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How will IMO 2020 interrupt the current Short sea dry bulk market in Europe, in the 1500 – 8000 dwt range.

Jonas Blomberg

Supervisor: Øivind Andersen

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Abstract

In this thesis I have used historical data, research and market reports and statistics to analyze how IMO 2020 may interrupt the current Short sea shipping market in Europe, in the 1500 – 8000 dwt range.

By examining the collected data and comparing it with today's situation, I have managed to come up with, what I believe to be possible interruptions to the current Short sea market situation.

initially, I will be introducing relevant theory for this research. Most of the data can be classified as secondary data, that were collected through historical statistics acquired mostly from the European Union's data portfolio. The Primary data I collected were collected through interviews.

Today's European Short sea shipping market is already in a unique position, where the implementation of ECA has already set its mark in the industry. A lot of shipowners are already fully or partially compliant, and therefore only needs a smaller investment to become compliant. IMO 2020 may, therefore, not have a huge direct impact on European shipowners, but may have the possibility to affect the trading pattern of European manufacturing companies which relies on sea as their main method of shipping. Consumers of the shipped products could also see a higher cost, due to increased bunker expenses. Areas outside ECA are likely to see the biggest changes, but with active efforts to supply enough compliant fuel, we might only see big changes on a short-term basis.

Preface

This thesis is submitted as the independent work of the bachelor program at the Norwegian university of Science and Technology.

The work started in September 2019, when I was introduced to my internship at Wilson Agency Norge AS in Bergen, a subsidiary of Wilson ASA. Wilson group deliver remote agency services on the Norwegian coastline to many of their thousands yearly port calls. I would very much like to thank both Wilson Agency and Wilson ASA for giving me the opportunity to work as an intern during this semester and providing me with the opportunity to explore what shipping is all about.

This has given me both encouragement and the will to deliver the best I possibly can, both as an intern, and in this thesis. Working at Wilson has also given me a valuable insight about the segment I am focusing my thesis towards. I've therefore had the opportunity to gather industry and segment knowledge, crucial to this thesis, at a much faster pace than I would generally be able to.

Collecting the data required for this thesis, proved to be a major and very time-consuming part of my work. I would therefore like to thank my mom and dad for providing me with great support and much needed time and tea, it made the entire process much more manageable.

I found working on this subject very rewarding. Much of my knowledge acquired over the two years studying at NTNU Aalesund proved relevant while working on this thesis. The entire process was very exciting, informative and at times hard, but I feel I have benefitted greatly from the experience, and I would not go without it.

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1. Introduction

1.1 MARPOL Annex VI – aka IMO 2020

January 1st, 2020, the International Maritime Organization (IMO) is introducing the revised MARPOL Annex VI, commonly known as IMO 2020. The new MARPOL Annex VI introduces a global cap on Sulphur oxides (SO_x) of 0,5% m/m (mass by mass). The current Sulphur cap lies at 3,5%, as long as your ships operate outside Emission Control Areas (ECAs), where the cap for Sulphur already is at 0,1% and have been since January 1st, 2015.

I am therefore interested in finding out how IMO 2020 will interrupt the current Short sea dry bulk market in Europe, in the 1500 – 8000 dwt range.

In order to accomplish the 0,5% Sulphur cap as a shipowner, one only has three options:

1) Fit the vessel with an exhaust gas cleaning system, also known as scrubber
2) Run its engines on low Sulphur fuel
3) Use liquified natural gas (LNG), but this is very expensive, and does not have the supported infrastructure yet

Some of these options demand a larger initial financial investment, but it might give shipowners the opportunity to lower their operation costs in the future.

As the shipping industry has a wide global footprint, I have found it essential to narrow down my research question. Therefore, I've only focused on the European dry bulk Short sea shipping market in the 1500 to 8000 dwt range. Considering Europe already has a massive Emission Controlled Area(s) (ECAs), Some European shipowners have already made their ship compliant with the new regulations, but there are still new complications brought forward with IMO 2020, that they will have to comply with.

Considering a lot of European shipping traffic already sails in ECAs, will there be a big interruption in the European market? Is it even a viable option to outfit your 1500 – 8000 dwt fleet with scrubbers? Will a possible change in bunker prices shrink the demand for Short sea shipping? How might IMO effect industrial and manufacturing companies in Europe?

1.2 Glossary

ECA ZONE

Emission Control Areas (ECAs), are sea areas in which stricter controls were established to minimize airborne emissions from ships as defined by Annex VI of the
1997 MARPOL Protocol.
The emissions specifically include SOx, NOx, ODSs and VOCs and the regulations came into effect in May 2005

ELASTICITY

Elasticity is a measure of a variable's sensitivity to a change in another variable. In business and economics, elasticity refers the degree to which individuals, consumers or producers change their demand or the amount supplied in response to price or income changes. It is predominantly used to assess the change in consumer demand as a result of a change in a good or service's price

GDP

Gross Domestic Product (GDP) is the total monetary or market value of all the finished goods and services produced within a country's borders in a specific time period. As a broad measure of overall domestic production, it functions as a comprehensive scorecard of the country's economic health

MARPOL

The International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78, MARPOL is Short for maritime pollution and 73/78 Short for the years 1973 and 1978) is one of the most important international
marine environmental conventions. It was developed by the International Maritime Organization in an effort to minimize pollution of the oceans and seas, including dumping, oil and air pollution

SHORT SEA SHIPPING (SSS)

Short sea shipping means the movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and ports situated in non-European countries having a coastline on the enclosed seas bordering Europe. Short sea shipping includes domestic and international maritime transport, including feeder services along the coast, to and from the Islands rivers and lakes. The concept of Shortsea shipping also extends to maritime transport between the Member States of the Union and Norway and Iceland and other States on the Baltic Sea, the Black Sea and the Mediterranean

SUPPLY CHAIN

A supply chain is a network between a company and its suppliers to produce and distribute a specific product to the final buyer

1.3 Figures and Tables

Figures:

Tables:

1.4 Limitations

During my time collecting data and researching my discoveries, I have not managed to find any information regarding the numbers of vessels in Europe already being compliant with IMO 2020. Shipping is a secretive business, where the player with the most information, always has the power to make the best deals. Therefore, I have used statistics from global predictions and used that as a starting point for my conclusions.

Since I am asking what the interruption of IMO 2020 will be, this directly affects my research questions seeing that it might be a massive investment for shipowners to be compliant, depending on what option they choose. I have therefore combined the data from a vessel density map, the global compliant predictions and freight numbers form the EU-28 countries as a guideline for how shipowners are positioned in the market as of December 2019.

