in accordance with the provisions of the Convention;

(d) To prepare reports on its activities and present them to the Conference of the Parties;

(e) To ensure the necessary coordination with the secretariats of other relevant international bodies;

(f) To enter, under the overall guidance of the Conference of the Parties, into such administrative and contractual arrangements as may be required for the effective discharge of its functions; and

(g) To perform the other secretariat functions specified in the Convention and in any of its protocols and such other functions as may be determined by the Conference of the Parties.

3. The Conference of the Parties, at its first session, shall designate a permanent secretariat and make arrangements for its functioning.

Article 9

SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE

1. A subsidiary body for scientific and technological advice is hereby established to provide the Conference of the Parties and, as appropriate, its other subsidiary bodies with timely information and advice on scientific and technological matters relating to the Convention. This body shall be open to participation by all Parties and shall be multidisciplinary. It shall comprise government representatives competent in the relevant field of expertise. It shall report regularly to the Conference of the Parties on all aspects of its work.

2. Under the guidance of the Conference of the Parties, and drawing upon existing competent international bodies, this body shall:

(a) Provide assessments of the state of scientific knowledge relating to climate change and its effects;

(b) Prepare scientific assessments on the effects of measures taken in the implementation of the Convention;

(c) Identify innovative, efficient and state-of-the-art technologies and know-how and advise on the ways and means of promoting development and/or transferring such technologies;

(d) Provide advice on scientific programmes, international cooperation in research and development related to climate change, as well as on ways and means of supporting endogenous capacity-building in developing countries; and

(e) Respond to scientific, technological and methodological questions that the Conference of the Parties and its subsidiary bodies may put to the body.

3. The functions and terms of reference of this body may be further elaborated by the Conference of the Parties.

Article 10

SUBSIDIARY BODY FOR IMPLEMENTATION

1. A subsidiary body for implementation is hereby established to assist the Conference of the Parties in the assessment and review of the effective implementation of the Convention. This body shall be open to participation by all Parties and comprise government representatives who are experts on matters related to climate change. It shall report regularly to the Conference of the Parties on all aspects of its work.

2. Under the guidance of the Conference of the Parties, this body shall:

(a) Consider the information communicated in accordance with Article 12, paragraph 1, to assess the overall aggregated effect of the steps taken by the Parties in the light of the latest scientific assessments concerning climate change;

(b) Consider the information communicated in accordance with Article 12, paragraph 2, in order to assist the Conference of the Parties in carrying out the reviews required by Article 4, paragraph 2 (d); and

(c) Assist the Conference of the Parties, as appropriate, in the preparation and implementation of its decisions.

Article 11

FINANCIAL MECHANISM

1. A mechanism for the provision of financial resources on a grant or concessional basis, including for the transfer of technology, is hereby defined. It shall function under the guidance of and be accountable to the Conference of the Parties, which shall decide on its policies, programme priorities and eligibility criteria related to this Convention. Its operation shall be entrusted to one or more existing international entities.

2. The financial mechanism shall have an equitable and balanced representation of all Parties within a transparent system of governance.

3. The Conference of the Parties and the entity or entities entrusted with the operation of the financial mechanism shall agree upon arrangements to give effect to the above paragraphs, which shall include the following:

(a) Modalities to ensure that the funded projects to address climate change are in conformity with the policies, programme priorities and eligibility criteria established by the Conference of the Parties;

(b) Modalities by which a particular funding decision may be reconsidered in light of these policies, programme priorities and eligibility criteria;

(c) Provision by the entity or entities of regular reports to the Conference of the Parties on its funding operations, which is consistent with the requirement for accountability set out in paragraph 1 above; and

(d) Determination in a predictable and identifiable manner of the amount of funding necessary and available for the implementation of this Convention and the conditions under which that amount shall be periodically reviewed.

4. The Conference of the Parties shall make arrangements to implement the above-mentioned provisions at its first session, reviewing and taking into account the interim arrangements referred to in Article 21, paragraph 3, and shall decide whether these interim arrangements shall be maintained. Within four years thereafter, the Conference of the Parties shall review the financial mechanism and take appropriate measures.

5. The developed country Parties may also provide and developing country Parties avail themselves of, financial resources related to the implementation of the Convention through bilateral, regional and other multilateral channels.

Article 12

COMMUNICATION OF INFORMATION RELATED TO IMPLEMENTATION

1. In accordance with Article 4, paragraph 1, each Party shall communicate to the

Conference of the Parties, through the secretariat, the following elements of information:

(a) A national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be promoted and agreed upon by the Conference of the Parties;

(b) A general description of steps taken or envisaged by the Party to implement the Convention; and

(c) Any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its communication, including, if feasible, material relevant for calculations of global emission trends.