2. Current market

2.1 What is Short sea shipping?

"Short sea shipping is the movement of cargo and passengers by sea over Short distances. The European commission describes Short sea shipping as follows: "Short sea shipping" includes domestic and international maritime transport, including feeder services, along the coast and to and from the islands, rivers and lakes. The concept of Short sea shipping also extends to maritime transport between the Member states of the union and Norway and Iceland and other states on the Baltic Sea, the Black Sea and the Mediterranean." (ECSA- European Community Shipowners's Associations, 2016)

The European Short sea shipping market can be divided into five major regional markets, each with its own characteristics; the Black sea, the Mediterranean, the Atlantic Range, the North Sea and the Baltic. According to Eurostat, the EU-28 nations transported almost 1.9 billion tons in 2017. Short Sea shipping made up close to 60% (1.14 billion tons) of the total sea

Short sea shipping of freight, 2007-2017
(million tonnes)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017			Change 2017/2016 (%)	Change 2017-2007(%)
	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Inwards	Outwards	Total		
EU-28	**1 865.5**	**1 861.8**	**1 691.2**	**1 764.7**	**1 799.6**	**1 776.0**	**1 756.3**	**1 792.3**	**1 807.3**	**1 855.6**	**1 504.3**	**1 049.4**	**1 864.6**	**+0.5**	**-0.0**
Belgium	121.6	128.7	111.7	130.1	125.6	123.9	126.6	134.3	131.2	143.2	75.1	55.6	**130.5**	**-8.8**	**+7.3**
Bulgaria	19.4	20.9	18.2	18.9	21.2	22.1	24.1	21.9	21.5	23.2	12.1	13.5	**25.5**	**+10.3**	**+31.8**
Denmark	76.8	76.7	65.2	66.8	67.7	66.2	66.3	66.6	73.1	74.4	42.9	32.2	**73.0**	**-1.9**	**-5.0**
Germany	192.8	189.9	156.0	157.7	168.3	170.4	171.9	177.0	174.1	177.6	112.2	67.2	**175.4**	**-1.3**	**-9.1**
Estonia	30.0	22.9	22.6	28.3	31.2	25.5	28.3	29.9	23.7	22.9	9.4	14.6	**24.0**	**+5.2**	**-19.8**
Ireland	40.5	38.1	35.0	37.1	36.1	37.0	37.1	36.8	40.0	41.2	26.5	16.5	**42.9**	**+4.1**	**+6.1**
Greece	93.3	89.4	83.3	81.5	78.0	90.5	94.6	96.0	98.2	100.9	65.5	60.4	**103.9**	**+3.1**	**+11.4**
Spain (¹)	192.0	187.1	174.4	176.8	187.0	191.1	186.0	196.3	196.7	199.1	129.3	91.8	**193.8**	**-2.7**	**+0.9**
France (²)	215.6	222.1	194.9	194.2	194.1	170.9	166.5	170.5	167.5	164.7	116.8	64.0	**175.6**	**+6.6**	**-18.6**
Croatia	19.2	18.5	16.3	15.5	13.2	12.1	12.1	10.4	11.9	12.9	10.6	4.5	**14.4**	**+11.5**	**-25.0**
Italy	329.8	334.0	308.5	310.7	298.7	285.5	272.3	262.5	272.2	283.3	235.3	148.8	**289.5**	**+2.2**	**-12.2**
Cyprus (¹)	2.3	2.7	2.5	2.6	4.4	5.7	6.7	6.7	6.9	8.3	4.6	2.3	**7.0**	**-16.4**	**+198.2**
Latvia	49.4	49.2	48.8	47.0	53.4	61.0	56.3	58.2	56.2	50.1	5.9	40.2	**45.8**	**-8.7**	**-7.3**
Lithuania	23.3	28.6	25.4	28.3	32.2	32.4	31.3	30.7	31.3	33.0	16.4	18.8	**35.2**	**+6.7**	**+50.8**
Malta	3.0	3.1	3.0	3.5	3.0	3.0	2.8	2.9	3.4	3.5	3.3	0.4	**3.7**	**+6.4**	**+24.8**
Netherlands	259.3	250.8	243.8	275.9	256.8	262.9	261.2	272.6	286.2	286.1	208.1	83.6	**291.7**	**+1.9**	**+12.5**
Poland	44.5	39.4	37.7	49.5	48.1	48.8	52.0	54.2	55.8	55.4	32.5	23.6	**55.2**	**-0.5**	**+24.0**
Portugal	36.6	35.2	29.3	35.4	35.7	34.7	39.2	41.7	44.9	46.7	33.9	21.0	**49.4**	**+5.6**	**+34.8**
Romania (¹)	19.4	22.8	22.6	24.0	24.6	23.9	26.4	31.3	31.3	31.8	15.5	18.0	**33.5**	**+5.3**	**+72.8**
Slovenia	8.8	8.7	7.8	7.8	7.9	8.8	9.2	9.8	11.3	11.7	6.8	4.7	**11.4**	**-2.2**	**+29.5**
Finland	95.9	97.7	79.0	91.2	94.7	88.0	90.2	89.6	85.5	91.6	49.4	51.1	**96.2**	**+5.0**	**+0.3**
Sweden	144.3	148.0	130.4	148.7	148.0	142.1	145.8	149.9	151.1	153.1	82.4	76.8	**154.9**	**+1.2**	**+7.4**
United Kingdom	365.6	348.4	313.4	316.3	320.1	311.0	306.9	315.7	313.5	315.5	209.8	139.7	**316.2**	**+0.2**	**-13.5**
Norway	144.9	138.9	126.5	140.1	145.4	147.4	152.3	150.3	160.4	154.5	48.7	115.5	**148.7**	**-3.7**	**+2.7**
Turkey	:	211.4	214.5	242.6	256.9	254.6	264.0	258.5	268.5	274.0	177.2	151.8	**302.7**	**+10.4**	**:**

Note: the total figures exclude double counting of the same goods being reported as outward movements by one port and as inward movements by another. Country totals may therefore differ from the sum of inward and outward declarations, and EU-28 totals may differ from the sum of EU country totals (see methodological notes); Czechia, Luxembourg, Hungary, Austria, Slovakia and the EFTA countries Liechtenstein and Switzerland have no maritime ports.
(:) not available
(¹) The data reported for certain periods contain a significant share of declarations to and from unknown ports (see methodological notes).
(²) 2009-2016: partially estimated by Eurostat.
Source: Eurostat (online data code: mar_sg_am_cwd)

eurostat

Table 1 Short Sea Shipping of freight 2007 – 2017 (Million tonnes)
Source: (Eurostat , 2019)

transport of goods to and from the EU ports in 2017, losing more than 1 percentage point compared to 2016. However, the share of Short sea shipping in total sea transport varies considerably between the reporting countries. (Eurostat , 2019)

Short sea shipping is the hidden backbone of the European economy, without it, one would not be able to enjoy the pleasures of having products in our local stores, gas in our tanks, salt for our roads during winter and coffee on our table in the morning. All that we have grown so accustomed to.

2.2 European Industry need Shipping

Not only have we as consumers grown used to having this invincible supply chain working for us day and night, but we have a large European industry depending on the shipowners to deliver. Companies like ThyssenKrupp, ArcelorMittal, Yara, Equinor, Norsk Hydro, Mowi, Cargill, and Elkem, to name a few, depends daily on Short sea shipping companies and their owners to deliver. If their products doesn't get delivered, we as consumers may not be able to purchase the steel beams we need to build our new home, and the companies that send their cargo with ships, risks not getting their products out on time, or a company might be waiting for a crucial part of a subsea system and its not getting delivered on time. Therefore, one cannot simply avoid the shipping industry.