2. Each developed country Party and each other Party included in Annex I shall incorporate in its communication the following elements of information:

(a) A detailed description of the policies and measures that it has adopted to implement its commitment under Article 4, paragraphs 2 (a) and 2 (b); and

(b) A specific estimate of the effects that the policies and measures referred to in subparagraph (a) immediately above will have on anthropogenic emissions by its sources and removals by its sinks of greenhouse gases during the period referred to in Article 4, paragraph 2 (a).

3. In addition, each developed country Party and each other developed Party included in Annex II shall incorporate details of measures taken in accordance with Article 4, paragraphs 3, 4 and 5.

4. Developing country Parties may, on a voluntary basis, propose projects for financing, including specific technologies, materials, equipment, techniques or practices that would be needed to implement such projects, along with, if possible, an estimate of all incremental costs, of the reductions of emissions and increments of removals of greenhouse gases, as well as an estimate of the consequent benefits.

5. Each developed country Party and each other Party included in Annex I shall make its initial communication within six months of the entry into force of the Convention for that Party. Each Party not so listed shall make its initial communication within three years of the entry into force of the Convention for that Party, or of the availability of financial resources in accordance with Article 4, paragraph 3. Parties that are least developed countries may make their initial communication at their discretion. The frequency of subsequent communications by all Parties shall be determined by the Conference of the Parties, taking into account the differentiated timetable set by this paragraph.

6. Information communicated by Parties under this Article shall be transmitted by the secretariat as soon as possible to the Conference of the Parties and to any subsidiary bodies concerned. If necessary, the procedures for the communication of information may be further considered by the Conference of the Parties.

7. From its first session, the Conference of the Parties shall arrange for the provision to developing country Parties of technical and financial support, on request, in compiling and communicating information under this Article, as well as in identifying the technical and financial needs associated with proposed projects and response measures under Article 4. Such support may be provided by other Parties, by competent international organizations and by the secretariat, as appropriate.

8. Any group of Parties may, subject to guidelines adopted by the Conference of the Parties, and to prior notification to the Conference of the Parties, make a joint communication in fulfilment of their obligations under this Article, provided that such a communication includes information on the fulfilment by each of these Parties of its individual obligations under the Convention.

9. Information received by the secretariat that is designated by a Party as confidential, in accordance with criteria to be established by the Conference of the Parties, shall be aggregated by the secretariat to protect its confidentiality before being made available to any of the bodies involved in the communication and review of information.

10. Subject to paragraph 9 above, and without prejudice to the ability of any Party to make public its communication at any time, the secretariat shall make communications by Parties under this Article publicly available at the time they are submitted to the Conference of the Parties.

Article 13

RESOLUTION OF QUESTIONS REGARDING IMPLEMENTATION

The Conference of the Parties shall, at its first session, consider the establishment of a multilateral consultative process, available to Parties on their request, for the resolution of questions regarding the implementation of the Convention.

Article 14

SETTLEMENT OF DISPUTES

1. In the event of a dispute between any two or more Parties concerning the interpretation or application of the Convention, the Parties concerned shall seek a settlement of the dispute through negotiation or any other peaceful means of their own choice.

2. When ratifying, accepting, approving or acceding to the Convention, or at any time thereafter, a Party which is not a regional economic integration organization may declare in a written instrument submitted to the Depositary that, in respect of any dispute concerning the interpretation or application of the Convention, it recognizes as compulsory ipso facto and without special agreement, in relation to any Party accepting the same obligation:

(a) Submission of the dispute to the International Court of Justice; and/or

(b) Arbitration in accordance with procedures to be adopted by the Conference of the Parties as soon as practicable, in an annex on arbitration.

A Party which is a regional economic integration organization may make a declaration with like effect in relation to arbitration in accordance with the procedures referred to in subparagraph (b) above.

3. A declaration made under paragraph 2 above shall remain in force until it expires in accordance with its terms or until three months after written notice of its revocation has been deposited with the Depositary.
4. A new declaration, a notice of revocation or the expiry of a declaration shall not in any way affect proceedings pending before the International Court of Justice or the arbitral tribunal, unless the parties to the dispute otherwise agree.

5. Subject to the operation of paragraph 2 above, if after twelve months following notification by one Party to another that a dispute exists between them, the Parties concerned have not been able to settle their dispute through the means mentioned in paragraph 1 above, the dispute shall be submitted, at the request of any of the parties to the dispute, to conciliation.

6. A conciliation commission shall be created upon the request of one of the parties to the dispute. The commission shall be composed of an equal number of members appointed by each party concerned and a chairman chosen jointly by the members appointed by each party. The commission shall render a recommendatory award, which the parties shall consider in good faith.

7. Additional procedures relating to conciliation shall be adopted by the Conference of the Parties, as soon as practicable, in an annex on conciliation.

8. The provisions of this Article shall apply to any related legal instrument which the Conference of the Parties may adopt, unless the instrument provides otherwise.

Article 15

AMENDMENTS TO THE CONVENTION

1. Any Party may propose amendments to the Convention.

2. Amendments to the Convention shall be adopted at an ordinary session of the Conference of the Parties. The text of any proposed amendment to the Convention shall be communicated to the Parties by the secretariat at least six months before the meeting at which it is proposed for adoption. The secretariat shall also communicate proposed amendments to the signatories to the Convention and, for information, to the Depositary.

3. The Parties shall make every effort to reach agreement on any proposed amendment to the Convention by consensus. If all efforts at consensus have been exhausted, and no agreement reached, the amendment shall as a last resort be adopted by a three-fourths majority vote of the Parties present and voting at the meeting. The

adopted amendment shall be communicated by the secretariat to the Depositary, who shall circulate it to all Parties for their acceptance.

4. Instruments of acceptance in respect of an amendment shall be deposited with the Depositary. An amendment adopted in accordance with paragraph 3 above shall enter into force for those Parties having accepted it on the ninetieth day after the date of receipt by the Depositary of an instrument of acceptance by at least three fourths of the Parties to the
Convention.

5. The amendment shall enter into force for any other Party on the ninetieth day after the date on which that Party deposits with the Depositary its instrument of acceptance of the said amendment.

6. For the purposes of this Article, "Parties present and voting" means Parties present and casting an affirmative or negative vote.

Article 16

ADOPTION AND AMENDMENT OF ANNEXES TO THE CONVENTION

1. Annexes to the Convention shall form an integral part thereof and, unless otherwise expressly provided, a reference to the Convention constitutes at the same time a reference to any annexes thereto. Without prejudice to the provisions of Article 14, paragraphs 2 (b) and 7, such annexes shall be restricted to lists, forms and any other material of a descriptive nature that is of a scientific, technical, procedural or administrative character.

2. Annexes to the Convention shall be proposed and adopted in accordance with the procedure set forth in Article 15, paragraphs 2, 3 and 4.

3. An annex that has been adopted in accordance with paragraph 2 above shall enter into force for all Parties to the Convention six months after the date of the communication by the Depositary to such Parties of the adoption of the annex, except for those Parties that have notified the Depositary, in writing, within that period of their non-acceptance of the annex. The annex shall enter into force for Parties which withdraw their notification of non-acceptance on the ninetieth day after the date on which withdrawal of such notification has been received by the Depositary.

4. The proposal, adoption and entry into force of amendments to annexes to the Convention shall be subject to the same procedure as that for the proposal, adoption and entry into force of annexes to the Convention in accordance with paragraphs 2 and 3 above.

5. If the adoption of an annex or an amendment to an annex involves an amendment to the Convention, that annex or amendment to an annex shall not enter into force until such time as the amendment to the Convention enters into force.

Article 17

PROTOCOLS

1. The Conference of the Parties may, at any ordinary session, adopt protocols to the Convention.

2. The text of any proposed protocol shall be communicated to the Parties by the secretariat at least six months before such a session.

3. The requirements for the entry into force of any protocol shall be established by that instrument.

4. Only Parties to the Convention may be Parties to a protocol.

5. Decisions under any protocol shall be taken only by the Parties to the protocol concerned.

Article 18

RIGHT TO VOTE

1. Each Party to the Convention shall have one vote, except as provided for in paragraph 2 below.

2. Regional economic integration organizations, in matters within their competence, shall exercise their right to vote with a number of votes equal to the number of their member States that are Parties to the Convention. Such an organization shall not exercise its right to vote if any of its member States exercises its right, and vice versa.

Article 19

DEPOSITARY

The Secretary-General of the United Nations shall be the Depositary of the Convention and of protocols adopted in accordance with Article 17.

Article 20

SIGNATURE

This Convention shall be open for signature by States Members of the United Nations or of any of its specialized agencies or that are Parties to the Statute of the International Court of Justice and by regional economic integration organizations at Rio de Janeiro, during the United Nations Conference on Environment and Development, and thereafter at United Nations Headquarters in New York from 20 June 1992 to 19 June 1993.