3. Short sea drivers and challenges

3.1 Shipping economy and drivers

The European shipping industry is a driver and contributor into the European economy. According to Oxford Economics, the European shipping industry has a total economic impact of €147 billion to the EU GDP together with 2.2 million jobs. Also, for every €1 million of GDP the shipping industry creates, another €1.6 million is created elsewhere in the EU economy (Oxford Economics , 2015).

Considering that almost 90 percent of everything we use or buy is transported by ships, (ECSA - European community shipowners' associations , u.d.) it's not hard to see why shipping is a huge industry, with a massive economic power and impact.

In recent years, there have been some emerging challenges and issues to the shipping industry, both Short and deep sea. This includes rapidly changing global economic scenarios, rising environmental and energy sustainability imperatives and growing climate change concerns. The Maritime industry will have to cope with several new trends, issues and challenges (European Comission DG Mobility and Transport , 2015)

"Although there has been a significant increase in the volume of freight transported within the EU, most of the additional freight traffic has been transported by road". (European Comission DG Mobility and Transport , 2015) Even though transportation by road is a massive threat on Short sea shipping as it holds a near 45% of the modal share, Short sea shipping still has advantages that transportation by road can never achieve in its current form. I.e.; quantity and price/tonne.

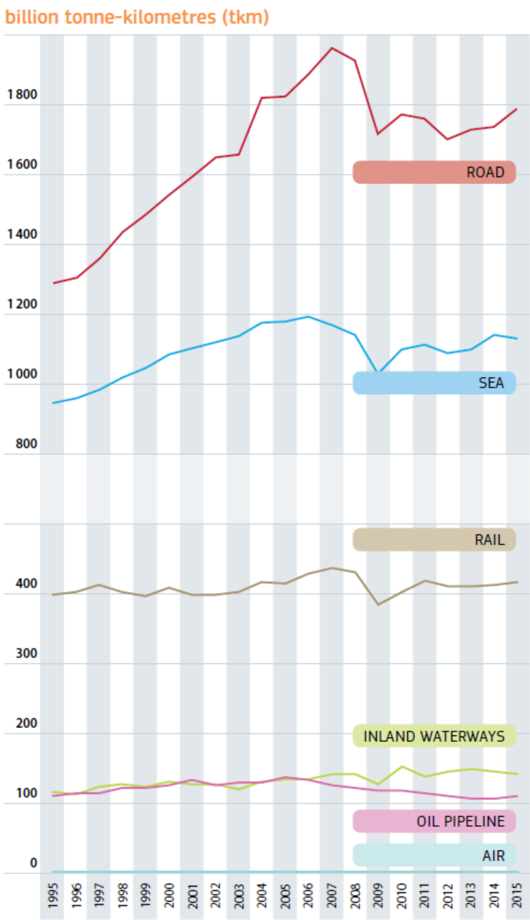

Figure 1 EU-28 Performance by Mode for Freight Transport 1995-2015
Source: (European Commission, 2017)

Looking at Short sea drivers, one can distinguish between "external drivers (i.e.: energy and environment, economy, finance, demography and society, technology and social changes) and internal transport drivers, which are originated in the transport sector or as a consequence of the impacts on the environment and technological development such as new infrastructures, vehicles and alternative fuels. In addition, policy drivers should be considered which affect the evolution of the transport system and its governance" (European Comission DG Mobility and Transport , 2015). Each of these drivers, can again be divided into subcategories.

Particularly interesting for this thesis are the external drivers - "Energy and Environment" and the "Policy" driver.

Seeing as the transport sector is one of the most important sectors for the development of energy consumption and the related environmental emissions (European Comission DG Mobility and Transport , 2015), it is fair to say that it has the possibility to have a great impact on Short sea shipping, and shipping in general.

“The energy price is without a doubt one of the most important drivers in the world… Transportation costs are expected to rise on the short and medium term, and transport demand will be readjusted, depending on the price elasticity of each mode of transport” (European Comission DG Mobility and Transport , 2015).

“Along with the aviation sector, shipping is one of the fastest growing sectors in terms of greenhouse gas emissions, causing climate change. Emissions from the global shipping industry mount to around 1 billion tonnes a year, accounting for 3% of the world’s total greenhouse gas (GHG) emission and 4% of the EU’s total emissions” (European Comission DG Mobility and Transport , 2015). Even though Sulphur is not a direct greenhouse gas emission, it is important to talk about GHG emissions in shipping, seeing that it’s not likely to lose its focus in the forthcoming years, and we can possibly soon see implementations of CO_2 regulations and other greenhouse effecting emissions from the industry.

Drivers of change		Impact	Effect on the SSS sector
Energy and environment	Energy prices and fuel costs	Short term	The energy cost plays an important role because it might involve a direct reduction of SSS’s competitiveness and as a consequence, on demand. The bunkering cost is one of the most important operating cost and really sensitive to price changes
	Climate change	Short-medium term	It has a direct effect on demand because of price increases. The unit cost is increased and thus, modal back shift is likely to occur.
	Role of biofuels	Short-medium term	It has a direct effect on demand because of price increases. The unit cost is increased and thus, modal back shift is likely to occur.

Table 2 Most important impacts on the SSS of main drivers of change
Source: (European Comission DG Mobility and Transport , 2015)

As IMO 2020 is a major change of direction, one need to understand how these changes are politically driven. “The transportation sector is subject to many forms of policy measures that can be classified in four categories: Institutional; planning and investment; operational, regulatory and licensing; and pricing, cost recovery, taxation and subsidy (European Comission DG Mobility and Transport , 2015). Policy drivers can work both ways. Depending on who holds the power, policy drivers can both encourage and discourage shipowners, companies and governments to either increase or decrease its competitiveness in the Short sea shipping segment. The two most important categories of drivers are the *institutional policy* and the *planning and investment policies*.

"Institutional Policy measures relate to the role of governments, public authorities and private sector in developing and operating transport infrastructure and services. The planning and investment policies define the criteria for economic, financial or environmental and safety standards to govern public investments and controls that should be applied to the private sector investments" (European Comission DG Mobility and Transport , 2015).

Drivers of change		Impact	Effect on the SSS sector
Policy	Institutional	Long term	Improve the competitiveness in general. The most important impacts are allocated in the efficiency of the transport system, reduction of the administrative efforts and climate change.
	Planning and investment	Long term	Improve the competitiveness in general
	Operational, regulatory and licensing	Short term	As a reaction of major environmental changes. Mostly, these have a direct effect on prices and operational costs, social and environmental aspects
	Pricing, cost recovery, taxation and subsidy	Short-medium term	Improve specific aspects of the transport supply (ship owners, ship buildings, etc.)

Table 3 Most important impacts on the SSS of main drivers of change
Source: (European Comission DG Mobility and Transport , 2015)

3.2 Political challenges

Even though the climate change movement can trace its roots back to the early 1990s, possibly even earlier, it really began rapidly evolving after the 2009 United Nations Climate Change Conference in Copenhagen. (Environmental history organization, u.d.) (United Nations, 2009).

The climate change movement have since, left a truly remarkable impact. Both in politics, but also our day to day lives. More than ever, communities, countries, organizations and people are working harder than ever to affect our climate in a positive way.

Some way or another, the climate change movement will affect and push both politicians and regulators alike, to regulate how we, as users of the environment, are allowed to influence the natural change on our planet and in our atmosphere. Therefore, organizations like the

International Maritime Organization (IMO) are starting to challenge ship owners and shipping nations introducing new regulations. Even though the global IMO 2020 cap was announced as early as 2008, IMO had already started as early as 2006 to slowly implement limitations on Sulphur both in the Baltic and North Sea. Fortunately for IMO, they couldn't have been more precise with their timing of the global Sulphur cap. One only needs to do a quick google search to understand the attention and importance the climate has gained in our society over the last couple of years. Just by googling, "ship pollution Europe", you will get around 23 million results and you will see thousands upon thousands of web pages talking about both cruise ships and normal ship freight, and how it impacts our environment. This include, but is not limited to reports on GHG emissions, anthropogenic emission and overcrowding of people and food waste. A report from June 2019, done by the European Federation for Transport and Environment found that 47 cruise ships owned by the global Carnival Corporation & PLC emitted about ten times more SOx in European EEZs than 260+ million passenger vehicles in Europe. (European Federation for Transport and Environment , 2019) One can therefore realistically imagine that the number of pollution regulations are going to increase in the coming years.

4. IMO and Sulphur dioxide

4.1 Sulphur Dioxide (SO_2)

"Sulphur dioxide, or SO_2 is a colorless gas with a strong odor, like a just-struck match. It is formed when fuel containing sulfur, such as coal and oil is burned, creating air pollution. Sulfur dioxide and nitrogen oxide affect the environment when they react with substances in the atmosphere to form acid rain" (U.S National Library of Medicine, 2019)

Exposure to Sulfur dioxide has several negative health effects, both Short and long term. Some of those are changes in lung function, Decreased fertility in women and men and Bronchitis and Shortness of breath (U.S National Library of Medicine, 2019), to name a few.

4.2 IMO 2020

Although air pollution from ships does not have the direct cause and effect associated with, for example, an oil spill incident, it causes a cumulative effect that contributes to the overall air quality problems encountered by populations in many areas. It also affects the natural environment, such as tough acid rain (International Maritime Organization , 2019). Therefore, IMO adopted the MARPOL Annex VI, as early as 1997, where they also defined an Emission Control Area (ECA), (See map figure 6) where they from 2005 lowered the Sulphur limit to 1,5%. They also decided in 2005 to revise Annex VI in 2008 with the goal to further strengthen the emission limits in light of technology improvements and implementation experience. After three years of examination, MPEC meeting 58 (October 2008) adopted the revised MARPOL Annex VI which introduced the global Sulphur limit of 0,5%, effective from 1 January 2020. (International Maritime Organization , 2019)

Outside ECAs	Inside ECAs
4.50% prior to 1 January 2012	1.50% prior to 1 July 2010
3.50% between 1 January 2012 and 2020	1.00% between 1 July 2010 and 1 January 2015
0.50% from 1 January 2020	0.10% from 1 January 2015

Table 4: Emission allowed inside ECA areas at specific dates
Source: (International Transport Forum, 2016)

“Ships generate approximately 5-10% of all Sulphur anthropogenic emission on a global level. These shipping emissions can represent a larger share of total emission in port-cities and have important health impacts” (International Transport Forum, 2016). It is therefore not hard to understand why IMO has created ECAs in areas where there a large ports and hubs for freight, while there also lives a lot of people there. Until 2008, shipping made a very limited contribution to the efforts to improve air quality in Europe. For instance, before Hong Kong implemented its

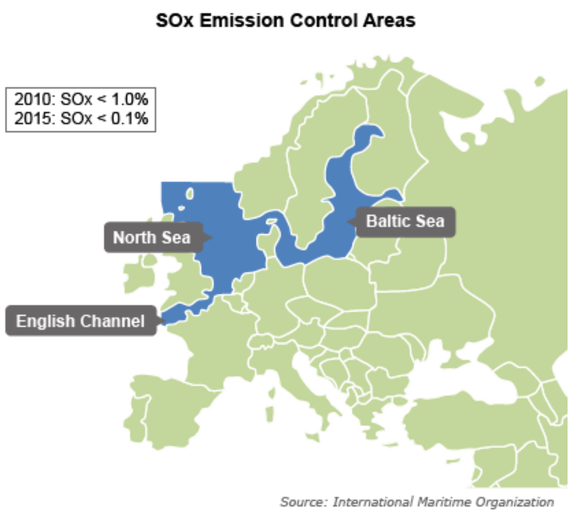

Figure 2 Sulphur emission control Area – EU
Source: (International Maritme Organization, 2019)

own ECA in 2019, the Sulphur dioxide emissions form shipping represented 54% of Hong Kong's total SO_2 emission. (International Transport Forum, 2016)

As stated earlier, the European shipping market, transported around 1,9 billion tonnes of goods in 2017. Of these, almost 1 billion is transported inside the ECA zone. If you include countries that are not entirely locked inside the ECA zone, the total number of transported goods is just above 1,7 billion tonnes[1]. The fact that more than half the total amount of goods transported by ships in Europe is inside the ECA zone, means that a lot of ships already needs to comply with low Sulphur emission regulations. This gets even clearer looking at the vessel density of Europe per annum.

Figure 3 EU vessel density map
Source: (European Union - EMODnet , 2019)

5. Technical data

5.1 Ships, engines and scrubbers

Every type of vessel has a minimum propulsion power requirement, set by the IMO, enabling captains and crew to maintain maneuverability of ships in adverse conditions. Since this thesis is focused on the 1500 to 8000 dwt segment, new ships in this weight class, are to comply with the following formulas to calculate their minimum engine power.

[1] This is numbers taken from the total amount of goods transported in the EU-28 area (plus EEZ countries) and is therefore not only short sea shipping numbers. This is because the vessels must still enter the ECA zone.

Ship Type	Minimum Propulsion Power (KW)
Bulk Carriers (20,000 ≤ DWT)	0.0687 x DWT + 2924.4
Tanker/Combination Carrier (20,000 ≤ DWT)	0.0689 x DWT + 3253.0

Table 5 Minimum power level for 20,000≤ dwt
Source: (ClassNK, 2015)

To give an example, a new 5000 dwt ship, would today be *required* to be delivered with a minimum of 3267,9 KW. The calculation looks like this: 0,0687 x 5000 + 2924,4 = 3267,9 KW.

Ship size (DWT)	Minimum Propulsion Power (KW)
1500 DWT	3027,45 / 3.027 MW
3500 DWT	3164,85 / 3.165 MW
5000 DWT	3267,9 / 3.268 MW
8000 DWT	3474 / 3.474 MW

Table 6 1500 – 8000 dwt feet propulsion requirements[2]

Unless your fleet of vessels is brand new, you're not likely going to meet these new requirements for all your ships. So, the older and smaller the vessel is, the further it is from today's requirement.

Onboard a freight vessel, space is key and often scarce. The more room you leave for your cargo hold, the more freight you can carry. In return, you sacrifice crew space and room that could have been used to retrofit the ship with new statutory elements. By comparing similar sized ships from three large Short sea shipping companies, Royal Wagenborg, Wilson and Amasus[3], one is able to calculate an average Length Over All (L.O.A) for the 1500 dwt and 8000 dwt ships.

Company	Ship name	Ship Size (DWT)	Lenght Over All (L.O.A)	Average Length
Royal Wagenborg	Samira	1760	79,95	
Royal Wagenborg	Willeke	1700	79,99	
Wilson	Wilson Saar	1679	73,84	79,11
Wilson	Wilson Rhine	1826	78,3	
Amasus	H&S PRUDENCE	1680	81,7	
Amasus	LEYLA	1760	80,9	

[2] This calculation, hinges on the limitations that your fleet only consist of bulker vessels.
[3] Operator for different owners

Company	Ship name	Ship Size (DWT)	Lenght Over All (L.O.A)	Average Length
Royal Wagenborg	Dongeborg	8350	133,41	
Royal Wagenborg	Dintelborg	8350	133,41	
Wilson	Wilson Narvik	8355	123,1	132,70
Wilson	Wilson Nanjing	8333	123,1	
Amasus	ROTRA MARE	8888	141,6	
Amasus	ROTRA VENTE	8888	141,56	

Considering everything a vessel need to bring on a voyage along with crew, tools, food, fixtures, etcetera, there is not much room left for anything else to come onboard.

5.2 Scrubbers technical data and compliance options

“Scrubbers are a cleaning system to remove Sulphur from the exhaust, permitting ships to use heavy fuel oil in ECAs. Scrubbers are also known as ship **exhaust gas cleaning systems**. There are two types of scrubbers: wet scrubbers with Sulphur oxides being absorbed in water, or dry scrubbers where Sulphur is reduced through reactions and chemically bound to a solid substance. Most of the scrubbers on ships are wet scrubbers. Three types of wet scrubbers can be distinguished: open loop scrubbers, closed loop scrubbers and hybrid scrubbers, which have both functions. The difference between these scrubbers is the type of water they use to absorb Sulphur dioxide” (International Transport Forum, 2016).

You have three different wet scrubbers, seawater scrubber (open loop), Freshwater scrubber (closed loop) and Hybrid scrubber (combination of sea-and freshwater.

“Seawater scrubbers is based on the natural alkaline characteristic of sea water, which is used to neutralize the acidic exhaust gases. After the absorption of the Sulphur molecules by the sea water, the water is then discharged back into the sea after extracting and storing the relevant sludge from scrubbing” (International Transport Forum, 2016).

“Freshwater scrubbing requires the addition of caustic soda to react with and absorb the sulphurous emission gases. It makes it possible to use scrubbing in sea areas where the natural alkalinity of the sea water is not sufficient to react on its own with sulphuric products” (International Transport Forum, 2016)

“Hybrid scrubbers combine the two technologies to be more flexible and be able to switch between sea water and fresh water depending on the alkalinity of the water. Hybrid scrubbers are used as an open loop system when the vessel is operating in the open sea and as a closed loop system when operating in ECAs. Hybrid scrubbers are most commonly used, because of their flexibility, even if their installation is more complicated and expensive” (International Transport Forum, 2016)

“The investment cost of scrubbers ranges from EUR 2-8 million per ship, depending on the ship type, scrubber type and new build/retrofit. In addition to investment costs, the operation of scrubbers increases fuel consumption, estimated to be around 1-3%. Moreover, scrubbers need space on a ship, which is often scarce. Along with scrubbers, peripheral equipment, such as equipment for wash-water, pumps, pipe systems and monitoring systems need space. This make it easier to install scrubbers on a large vessel” (International Transport Forum, 2016)

One of the world leading companies of pumps, vents, heat exchanger and scrubbers, Swedish Alfa Laval, has together with The American Bureau of Shipping, come up with a report, stating facts and data regarding outfitting either your old or new vessel with scrubber technology. By using this report, shipowners may follow a clear checklist in order to determine the feasibility to install scrubbers. According to this checklist, the most important aspects, are space and machinery. Is there enough available room onboard the vessel, is the machinery compatible with the scrubber in question and whether the cost of possibly changing the ships arrangement, structure and machinery have been estimated. On the other hand, fitting a scrubber on a newbuild, is more of an operational focused checklist. Questions like where the ship will operate, what kind of voyages it will make and how much time the vessel will spend in port, becomes essential. In the end, one must compare the total cost expected to fit a scrubber system on the ship, versus the cost for alternative means of compliance (American Bureau of Shipping - ABS, 2017).

Another important aspect if choosing a scrubber, are arising technical challenges and issues. The scrubbers have certain mechanical requirements to the machinery onboard, the most important being the engine output power. In table 7, Alfa Laval and The ABS, has listed the minimum requirements for engine output and space (American Bureau of Shipping - ABS, 2017). According to table 7, the minimum requirement for the engine output power is 4 MW – which is 4000 KW, and as shown in table 5 and 6, in this thesis, the vessels in our 1500 – 8000 dwt fleet, is not likely to have an engine above 4 MW.

Engine	Diameter	Length	Height	Dry Weight	Operational Weight
MW	m	m	m	tonnes	tonnes
4	1.7	3.4	7.1	3.3	4.0
8	2.4	4.4	8.1	5.9	7.4

Table 7 Alfa Laval scrubber technology
Source: (American Bureau of Shipping - ABS, 2017)

5.3 Low Sulphur fuel as a compliance option

"About 80% of the total bunker fuel is heavy fuel oil (HFO) which contains a share of Sulphur that is higher than what is allowed in ECAs. The first compliance option when sailing in ECA is to use fuels that have lower Sulphur content. This could be marine diesel oil (MDO), which mainly consists of distillate oil, and marine gas oil (MGO), which is a pure distillate oil that could be treated to reach a maximum Sulphur content of 0,10%. For Short sea shipping companies that operate solely in ECAs this would mean using low-Sulphur fuel all the time" (International Transport Forum, 2016)

Distillate fuels also gives shipowners the possibility to do some cost saving as it has higher thermal value which reduces engine wear – so it requires less frequent maintenance – and it lowers fuel consumption as it has higher energy content (International Transport Forum, 2016)

5.4 LNG as a compliance option

"Liquefied natural gas (LNG) is widely considered to be a promising energy source for shipping in the Short to medium term. Although the price of LNG is currently lower than for marine gas oil and heavy fuel oil, the cost of distributing LNG to ports and ships is very high. These distribution costs depend on the distance form LNG import terminals, the method of distribution and LNG volumes, which currently make LNG a more expensive fuel than MGO or HFO. This might change if the LNG bunkering network would be expanded and more ports would be able to offer LNG bunkering possibilities" (International Transport Forum, 2016)

Alongside the cost of buying LNG as fuel, shipowners would have to make a large investment before they could use LNG, just like scrubbers. The initial investment cost for a new build vessel is estimated to be EUR 4-6 million. But may be even higher. Taking into consideration of the cost to retrofit a vessel with LNG, some owners might find LNG less attractive. The LNG conversion of a 19 000 tonnes Great Lakes bulk carrier would cost USD 24 million, and it is speculated that the conversion cost of Panamax and Post-Panamax container vessels would be larger, considering that they have bigger engines. Even though LNG has various environmental side-effects, predominantly positive, as eliminating all Sulphur emissions and particulate matter, as well as NO_x by approximately 90% and CO_2 by 20-25%, it still lacks the competitive edge compared to scrubbing or fuel switching due to the high initial capital costs. (International Transport Forum, 2016)

5.5 Bunkers

Bunkers are expensive. Even though ocean shipping is the most energy efficient form of transportation, it still has a massive consumption. Fuel cost (bunkers) represent as much as 50-60% of the total ship operating costs, depending on the type of ship and service (Stratiotis, 2019). If we use the specs from DELTAMARINE of an average 5000 dwt vessel, we can calculate a fuel consumption of 5.0mt/day, which in return gives us a cruising range of 4750 nm. In order to illustrate the effect of rising fuel costs, consider the following example for an average 5000 dwt vessel. With the cost of HFO bunker at $262 (as of 11 December 2019, (Ship and Bunker, 2019) A trip from Reykjavik, Iceland to Istanbul, Turkey at 4395 nm, gives 18 days of sailing with a cruising speed of 10 knots. 18 days of sailing would cost us $23 580. Depending on weather it is your own ship, if it is a time charter or voyage charter, different people may make the initial payment for the bunkers, but it will most likely end up being passed along the contractual chain to shippers, and in turn, to the end consumer. If one considers switching to MGO, the fuels cost for the same trip, would be even higher. With the cost of MGO bunker at $564.5 (as of 11 December 2019, (Ship and Bunker, 2019) The same trip from Reykjavik to Istanbul would cost $50 805, more than double the cost of running on HFO. One way of mitigating the fuel price is to use Bunker Clauses in your charter party. There are several variations of such clauses, but the BIMCO Bunker Price Adjustment Clause, might be the most suitable. The clause, states that if "a contract is concluded on the basis of a bunker price of USD __ per metric ton for __ oil* of __ grade. If the bunker price per metric ton at __** on the first day of loading is higher than USD __ or lower than USD __ , any amount in excess of such increase or decrease shall be payable to Owners or Charteres as the case may be." (Langton, 2019)

"This a relatively broadly worded provision that contemplates adjustment where the price of bunkers on the first day of loading falls outside a stated range. More complex formulas may be appropriate where prices are extremely volatile and the price of bunkers on a single date may not represent the cost incurred during the entire charter" (Langton, 2019).

Seeing that price on fuel can have such a huge impact on the cost of a voyage and ship operation in general, it is not difficult to understand why several major carriers have already announced and indicated that they will be implementing fuel surcharges, bunker adjustment factors, or other appropriate mechanisms to address the higher rate of lower Sulphur fuel (Langton, 2019).

Even though MGO prices are relatively stable across Europe compared to HFO (as of 11 December 2019), It still has a variation of more than $100, which in our voyage example is a difference of $11 700. The fluctuation in both HFO and MGO bunkers is a very important aspect in your choice of compliance alongside your vessel specifications. The bigger the difference between HFO and MGO, the shorter the payback time for your scrubber investment (provided MGO is more expensive than HFO). On the other hand, research suggest that after the implementation of IMO 2020, bunker prices may vary even more. Remembering that only vessel fitted with scrubber technology is allowed to burn HFO from 2020, a research showing estimates that around 19% of the global shipping fleet will do just that, whereas the remaining 81% will burn compliant fuel, and it would not be unnatural to see the premium for MGO over HFO rise even further. During the last five years, the average premium for MGO over HFO in Rotterdam has been $255/mt, but the shift in demand away from HFO is also expected to cause HFO prices to decline and, conversely, MGO prices to rise (ExxonMobile, 2018).

Whether or not there will be a sufficient supply of compliant fuel is broadly discussed. An official IMO study says there will, an alternative BIMCO backed study suggest otherwise. Questions, like scrubber uptake levels, how soon and how strict governing rules will be, as well as calls for a phased introduction to the new cap /rather than a "hard" start for all on January 1, 2020 means refiners have little idea what the true demand for MGO in 2020 will be. The one thing we do know, is that the response to lack of demand will be slow, as well as the initial investment in the technology needed is not only expensive ($1 billion + per refinery) it is also time consuming to implement (5 -7 years). Buyers can expect price spikes if there is a shortfall. (ExxonMobile, 2018)

"Goldman Sachs estimates that the overall impact on consumers in 2020 could be as much as $240 billion, as the added cost cascade across global supply chains, adding approximately $40 billion in increased shipping costs. "This is the largest regulatory change in the oil space ever, and it will have a massive effect far outside of shipping," says Svelland Capital portfolio manager Kenneth Tveter." (Logisticts management, 2019)

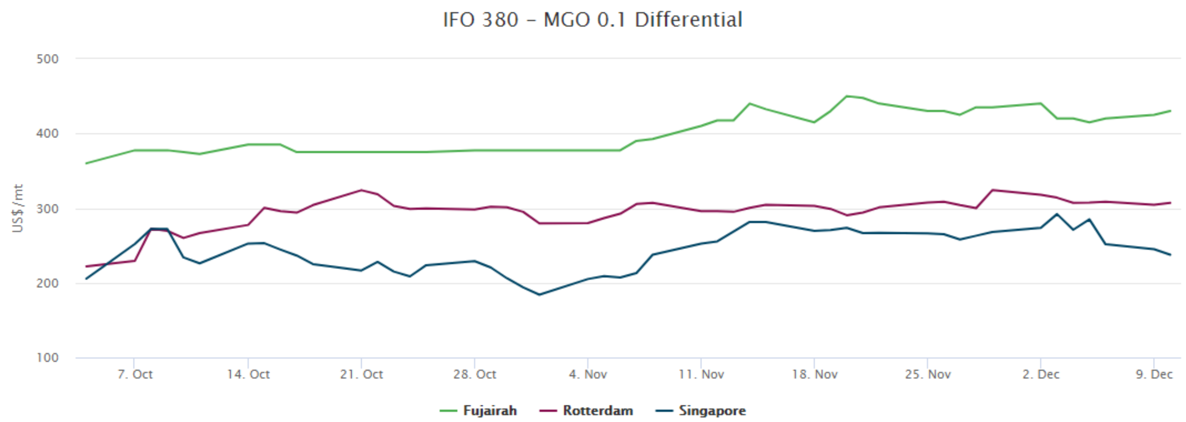

Figure 4 IFO 380 – MGO 0.1 Differential in large bunker ports
Source: (Bunker Index, 2019)

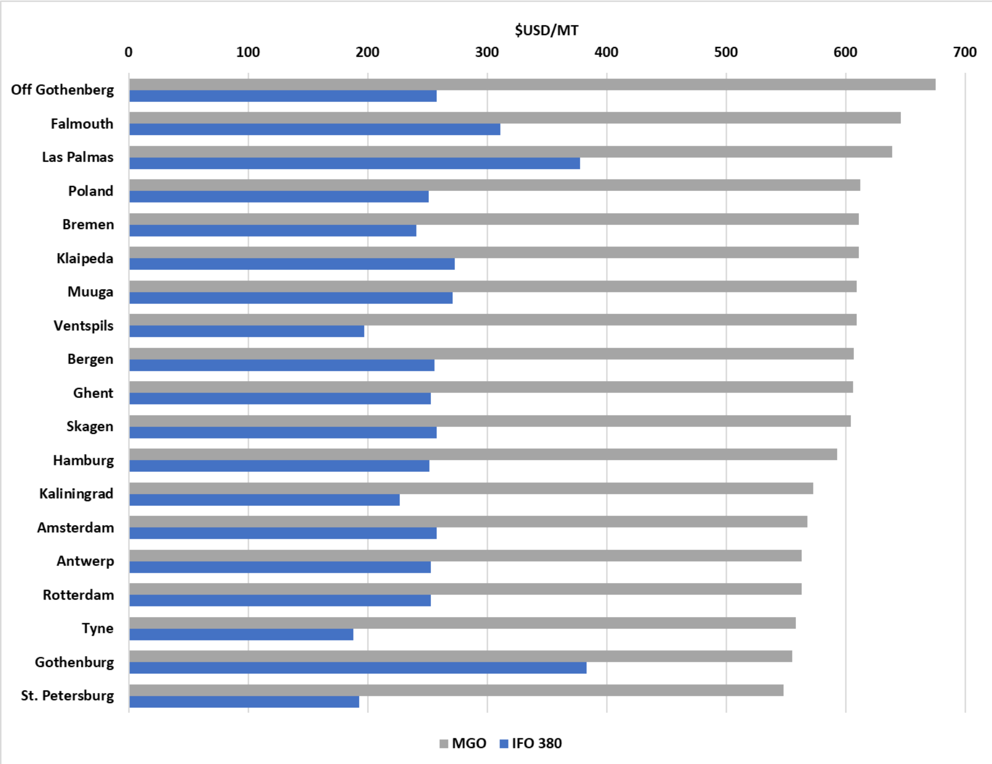

Figure 5 European bunker ports – price $usd per metric ton
Source: (Oil Monster, 2019)

6. Methodology

6.1 Approach and methods

The aim of this thesis is to investigate plausible outcomes and interruptions IMO 2020 will have on the European Short sea shipping market, in the 1500 – 8000 dwt range. This chapter will explain how the research was conducted.

First, the choices of quantitative research will be discussed. Subsequently, it will be explained how the data was gathered and, lastly, how it was analyzed.

Quantitative methods are mostly standardized procedures, trying to measure social phenomena by numbers and testing hypotheses through fixed variables. Due to their standardized measures the are applicable for rather large samples. (Silverman, 2006)

Quantitative research approach can be seen as being scientific in nature. The use of statistical data for the research, reduces the time spent on describing the result. Therefore, saving a lot of energy and resources (Eyisi, 2016). "A method is an approach, a means to solve a problem and come up with new knowledge. Any means such as serves this purpose, belongs to the arsenal of methods” (University of Oslo , 2006).

6.2 Research

In order to gather data to be used in my research, a suitable research method needed to be utilized. I started to look at what data I needed to have my questions answered. I quickly realized that Europe is in a unique position, having already gone through several ECAs stages of SO_x restrictions. This meant that I needed to find historical data and reports on the European shipping market and analyze these against new regulations, market outlooks and recent reports and shipping data. This to see how the market may react after January 1st. Therefore, I found it logical to access and research papers, from European sources like the EU and other world-renowned sources, like the UN, Oxford University and of course, The International Maritime Organization (IMO). Interviews with shipowners, have not been an option, as I wanted this thesis to remain open for the public. I have therefore decided to opt out from doing interviews.

6.3 Data analysis

This thesis is heavily based on data analysis and public information. This from European shipowners, public papers by several organizational authors and statistical data, largely from The European Union, and its departments.

By researching data from such well-known sources, I find it reasonably reliable that the information I’ve analyzed, is both grounded in reality and straight facts, but also transferable to a global view on IMO 2020. When using quantitative data, one is searching for an objective reality. One must find objective claims to support your discussion, answering your research question. I have therefore collected, read and analyzed numerous data from several independent reports, import and export data (excel), websites and information sheets. I have then decided upon which theory to bring into this thesis, to discuss, what I believe to be the most plausible outcome and interruption on the European Short sea shipping market, in the 1500 – 8000 dwt range.

7. Discussion

7.1 Is it even a viable to outfit fleet with scrubbers?

If HFO prices are predicted to fall, why doesn't everyone just outfit their vessel with a scrubber system? One thing is clear, onboard a vessel, free space is scarce. Space that is not already occupied by food supplies, bunkers, inventory or other essential items, often has no place abord a ship, especially in this segment where the ships are not exactly spacious to begin with.

If a shipowner was to build a new dry bulk vessel today, would they choose scrubbers? There are good reasons for both yes and no. If the shipowner was to install a scrubber, and the price for HFO drops, as predicted, the shipowner could sail with a lower operational cost (opex), versus ships that have switched to either compliant fuel or LNG. Even though the ship's capital expenditure (capex) would be higher - due to the cost of the scrubber, than on a vessel without scrubbers, the fact that the shipowner may use cheaper fuel, could make the extra capex viable. On the other side, the shipowner would need a larger initial investment, which they may struggle to find. Also, the shipowner might need to sacrifice other commodities onboard the vessel. Perhaps the space now occupied by the scrubber, could have gone to a larger fuel tank, or possibly a larger cargo hold. Whether or not the shipowner would be willing to possibly take on smaller quantities of cargo in exchange for a cheaper running vessel, is hard to say, but in the fight to stay alive and make money, it may come across as a smart decision.

Let us say that this shipowner also owns a few older vessels, would he fit scrubbers on those? As mentioned earlier retrofitting a scrubber, is not cheap. It often comes at a steep premium compared to install it into a ship during construction. Considering this and the lack of free space, one would have to carefully calculate the financial aspect. Even if the financial calculation gave the scrubber a go ahead, one would still have to consider the fact that the engine size, most likely would not fit the required power output of 4 MW. If we take into account that the process of changing from HFO to MGO is a relatively short process, with a lower financial investment, including the fact that you don't lose any space to the scrubber, it may be worth changing to MGO. Especially since most of the predicted higher bunker cost, one way or another, will trickle down the supply chain and in the end, end up with the consumers.

Either way, shipowners must comply with the new IMO 2020 regulations, if they choose to go with scrubbers or change to a compliant fuel, the cost of this investment, will most likely be sent down the supply chain, and end up with the consumers. One might therefore argue that in the end, the choice of compliance doesn't matter as long as it in line with the shipowner's strategy and plans for his fleet the coming years.

7.2 Will freight by truck or rail be a better option?

The predicted increase in MGO prices, may be a demand shrinker for Short sea shipping. If a ships bunker expenses is at 50-60% of total voyage expenses, and It suddenly has a $250 premium /mt, rising from $250 per ton to $500 per ton, which is a 100% increase in bunker costs, we might see a decreasing demand for Short sea shipping. Almost 45% of all transport within the EU-28 is already delivered by trucks, is there a possibility that this may rise? It is clear that 3000 mts cargo of anorthosite might not be the best cargo to start transporting by trucks, but other cargos, like lighter project cargo and light steel cargo may be transported by trucks. A viable option for heavier cargo might be to use trains. Trains transport around 400 billion tonnes of goods already, and might be an option if sea freight gets too expensive. On the other hand, sea freight has a massive advantage. The sea is an open "highway" and therefore a lot of cargo can be transported simultaneously, without creating a lot of congestion. Yes, there are areas with more ship traffic than other, but as we see on the density map, we still manage to clear a lot of traffic. Whereas trucks and rail, have a greater risk of being slowed down by congestion and slow cargo terminals.

Freight has always been about the fight to deliver the lowest price/tonne, whether it is on a ship, truck or train. The increase in bunker prices will in one way or another affect the demand for Short sea shipping. The vessels that may deliver the lowest price/tonne, will be the winner. Perhaps we will see an increase in the number of scrapped ships in the forthcoming years and a surge in new building. New ships with lower bunker usage and more environmentally friendly emissions, will both have the opportunity to sail cheaper, but also have a lesser effect on the environment. On the other hand, most of the cargo moved within Europe, already sails inside the ECA zone, so one might argue that the market already has reacted to the lower emission regulations and therefore the demand shrinkage may not be as large as it could have been, if Europe did not already have the ECA zone.

7.3 Impact on the industry in Europe?

2,2 million jobs are directly connected to the shipping industry and it has a €147 billion impact on the European GDP. For the European industry, cost accruals must be low to ensure competitiveness in a growing global market. Freight cost, and in this, cost related to Short sea shipping is an important factor. Will this change after the introduction of IMO 2020?

Will the cost of freight increase in such a way that it might affect the industry and its long-term price structures, and in a worst-case scenario force manufacturing companies to move its facilities and activities to other regions?

Let us say that Yara is shipping fertilizers from Norway to Egypt, but the increase in freight prices has contributed to a higher cost price to the consumers, and therefore, the demand for Yara's fertilizer decreases, forcing Yara to make changes in how they operate. Maybe they'll even consider moving their factory closer to the end market and by doing that, minimizing the freight costs but affecting their workers and the society around them. The social economic effects might be bigger than just lower Short sea shipping demand.

On the other hand, one might ask why this has not happen yet, since Europe already has a massive ECA zone. Even though Europe has had an ECA zone for many years, one has to remember that up until January 1st, 2020, one has the opportunity to burn HFO outside ECA, which means that if you for example are transporting goods from Norway to Egypt, you may burn HFO outside ECA and therefore reducing the bunker cost considerably.

However, IMO 2020 is a global regulation, which in many ways means that companies all around the world might be affected by a decrease in demand and therefore decreasing the likelihood that Europe will suffer the hardest. Maybe the European industry have already anticipated the increase in freight costs, and they therefore already have a clear strategy for 2020. Decreasing the chances that we will see large companies having to make big changes in their structure. IMO 2020 hold the biggest threats to those companies situated outside the already structured ECA zone. These companies have had a chance, to send their freight outside the ECA zone, and therefore eliminating the higher bunker cost. After January 1st, 2020, this will no longer be possible. The effects might, therefore, be felt strongest on those furthest away, i.e.: northern Norway, northern Russia (white sea) and Iceland.

In the end, the consequences and the impact of IMO 2020 on European industry, hinges on how expensive the compliant bunker options will be. If the spread between HFO and MGO continues to increase and most of the European Short seas shipping fleet are running on compliant bunkers, the cost for longer voyages, may be too expensive for some specific cargo, especially cargo with a low value per ton.

With an estimated impact on consumers in 2020, being as much as $240 billion, because of the predicted $40 billion increased shipping cost. It is not unlikely that we will se some changes in the trading pattern in Europe. However, if the refineries in Europe continue to invest in infrastructure and support the switch to lower Sulphur bunker, the supply will start to grow eventually, and, in the end, decreasing the bunker price to a price the market is comfortable paying. Giving us reason to believe that the possible change in trading patters is short term, as shown in table 2.

8. Summary

8.1 Conclusion

Based on the research I have done; I do not see a large downside for shipowners in Europe. Seeing that a considerably large amount of Short sea shipping in Europe already sails within ECA, a lot of shipowners already are fully, or partially compliant with the new IMO 2020 regulations. There should only be smaller investment needed to be fully compliant.

Additionally, most shipowners in this segment are likely to go for a bunker change to meet the new regulations. This being based on the fact that there is often no spare room for scrubbers plus, the engine does not have the required power output and LNG is too expensive at the moment. Therefore, the financial investment needed, is not as large, as it could have been. Bunker change is the cheapest and quickest way to be compliant, and thus increasing the overall fleet efficiency by having minimum time off the market.

It is also likely to expect shipowners to try and force cost increasements through the chain, and basically down to end users/consumers. Provided a balanced market situation, this would be the most natural result. This also means that for the industry depending on Short sea shipping as their main route of transportation, could encounter higher supply cost within their business. This is a challenge that the industry needs to mitigate. Depending on the supply of MGO and the possible increased shipping costs, we might see changes in the trading pattern in Europe. Hopefully these changes are short-term based, and thus, not affecting workers and societies, who depends on shipping and the companies using it services. With energy price, being one of the most important drivers in Short sea shipping, I also see it as a clear solution to the cost increase. Therefore, we must provide refineries with the tools and policies they need to increase their supply of compliant fuel quicker to the market. If the prices for MGO falls, after the supply boost, one can start to renegotiate terms of shipping costs and therefore see a more familiar trading pattern.

Shipping will always be an industry with a lot of challenges, whether it be political, operational or economical. It demands large amounts of capital to stay relevant and up to date with new rules and regulations, while still managing to operate a fleet with a positive voyage income.

The shipowners who manage to gather the most information, will always have the upper hand. Whether it be on new regulations arriving, knowing the competitor's strategy for the future or in any other way, having an industry advantage. It is expensive to always follow new regulations in the shipping industry, but maybe that is what we must do be a relevant method of transportation in the future. Always innovating and finding more efficient and environmentally friendly ways to utilize our ships.

By adopting changes quickly, remembering the past and be prepared for an ever-evolving industry, one might live to sail another day.

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