Article 21

INTERIM ARRANGEMENTS

1. The secretariat functions referred to in Article 8 will be carried out on an interim basis by the secretariat established by the General Assembly of the United Nations in its resolution 45/212 of 21 December 1990, until the completion of the first session of the Conference of the Parties.

2. The head of the interim secretariat referred to in paragraph 1 above will cooperate closely with the Intergovernmental Panel on Climate Change to ensure that the Panel can respond to the need for objective scientific and technical advice. Other relevant scientific bodies could also be consulted.

3. The Global Environment Facility of the United Nations Development Programme, the United Nations Environment Programme and the International Bank for Reconstruction and Development shall be the international entity entrusted with the operation of the financial mechanism referred to in Article 11 on an interim basis. In this connection, the Global Environment Facility should be appropriately restructured and its membership made universal to enable it to fulfil the requirements of Article 11.

Article 22

RATIFICATION, ACCEPTANCE, APPROVAL OR ACCESSION

1. The Convention shall be subject to ratification, acceptance, approval or accession by States and by regional economic integration organizations. It shall be open for accession from the day after the date on which the Convention is closed for signature. Instruments of ratification, acceptance, approval or accession shall be deposited with the Depositary.

2. Any regional economic integration organization which becomes a Party to the Convention without any of its member States being a Party shall be bound by all the obligations under the Convention. In the case of such organizations, one or more of whose member States is a Party to the Convention, the organization and its member States shall decide on their respective responsibilities for the performance of their obligations under the Convention. In such cases, the organization and the member States shall not be entitled to exercise rights under the Convention concurrently.

3. In their instruments of ratification, acceptance, approval or accession, regional economic integration organizations shall declare the extent of their competence with respect to the matters governed by the Convention. These organizations shall also inform the Depositary, who shall in turn inform the Parties, of any substantial modification in the extent of their competence.

Article 23

ENTRY INTO FORCE

1. The Convention shall enter into force on the ninetieth day after the date of deposit of the fiftieth instrument of ratification, acceptance, approval or accession.

2. For each State or regional economic integration organization that ratifies, accepts or approves the Convention or accedes thereto after the deposit of the fiftieth instrument of ratification, acceptance, approval or accession, the Convention shall enter into force on the ninetieth day after the date of deposit by such State or regional economic integration organization of its instrument of ratification, acceptance, approval or accession.

3. For the purposes of paragraphs 1 and 2 above, any instrument deposited by a regional economic integration organization shall not be counted as additional to those deposited by States members of the organization.

Article 24

RESERVATIONS

No reservations may be made to the Convention.

Article 25

WITHDRAWAL

1. At any time after three years from the date on which the Convention has entered into force for a Party, that Party may withdraw from the Convention by giving written notification to the Depositary.

2. Any such withdrawal shall take effect upon expiry of one year from the date of receipt by the Depositary of the notification of withdrawal, or on such later date as may be specified in the notification of withdrawal.

3. Any Party that withdraws from the Convention shall be considered as also having withdrawn from any protocol to which it is a Party.

Article 26

AUTHENTIC TEXTS

The original of this Convention, of which the Arabic, Chinese, English, French, Russian and Spanish texts are equally authentic, shall be deposited with the Secretary-General of the United Nations.

IN WITNESS WHEREOF the undersigned, being duly authorized to that effect, have signed this Convention.

DONE at New York this ninth day of May one thousand nine hundred and ninety-two.

Annex I
Australia
Austria

Belarus**a**
Belgium
Bulgaria**a**
Canada
Croatia**a** *
Czech Republic**a** *
Denmark
European Economic Community
Estonia**a**
Finland
France
Germany
Greece
Hungary**a**
Iceland
Ireland
Italy
Japan
Latvia**a**
Liechtenstein*****
Lithuania**a**
Luxembourg
Monaco*****
Netherlands
New Zealand
Norway
Poland**a**
Portugal
Romania**a**
Russian Federation**a**
Slovakia**a***
Slovenia**a***
Spain
Sweden
Switzerland
Turkey
Ukraine**a**
United Kingdom of Great Britain and Northern Ireland
United States of America

Annex II
Australia
Austria
Belgium
Canada
Denmark
European Economic Community
Finland
France
Germany

Greece
Iceland
Ireland
Italy
Japan
Luxembourg
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
United Kingdom of Great Britain and Northern Ireland
United States of America


ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS
ΟΙΚΟΝΟΜΙΚΟ ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΘΗΝΩΝ