Environmental strategy in the Swedish shipping industry
The drivers of becoming proactive

A master thesis at the MSc in Logistics and Transport management at the Department of Business Administration

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SCHOOL OF BUSINESS, ECONOMICS AND LAW

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Abstract

There is an increased rate of the legislation being implemented to reduce emissions and impact from the shipping sector around the world. These legislations have been or are about to be implemented either worldwide or in certain areas of the world. The focus of this thesis was to investigate the impact these have on the Swedish shipping sector. The legislations of interest were the different Emission control areas, the Energy efficiency design index and the Ballast water treatment convention. The aim was to be able to answer what strategies and activities that Swedish shipping companies use to handle the increased pressure on their fleets and operations.

The results were gathered through semi-structured interviews with companies operating in Sweden. These interviews aimed to find what strategies are used, what critique exists against aforementioned legislation and how it affects the area. To generate an overview of the results, a thematic analysis method was used to create codes and themes describing the gathered data.

Mainly this method and approach lead to a result where the shipping sector in Sweden can be seen to be in an anticipatory state. The customer demand for environmental procedures is low and hence the companies cannot charge premium prices for their product to promote innovation. It is rather the increased rate of legislation that drives companies to be more proactive and create new tools to lower emissions or create energy efficiency. Some critique was also mentioned, especially towards the Energy efficiency design index which was mentioned to not be well suited for certain segments of the sector.

Keywords: *Shipping, SECA, NECA, Ballast Water Management, Energy Efficiency Design Index, Sustainability, Legislation, IMO, Swedish shipping sector.*

Acknowledgement

The process of writing this thesis has included help from a lot of parties and we would like to hand out our thanks. These parties have supported, contributed and helped in the path to reaching a successful result and we are highly thankful for this.

First of all, we would like to devote a special gratitude towards our supervisor, Johan Woxenius, Professor of maritime transport management and logistics at the School of Business, Economics and Law in Gothenburg, for assisting us with valuable opinions, insight and feedback. We would also like to thank Zeeshan Raza and Zoi Johansson Nikopoulou, PhD researchers at the section of Industrial and Financial Economics and Logistics. Their insight and expertise was very important in conducting this work.

Lastly we would like to thanks all the participant companies and respondents for sharing their knowledge and information with us by participating whole heartedly in our interviews. The information and knowledge we were able to gather were invaluable and we highly appreciate your openness.

Finally, thanks to all students participating in the oppositions and seminars handing us feedback and ideas creating a better final result.

Gothenburg, May 30, 2017

Alexander Gustafsson Jonas Nyström

Abbreviations

- BWM Ballast Water Management
- BWMS Ballast Water Management Systems
- CAAA Clean Air Amendment Act
- ECA Emission Control Area
- EEDI Energy Efficiency Design index
- EGR Exhaust Gas Recirculation
- HFO Heavy Fuel Oil
- IMO International Maritime Organization
- LNG Liquid Natural Gas
- LBG Liquid Bio Gas
- MEPC Marine Environment Protection Committee
- MDO Marine Diesel Oil
- MGO Marine Gas Oil
- NECA NO_x Emission Control Area
- NO_X Nitrogen Oxides
- SCR Selective Catalytic Reduction
- SECA Sulphur Emission Control Area

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1. Introduction

This section aims to provide a deeper background of the different legislations affecting the Swedish shipping sector and describe the problem companies are facing with an increased rate of implemented and planned legislation. Additionally, the problem background and research questions will be presented, which will be used to present the result and the conclusion later.

1.1 Background introduction

There is currently an undergoing legislating flurry towards more sustainable practices in the world of shipping and new legislation have taken both global as well as regional effects (IMO, 2017b). Additionally, certain legislation only affects ships built after a set date while other legislation affects all ships over a certain gross tonnage (IMO, 2017d). It is clear is that the scope and depth of what IMO (International maritime organization) are willing to legislate on is increasing (UNCTAD, 2015). This scope includes several aspects of security and sustainability in the shipping sector. However, this report will focus on emissions and environmental issues connected with shipping.

In general shipping is considered a good option considering transport efficiency per ton transported and therefore a good way to lower CO_2 emissions compared to other modes (Jonson et al., 2014) (Buhaug et al., 2009). Other issues have not been dealt with to the same degree in shipping as it has been in land based industries and is therefore gaining increasing attention (Jonson et al., 2014). The four main issues that that we will look more in depth on is:

- Sulphur emissions
- Nitric Oxide emissions (NO_X)
- Energy efficiency (and indirectly CO_2 emissions)
- Ballast water transporting invasive species

The emission types can be connected to terrestrial eutrophication, acidification and human health problems (Brynolf et al., 2014 p.16). In other words, benefits can be had for countries with coastlines close to heavily trafficked traffic lanes such as English Channel or Baltic Sea when reducing these emissions. Both sulphur and NO_X, however, can travel quite far and therefore impact human life and nature far from the shipping lanes where it was released into the atmosphere (Corbett et al., 2007).

The regulatory body which handles most of these issues is IMO with a long history of handling legislation concerning international shipping. The increasing focus on issues that are not relatable to CO_2 emissions from ships have partly taken the form of a future restriction on sulphur content in marine fuel which will take effect worldwide (Winnes et al., 2016). Additionally, the implementation of emission control areas with even stricter limits with regards to sulphur content in the fuel as well as the acceptable limit on NO_X in the exhaust from the ships (Winnes et al., 2016).

These Sulphur Emission Control Areas (SECA) aim to regulate the use of fuel **containing** a large percentage of sulphur [1], such as Heavy Fuel Oil (HFO) (IMO, 2017b). Since 2015 the allowed sulphur

[1] *Marpol Annex VI is an international convention on pollution from ships. Annex VI specifies the requirements of air pollutions emitted by ships.*

content of a fuel in a SECA is 0,1% which requires shipping companies to adapt (IMO, 2017b). A decision has been made to also introduce NO_X Emission Control Areas (NECA) which will require new built ships to be adapted to meet certain requirements regarding emitting NO_X (IMO, 2017d). There are three tier classifications of ships regarding NO_X efficiency where the NECA will require them to meet the standards of the toughest tier, namely Tier 3 (IMO, 2017d). The restrictions in each tier is based on g/kWh of NO_X produced in relation to the engine RPM (IMO, 2017d). Tier 1 and 2 are global requirements where Tier 2 superseded Tier 1 in ships constructed after 2011 (IMO, 2017d). Tier 3 on the other hand are only applicable for ships built after a set date when operating in a NECA area (IMO, 2017d).

At the time of writing four areas were already designated SECAs namely the north American emissions control area, United States Caribbean Sea emissions control area as well as the Baltic and North Sea (Two separate areas linked together) as illustrated in Figure 1. (IMO, 2017b). In 2016 the north American ECA was the first region to implement new regulations regarding emissions of NO_X on all ships built that year or later in line with Tier 3 regulations of MARPOL annex VI[1]. In 2016 it was also decided that the same regulations take effect in the European ECA in 2021 (Trafikanalys, 2017).

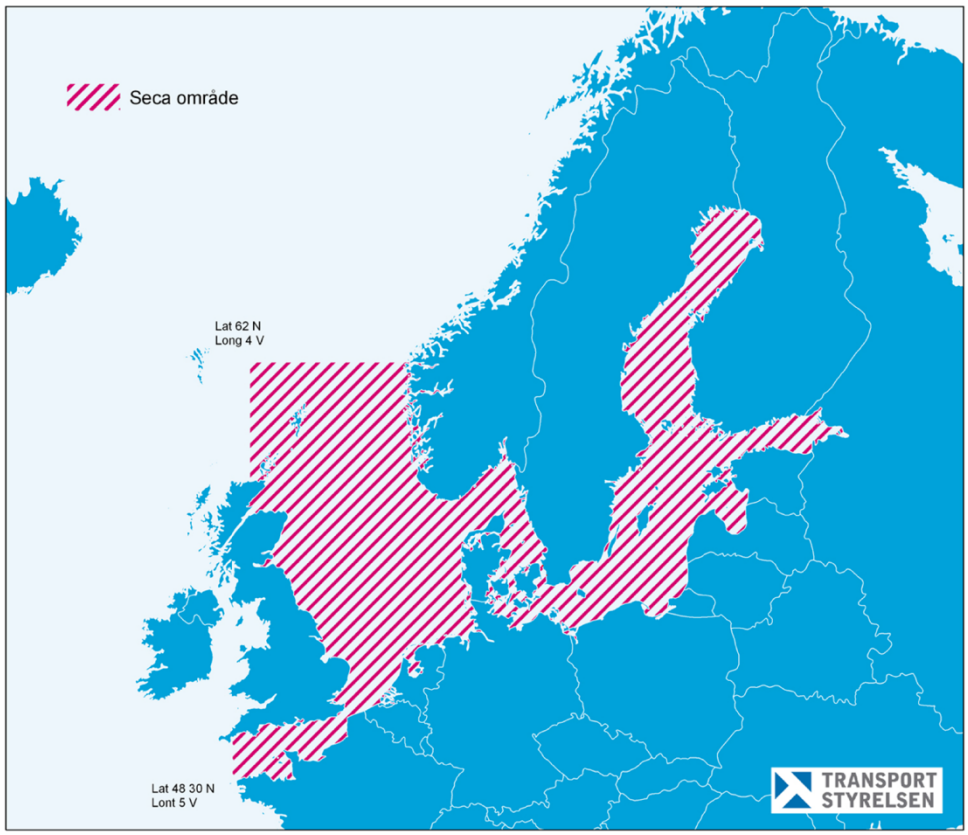

Figure 1, Map of the European SECA-zone (Transportstyrelsen, 2017)

In both the case of SECA and NECA there have been an effort to make the new regulation "technology-neutral" (European Commission, 2011). To comply with SECA for example, a shipping company could comply using low sulphur fuel such as Marine Gas Oil rather than more sulphur rich Heavy Fuel Oil (IMO, 2017b). The shipping companies operating in the affected waters could also invest in abatement technologies such as scrubbers to comply with the new regulations (Swedish MA, 2009). Likewise, a ship could reach Tier 3 compliance in NO_X emissions using alternative fuels such as methanol or Liquid Natural Gas (LNG) but could also seek technological solutions such as Selective Catalytic Reduction (SCR) or Exhaust Gas Recirculation (EGR) (Winnes et al., 2016). These alternatives will be dealt with

in more detail later. The effect, however, is that compliance method could be considered a strategic decision for shipping companies operating in the area.

In European waters, it is mainly the Baltic and North Sea where there is currently active SECAs (Figure 1) which since 2010 require a reduction of sulphur content in marine fuel to 1 percent and a reduction to 0.1 percent since 1 January 2015 (IMO, 2017b). In annex VI it is stated that abatement technologies are permitted to achieve the reduction (Cullinane & Bergqvist, 2014). Even though the 0,1% maximum content is an improvement from the current average of 2,7% sulphur it could still be compared negatively to the maximum allowed sulphur content in automotive diesel fuels which is 0,001% (Buhaug et al., 2009).

Additionally, energy efficiency is becoming a more urgent issue to deal with for the shipping community and it offers large potential but also several barriers (Rethmatulla & Smith, 2015). Due to the aim of IMO to achieve technology neutral legislation shipping companies are generally left with a choice of how to comply with new legislation (European Commission, 2011). In other words, how to comply with each legislation can become a strategic decision. It is therefore not clear how shipping companies will react to any new set of policies. In these strategies, the shipping company might choose to only comply with legislation or may actively go beyond legislation (European Commission, 2011). Understanding these strategies will likely give a better understanding of the outcome of new legislation.

When introducing cost-increasing legislation on SOx and NO_X within the Baltic region, different actors were worried that it would provoke a modal backlash, in other words, more traffic on roads rather than sea (Holmgren et al., 2014). This illustrates that legislation in some instances can become a trade-off between the issue at hand and global warming. In connection with the introduction of a ECA in the Baltic and North Sea there was no consensus on the extent of the impact of the legislation. Partly due to the number of factors that are relevant to the competition between the two modes and the differences in methodology to explain the results (Holmgren et al., 2014).

The different legislations have varying requirements and application-dates, meaning that shipping companies have a challenge to manage new technology as have clear strategies to meet future needs.

1.2 Research purpose and research questions

The purpose of this thesis is to examine what strategies Swedish shipping companies use for complying with new environmental legislation, the rationale behind the strategic choices and their attitude towards environmental legislation. The Swedish shipping sector has partly been chosen since it is affected by all four of the legislations previously mentioned. This means that in a very short period, new challenges and opportunities have arisen for them requiring direct and high attention. Therefore, this study hopes to broaden the understanding of how the legislation will affect the companies as well as if environmental concerns in these organisations will move beyond compliance.

The first research question (RQ) of the study will hence focus merely on what direct solutions and strategies the involved companies have chosen to meet the requirements of new regulations. Where the second part will cover the underlying parameters and thoughts regarding how both new and old legislation has affected the Swedish shipping sector.

RQ1: "What strategies are Swedish shipping companies using to deal with current and future environmental legislation?

To answer the main question, the following sub-questions will be used.

RQ2: "Does the increasing speed and scope of new legislation force the companies to organise for addressing future legislation more proactively?"

RQ3: "What are the Swedish shipowners attitude towards new environmental legislation?"

1.2.1 Scope

This report will include Swedish companies only which will make the scope of the paper reasonably large. Additionally, it will cover merchant shipping (passenger and cargo) where ships are large enough to meet criteria's to be affected of relevant legislation.

2. Theoretical Framework

The theoretical framework will be presented in the following chapter. Primarily a description of the application and outline of the theory will be presented. The core of the theoretical framework is the legislations of focus and the environmental strategies which together will provide the framework needed for the analysis.

2.1 Applying the theoretical framework

During the discussion and analysis phase of this thesis the theories listed in this chapter will be used with different purposes and this introduction aims to clarify how and why.

Primarily the legislations and focus areas of the thesis will be presented to create an understanding of what rules apply and what effects it has on the Swedish shipping sector. The triple bottom line together with the framework regarding drivers for sustainable management will be used merely as a tool to create a broader understanding of how sustainability works and has evolved into a managerial necessity. Understanding the drivers and pillars that create sustainability and green movements is important when analysing the situation of the companies but even more relevant to understand further theories used in this chapter.

The main tool used in the analysis section of this thesis will be the theory regarding environmental practices by Azzone Bertelè (1994) as presented in Table 3. The five stages of managerial strategies of working with environmental issues will be the foundation of how companies in this study are characterised. When applying these stages to the data gathered in this paper it can create an understanding of strategies chosen by companies and the rationale behind these choices. This model combined with the understanding of critique of current legislation regarding the actual policies affecting the Nordic region will provide a sufficient base to pinpoint the shortcomings and possibilities that exist in the sector.

2.2 The legislative landscape

This sub-section will present the legislations brought up in this thesis which are:

- Sulphur Emission Control Area
- NO_X Emission Control Area
- Energy Efficiency Design Index
- Ballast Water Management
- Global Sulphur Cap

In addition to describe the outlining and meaning of the different legislations, this chapter also aims to emphasize the impact and abatements used to comply according to the reviewed literature. In some cases, critique has been directed towards the legislations which will also be presented.

2.2.1 Sulphur emission control area

Currently there are four SECA's established around the world located in (IMO, 2017b):

- The North Sea
- The Baltic sea

- North America
- United states Caribbean area

These areas restrict the allowed percentage of sulphur in marine fuels to a degree specified by IMO. The regulation has been implemented due to fossil fuels, and especially HFO which is the common fuel used in today's shipping, containing high amounts of Sulphur, NO_X and particulate matters in addition to CO_2. The current limitations defined by a SECA can be seen in Table 1.

Table 1, Definition of SECA regulations, (IMO, 2017b)

Percentage of sulphur allowed	
Outside a SECA	**Inside a SECA**
4,5% prior to January 2012	1,5% prior to July 2010
3,5% after January 2012	1% after July 2010
0,5% after January 2020	0,1% after January 2015

As seen in Table 1 the allowed percentages will be lowered both inside and outside a SECA over time. The current restriction of fuel containing a maximum of 0,1% sulphur in a SECA requires shipping companies to use alternative fuels or abatement technologies when entering the area rather than using HFO as the main alternative as it has been historically (IMO, 2017b).

2.2.1.1 Global sulphur cap

In 2016 the 70th session of the Marine Environment Protection Committee (MEPC) was held by IMO. Among the decisions made was the approving of the Baltic and North Sea becoming a NECA but also a global sulphur cap limiting the sulphur content in marine fuel to 0.5 percent by 2020 which is a substantial reduction compared to the earlier 3.5 percent (IMO, 2017c). The compliance method for existing vessels are the very same that will reach compliance with SECA although the limits are lower (DNV GL, 2016). These measures are (DNV GL, 2016):

- MGO
- Ultra-low sulphur HFO
- Retrofitting vessels to use alternative fuels such as LNG or other alternative fuel
- Scrubbers

Winebrake et al (2009) argued that while coastal caps such as NECA are the most efficient means of reducing avoidable mortality, a global cap could decrease the mortality with a further 5000-9000 deaths annually. This would put the total figure at 36 000 - 46 000 deaths avoided compared to the situation before 2009. The highest benefits would be achieved in Europe and Asia and in addition, it is argued that the measure would lower acidification and eutrophication

There are concerns in the shipping industry that there is not a high enough supply of distillate products such as Marine Gas Oil (MGO) to support the switch from HFO putting the distillate market into disarray (DNV GL, 2016). IMO, however, ordered a report which found that refineries had the capacity to supply low sulphur fuels to both shipping as well as other consumers by 2020 (Faber et al., 2016).

Regardless of whether refineries have capacity most agree that the legislation will come with a hefty bill and could lead to large increases in the price of MGO even though the future of fuel prices are hard to predict (DNV GL, 2016) (Platts, 2016).

DNV (2016), in their report on the sulphur cap, argues that it could potentially lead to a better competitive situation for LNG due to the increased price of shipping even outside previous ECA's. The report also argues that it is likely that the cap will lead to an increase in scrubber installations leading up to 2020 and that the instalment process of these may not keep up.

2.2.1.2 Alternatives to achieve compliance with SECA

To comply with the SECA shipowners in general have two distinct options. Either compliance can be achieved through fuel substitution. Examples of fuels that comply with SECA is MGO, Liquefied Natural Gas (LNG) or Methane. LNG does lower SOx, NO_X and CO_2 emissions considerably but also increases the emission of methane and other hydrocarbons (Anderson, Salo and Fridell, 2015). Methane is a highly potent greenhouse gas and therefore some questions marks remain regarding future handling of LNG (Zetterdahl, 2017). MGO also contains less sulphur than HFO and therefore emits less SOx (Swedish MA, 2009). The two main issues regarding a switch to MGO rather than HFO was by Swedish Maritime administration (2009) considered to be availability of the fuel as well as the price difference between the two kinds of fuels. In the study performed by Swedish maritime administration they found that between 2003 and 2008 the price difference between HFO and MGO was in the range between 250-300 USD per ton (Swedish MA, 2009).

The other main alternative for compliance with SECA is through abatement technologies. There are two kind of scrubbers relevant for maritime use, either an open or a closed system (Swedish MA, 2009). The open system requires a large quantity of seawater to flow through which could be directly unsuitable for the Baltic sea (Bacher and Albrecht, 2013).

A closed scrubber system would use fresh water and therefore solve the issue of the discharge water (Swedish MA, 2009). There are, however, issues regarding crew safety and discharging in ports of the dangerous goods that will be accumulated during operations of the scrubber (Swedish MA, 2009). Additionally, there are some concerns of the environmental impact for the oceans with open loop scrubbers which have resulted in Germany and Belgium in essence prohibiting the release of scrubber water into the ocean making the use of open loop scrubbers less attractive (DNV GL, 2016).

2.2.2 NO_X emission control area

A decision to implement a NO_X emission control area in the North Sea and the Baltic region was accepted in 2016, meaning that shipping companies must apply to a new set of rules regarding fuel usage and emissions from ships (Trafikanalys, 2017). The rules regarding NO_X emissions from IMO includes three "Tiers" where Tier 1 and 2 applies as a global requirement, while Tier 3 is the restriction that will apply inside future NECA's (Trafikanalys, 2017) (IMO, 2017d).

Currently there is only one area in the world where a NO_X Tier 3 regulation is active which is along the coast in North America and the Caribbean (Trafikanalys, 2017). The North Sea and the Baltic region will be the second when it is introduced, creating new challenges on the market (Trafikanalys, 2017). The rules that define emissions to the different tiers are based on engine effect which can be seen in

table 2. The regulations take effect on construction date rather than affecting all ships after a current time, which is different to the sulphur emission regulations.

Table 2, Definition of NO_X regulation, (IMO, 2017d)

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·n(-0.2) e.g., 720 rpm – 12.1	9.8
II	1 January 2011	14.4	44·n(-0.23) e.g., 720 rpm – 9.7	7.7
III	1 January 2016	3.4	9·n(-0.2) e.g., 720 rpm – 2.4	2.0

According to Trafikanalys (2017), reaching the boundaries of Tier 3 from Tier 2 will require a reduced output of NO_X by 80%, showing the vast implications introduced by the NECA regulations.

2.2.2.1 Alternatives to achieve compliance with NECA

To reach Tier 3 levels of reduction generally ships will need to fit technological solutions to reach compliance. Winnes et al (2016) argue that the most viable solutions, except fuel substitution, which meet Tier 3 levels are:

- After treatment with selective catalytic reduction (SCR)
- Engine modification with Exhaust Gas Recirculation (EGR)

In addition, Winnes et al (2016) and Trafikanalys (2017) claim that a change of fuel to either methanol or LNG would be a viable option for reaching Tier 3 compliant levels of NO_X emissions. LNG ships could either use a compression ignition engine which can be run on either fuel, or a purer LNG spark ignition engine. LNG also, among other issues, does not currently have a widespread infrastructure for bunkering in place and a switch to LNG could therefore prove problematic.

When less fuel is used transporting goods the same distance it will generally also lead to a reduction of NO_X emissions (Winnes et al., 2016). Slow steaming is therefore often effective at reducing NO_X while performing the same transport work in total. It should be noted that while this is true in aggregate it is not necessarily true for each case. For ships with more than one engine, one engine can be used as high load rather than several at low loads, this way of operating the engines will result in slow steaming but still produce a higher amount of NO_X, due to the high engine load (Winnes et al., 2016).

The reduction necessary for operating within a NECA, however, require a reduction in NO_X emissions in relation to engine output (Winnes et al., 2016) (Trafikanalys, 2017). Measures aimed at lowering engine work will not be enough to reach Tier 3 standards even though they would lower emissions in absolute terms (but not relative terms). As mentioned, NECA will only affect ships built after the introduction in 2021 (2016 for the north American NECA) (IMO, 2017b). In other words, no retrofit of the abatement technologies will currently be necessary in ships whose keel was laid before these years (IMO, 2017f). This is likely since no solution is currently available for ships running on HFO that does

not require any kind of installation in ships to comply (Winnes et al., 2016) (Trafikanalys, 2017). In SECA on the other hand compliance could be achieved through changing fuel to MGO from HFO without expensive modifications.

After treatment with SCR works similar to the sulphur scrubber described above. Urea is used to bind NO_X to prevent it from being released into the atmosphere (Er, 2002). The technology can reach Tier 3 compliance but is less efficient when the exhausts contain a large percentage sulphur (Winnes et al., 2016). Therefore, the operation of the SCR requires a low sulphur fuel to be used or that a sulphur scrubber is used in tandem with the SCR installation. The combination of SCR and sulphur scrubber could is not yet thoroughly tested and could therefore be problematic (Winnes et al., 2016). There is, however, a case study by Brynolf et al (2014) regarding the usage of SCR installations in Sweden. It states that due to differentiated fairway fees for ship utilizing NO_X reduction technologies there is data on the usage of SCR in ships and the results. These results indicate that SCR is a viable option for achieving Tier 3 compliance (Brynolf et al., 2014).

The installation of a SCR system will mainly add costs to the shipping company through the installation and the usage of urea in the process (Winnes et al, 2016). To some extent the SCR installation will also lead to a pressure drop across the system negatively affecting the fuel consumption (Winnes et al, 2016). It is, however, expected that a SCR installation could lead to improvements in optimization leading to a more or less unchanged fuel efficiency or even some positive effects (Winnes et al, 2016). It is at this time unclear to which degree these optimizations are performed on ships with SCR-systems (Winnes et al, 2016).

2.2.3 SECA and NECA viewed holistically

While SECA and NECA are separate legislation the effects can be viewed as cumulative. Therefore, ships operating within the European ECA which are required to operate within Tier 3 standards will also be required to comply with SECA regulations. To meet both of these regulations Brynolf et al (2014) has identified three main alternatives:

- HFO combined with SCR and open loop seawater scrubber
- MGO combined with SCR
- LNG

Each of these alternatives have different aspects and could potentially be more or less economically viable depending on the factors such as fuel price, technology development etc. Both SECA and NECA regulation will increase costs for shipping performed in the affected areas (Winnes et al., 2016) (Swedish MA, 2009). How these costs spread will depend partly on what course shipping companies will choose with their new ships, as well as the development of fuel, prices and technology. Additionally, the competitive situation will likely depend on how the costs develop for road and rail transportation (Swedish MA, 2009).

The cost increase of achieving compliance with SECA and NECA compared to running on HFO will likely arise from different aspects. The fuel switch to either LNG or methanol will bring an increased installation cost compared to a conventional engine (Winnes et al., 2016). Regarding fuel costs, however, both LNG and methanol are less expensive than MGO or MDO (Winnes et al., 2016) (DNV GL, 2017). Winnes et al (2016) report LNG is considered to be potentially beneficial to the company compared to running on MGO in a SECA and NECA area. There are large variations in how fuel prices

could develop as well as the cost of installing LNG equipment compared to the quantity of fuel used making the span of outcomes large and LNG could also potentially cost substantially more (Winnes et al. 2016). Additionally, there is a large difference in price between retrofitting LNG-engines on older vessels making it a much harder initial cost to recuperate (Winnes et al., 2016).

The report by Trafikanalys (2017) showed that ship-owner was less interested in solutions that could only solve one legislation. In such cases additional legislation would require subsequent installations of other equipment making it a less desirable solution (Trafikanalys, 2017).

One of the main potentials of LNG is that it can completely remove SOx and particulate matters (PM) from the ship's exhaust (Wuersig et al., 2015*)*. Also, a NO_X reduction of up to 85 % is possible as well as a CO_2 reduction of at least 20%. Additionally, LNG have a positive impact on the EEDI of the ship (DNV, 2016). LNG is still a relative niche fuel with only 120 ships (excluding LNG-carriers) existing or in order powered by LNG in 2015 (Wuersig et al., 2015). Partly this can be explained by the lack of infrastructure available as well as methane slip (release of non-combusted methane) in operation which is a potent greenhouse gas (Zetterdahl, 2017).

2.2.4 Consequences of ECA's

The Life-cycle analysis performed by Brynolf et al (2014) on four distinct fuel options regarding compliance with SECA and NECA regulations (LNG, LBG, Methanol and bio-methanol) that shows clear improvements in many areas. These are innovative and progressive alternative strategies for compliance but it should be noted, however, that Brynolf et al (2014) found no positive effects on greenhouse gas emissions considering the full life cycle analysis. On the other hand, Buhaug et al (2009) found that LNG emissions had a reduced CO_2 percentage of 15% compared to HFO. Wuersig et al (2015) presented that CO_2 emissions were reduced by 20% by using LNG compared to HFO.

It is also of interest that a life-cycle analysis by necessity needs to make assumptions about further development and costs as well as availability of fuels. Therefore, if these assumptions prove to be invalid the results lose validity (Brynolf et al., 2014). The idea of new and alternative fuels is an important tool for understanding the impact on decisions on future events and the study by Brynolf et al (2014) found that all four stated alternatives would *"reduce the impact on particulate matter, photochemical ozone formation, acidification and terrestrial eutrophication potential in the life cycle"* (Brynolf et al., 2014 p.16).

The understanding of the environmental impact in shipping should not only be seen in light of the emissions emitted from shipping alone but also in contrast to other viable modes for transportation. In Europe, there is often several modes available for transportation where short sea shipping is one but railroad and road are usually viable options as well. Short sea shipping is considered a preferable mode of transportation due to its high energy efficiency, therefore generally releasing less CO_2 per tonkm (Jonson et al., 2014) (Buhaug et al., 2009). When SECA was implemented in Europe there was therefore a fear that increased cost due to more expensive fuel, or retrofitting of new technology, would lead to a modal backlash rather than facilitate more transportation being performed at sea (Swedish MA, 2009). According to Jonson et al (2014) 40% of intra EU transportation in tonkm was performed by short sea shipping.

The issue of modal backlash is also of high importance regarding shipping. Holmgren et al (2014) for example found no evidence to support a modal change from sea to road due to SECA regulation. Their analysis was based on an agent-based model rather than a macro-level model which might be responsible for some of the differences to other studies. The study also pointed out that for the Scandinavian countries it could be more helpful to view the competition as corridor-competition rather than modal competition (Holmgren et al., 2014).

Holmgren et al (2014) argues that to what extent a modal change will occur is dependent on factors such as fuel costs, development of handling of external cost for road, price elasticity as well as method used for compliance. In the study they criticized other studies for failing to take euro vignette and higher internalizing of external costs into account and therefore failing to represent the whole expected future costs of road transportation in the area.

In a study commissioned by the Swedish maritime administration (2009) a simulation model was used to calculate the risk of goods being transferred from short sea shipping to a land based transportation mode in Sweden. The study predicted increases in costs of between 12 and 81 percent depending on category of ship due to the more expensive fuel for one scenario while two other had larger increases (Swedish MA, 2009). All three scenarios, however, stated that the risk of a modal backlash was quite significant (Swedish MA, 2009). The study also found that their model predicted a total decline of transport work by 1 billion tonkm in the scenario with lowest cost situation and progressively more for the other.

2.2.5 Energy efficiency design index

While both sulphur and NO_X have become priorities concerning atmospheric emissions from shipping there have also been an increasing willingness to find legislation to combat CO_2 emissions as well. In 2007 shipping accounted for 2.7 percent of the global emissions of CO_2 which by 2012 had been reduced to 2.2 percent (Shi, 2016).

The main legislation aimed at energy efficiency is the Energy Efficiency Design Index. The purpose of the index is to achieve a continuous improvement of energy usage in relation to cargo carrying capacity per mile which could also be expressed as capacity mile (IMO, 2017a). As part of the design index a reference line has been established, calculating average efficiency between 2000 and 2010, that all incremental reductions in energy usage will be measured against (IMO, 2017a). The reference line states a specific figure for each ship type in grams of carbon dioxide per ship's capacity-mile. The first reduction took effect in 2013 and was a 10% reduction of CO_2 compared to the reference line. In order to ensure continuous reductions incremental steps will be taken each 5 years until 2025 when the reduction is mandated to be 30% compared to the reference line (IMO, 2017a)

The aim of the legislation is to stay technology neutral so that ship builders and owners can seek the most cost-effective solution for the reduction (European Commission, 2011). Therefore, there are several different routes for the construction and operation of a ship that can achieve compliance with the regulation. Below are some examples mentioned by Lloyd's Register (2016):

- Increase ship size & engine power ratio
- Reduce light ship weight
- Innovative solutions (air bubble– friction reduction)
- Optimize propeller efficiency
- Hydrodynamics improvement

- Speed reduction
- Use of renewable power source (Wind, Solar power)
- Low carbon fuels (e.g., LNG)
- Energy Saving Devices (e.g., WHR, Shaft Generators)"

At first only the following types of ships were covered in the legislation: tankers, bulk carriers, gas carriers, general cargo ships, container ships, refrigerated cargo carriers and combination carriers (Lloyd's register, 2016). In 2014, however, the legislation was amended to also contain the following types of ships: LNG carriers, ro-ro cargo ships, vehicle carriers, ro-ro passenger ships as well as cruise passenger ships (Lloyd's register, 2016).

It should be noted that at the time of drafting the new legislation a compromise was struck which meant that flag states could postpone the introduction of EEDI for the ships under their flags for four years if they deemed it necessary for achieving compliance. Otherwise the legislation went into effect globally the 1 January 2013(IMO, 2017a).

IMOs own estimation on the impact of the EEDI is that it will lead both to significant reductions in emissions as well as cost savings for the shipping industry (IMO, 2017a). The estimation is that by 2020 a reduction of 200 million tons CO_2 annually will be achieved compared to business as usual. IMO also estimate that the new legislation will lead to cost savings in shipping of $20 to 80 billion (IMO, 2017a).

2.2.6 Ballast water management convention

To enable ship manoeuvrability and stability, pumping ballast water into ballast water tanks in the hull of the ship is a necessity (Werschkun et al., 2014). The large amount of water needed means that different species and animals gets pumped into the tanks as well and since the water is gathered from the current location, this means that long journeys transport species to regions they do not belong (Werschkun et al., 2014). In many cases these species are invasive and can destroy local eco-systems which has arisen to a grand problem in shipping today, especially since it expands in relation to the increase of shipping activity around the world (Werschkun et al., 2014).

An initial step to solve this problem was taken in 2004 with the GloBallast study by IMO, the United Nations Development Programme and the Global Environment Facility (Werschkun et al., 2014). The immediate results showed that the invasive species transported accounted damage and impacts costing up to 100 billion dollars every year (Werschkun et al., 2014). It was also determined that some species were harmful to human life such as corrosive algae. The immense impact showed by these results was enough to initiate a development of guidelines and management procedures for ships to cope with the problem, called the Ballast Water Management Convention (BWM) (Werschkun et al., 2014).
The managerial tools and requirements presented was: (IMO, 2017e) (Werschkun et al., 2014).

- Requirement on ships to exchange a minimum of 95% of its ballast water 50 nautical miles from shore and in waters with 200m depth.
- Requirement on ballast water to be monitored so that it does not contain more restricted species than allowed.

The requirements will come into force the 8th of September 2017 (IMO, 2017e). Additionally, to meet the requirements installations are required which has to be controlled and prevent harm to the aquatic and human life (Werschkun et al., 2014). These Ballast Water Management Systems (BWMS) have

guidelines defined by IMO and it is estimated that when these requirements become applicable, over 50000 ships worldwide will have to retrofit their ballast tanks (Werschkun et al., 2014).

The systems are either based on physical or chemical technologies and the different technologies available are shown in Table 3.

Table 3, Overview of ballast water treatment measures on board a ship (Adopted by Werschkun et al., (2014)).

Ballast Water Treatment On Board	
Mechanical-Physical	**Chemical**
Particle separation - Filtration - Hydrocyclone	**Oxidative** - Halogen-containing - Halogen-free
Mechanical destruction of particles - Ultra sound - Cavitation	**Denaturing** - pH shift - Aldehydes
Damage at a molecular scale - Heating - UV Radiation - Electric pulse	**Surface active** - Quaternary ammonium salts
	Coagulating **Other**

2.3 Environmental strategies

The following chapter will focus on describing the different drivers and barriers to increase sustainable management in an organization. As described in the beginning of the theoretical framework, the triple bottom line and the literature review about sustainability will create a foundation while the frameworks later on will assist in the analysis.

2.3.1 Corporate sustainability and the triple bottom line

Engert and Baumgartner (2016), explains that the increasing importance of companies to take better care of their social and environmental impacts is more apparent than ever. The raised awareness comes mainly from mainly stakeholder and decision-maker demand which puts pressure on corporations to be more active and precise in their sustainability work (Engert and Baumgartner, 2016). Reasons for these reactions lies in both scandals and ethical problems that has been discovered, but also in the rapidly growing global presence of companies today. The higher amount of goods being produced and transported today has created more environmental and social dilemmas (Tencati and Perrini, 2011).

The basis of sustainability comes from the triple bottom line, a model created by Elkington (2002). The principle of the triple bottom line defines sustainability out of three pillars, environmental, social and financial which all has to contribute to create real sustainability (see figure 2). This model has since been the main tool to define sustainability and lead the development of corporate sustainability forward. Figure two was outlined by Carter & Rogers (2008) to address the issues of sustainability in Supply Chain Management, but is applicable to show the functions of the triple bottom line.

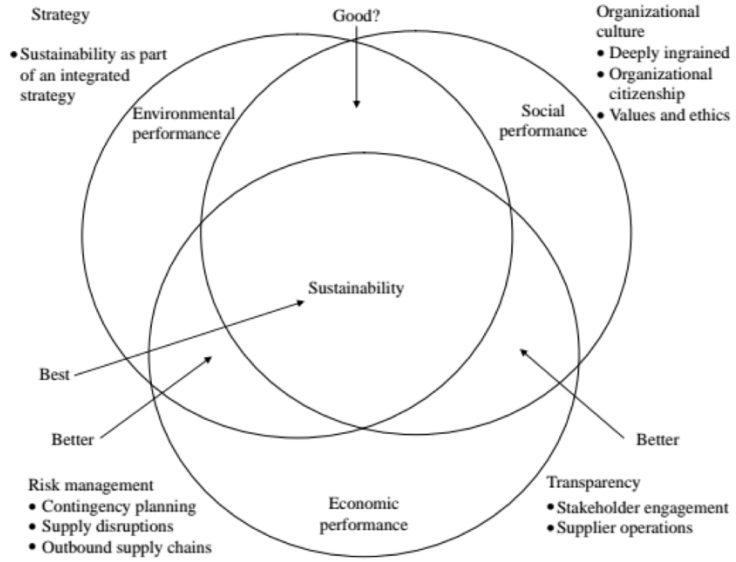

Figure 2, The triple bottom line, (Carter & Rogers 2008)

Reaching a successful sustainability strategy involves reaching social and environmentally acceptable performance while maintaining or even reaching higher profitability (Carter and Rogers, 2008). Environmental performance is measured by how the company addresses external effects of the operations such as emissions, noise and land-use. This area is well researched and understood at a company level today, especially the CO_2 standards which are very well measured by third parties around the world (Carter and Rogers, 2008). A company that works to reduce its CO_2 footprint is also highly demanded by many customers which is an incentive to work towards a sustainable approach (Carter and Rogers 2008).

Social performance on the other hand is measured by how the company takes care of its employees and people affected by its operations. It could include having adequate health and insurance policies towards the employees as well as working to prevent child-labour and bad working conditions at the factory sites (Carter and Rogers 2008). While this aspect of sustainability has been somewhat overshadowed by the environmental focus it is also a very highly sought after aspect of a company today (Carter and Rogers 2008).

Further on, Carter and Rogers (2008) explains that economic performance includes parameters that explain sustainable economic management and how resources are kept and utilized to obtain sustainability. As seen in Figure 2, two important parts of economic performance are risk management and transparency (Carter and Rogers 2008).

Having this in mind, each company will have different possibilities to reach these goals due to varying basic characteristics that affect management decisions (stakeholders, sector, government policies, structures etc.) (Engert and Baumgartner, 2016). Thus, each strategy for reaching corporate sustainability has to be tailor-made towards a specific company in order to be effective. Enablers of improved corporate sustainability is often technology, but also employee and leadership engagement which is important to reach wanted results (Engert and Baumgartner, 2016).

The maritime sector has its own possibilities and structures that enables sustainable development. The industry is heavy reliant on fossil fuels which makes it very dependent on access and price of these fuels

(Acciaro and Wilmsmeier, 2015). In addition, the maritime sector is critical for transporting large amounts of fossil fuels which should also be included in the sustainability planning of the companies. Normally there is a lot of regulations and restrictions in different areas of the world to put an external pressure on the companies involved in the sector. (Acciaro and Wilmsmeier, 2015).

2.3.2 Drivers of Corporate Sustainability

A good example of a complex question regarding corporate sustainability is:
"How can our actions to address climate change create value for shareholders as well as society to ensure they support leadership actions?" (Epstein and Roy, 2001 p.2)

This is a quote from Ford which clarifies the dilemmas of sustainability and that today the hard part is not implementing good measures but instead doing it in a way that receives gratitude from all stakeholders. Two of the most important drivers are costs, revenues and how to maximize the output of sustainable actions (Epstein and Roy, 2001). This is problematized due to social and environmental actions having three characteristics that affect the decisions:

- Long time-horizons
- High uncertainty
- Difficult to quantify

(Epstein and Roy, 2001)

In addition, the final effect on the total company performance is close to impossible to monitor since perfect information rarely is accessible and thousands of decisions and projects are included in the performance. Together, these aspects create significant problems for companies in creating strategies for sustainable performance and force them to work with drivers and enablers instead to launch large projects (Epstein and Roy, 2001).

Epstein and Roy (2001) introduced a framework (Figure 3) to determine the drivers for sustainable management and also the impacts on performance.

Figure 3, Drivers for sustainable performance (Epstein and Roy, 2001)

The framework is meant to link sustainable actions with performance indicators and stakeholder's reactions. This gives an understanding of how feedback and information is transferred during actions and how it can relate to a long term goal (Epstein and Roy, 2001). It shows how companies should approach sustainable strategy, meaning that it has to be suited for the company that uses it. The idea is that the company starts by defining the "Corporate and business unit strategy" (Epstein and Roy, 2001). The strategy is to continuously decide what sustainability actions they want to undertake. The important part is to determine what links there are between sustainability performance, stakeholder reactions and profitability for the company at hand. This creates an information flow that traces back to the initial stage to create new and even more effective strategies for coping with sustainability (Epstein and Roy, 2001).

The drivers that managers will find can be tested throughout the framework to decide if they are true or not. For example, if taking an action is considered to give a better public image and therefore increased sales, this driver has to be monitored through the framework to evaluate if the action had the corresponding link to financial performance (Epstein and Roy, 2001). If the project was successful, this will provide feedback for future projects as seen in Figure 3. Epstein and Roy (2011) emphasizes the importance of monitoring throughout the process to identify the intermediary results of the project, increased sales, market size, public image or new partners. Since this is equally as important when evaluating the success of the action.

The common drivers that are used to enable actions in this framework are (Epstein and Roy, 2011):

- Better public image (Social & Environmental)
- Higher productivity (Social)
- Regulations
- Stakeholder demands
- Management initiatives
- Lower costs

2.3.3 Drivers and implementation

Successful implementation can be identified throughout different functions of the company. To be able to implement sustainability on an organizational and strategic level all parts must strive in the same direction and cooperate (Engert and Baumgartner, 2016). The report by Engert and Baumgartner (2016) identifies how the successful implementation is found throughout the company starting off on a strategical level. Normally a function of the management committee can be found such as a "sustainability board" which is a key aspect of achieving success. Another factor that drives sustainability in an organization is culture where history and customs affect the importance that is given to the subject (Engert and Baumgartner, 2016). Company culture creates assumptions and influences employees and management towards certain decisions and is seen as a key issue or enabler of sustainable management.

Further on, Engert and Baumgartner (2016) describes that leadership should be distinguished from culture and organizational structure. Leadership is important since personal preference and leadership style highly can affect decisions even though the culture or structure may be heading elsewhere. This is highly important due to the previously mentioned importance of every part of the organization striving in the same direction (Engert and Baumgartner, 2016). Leadership also often has a large part in decision-making which makes it an important aspect of sustainable development.

The next dimension introduced by Engert and Baumgartner (2016) is management control, or the process of harvesting and controlling the results of the given project. This can be related to what Epstein and Roy (2001) means with monitoring the performance of projects including sustainability. It can also be a driver due to well performed measures and enable good and reliable feedback of the projects.

Lastly, an important driver is the people working at the company whom influence and can steer the company culture and strategy in certain directions (Engert and Baumgartner, 2016). They are also an important stakeholder to keep motivated and interested in the direction that the company takes and it is preferred to have well adapted ideas to steer the employees in the same direction as the company (Engert and Baumgartner, 2016). This drives sustainability in the way so that the implemented projects are performed in a more effective way.

To be able to cope with the implementation of sustainability projects communication is essential. As seen the process to drive an organisation towards new goals require several different parts of the project to strive in the right direction and the results may not be reached immediately (Engert and Baumgartner, 2016). The lack of direct results are often the hardest part to overcome when introducing these kinds of projects and this require well performed communication so that all instances know what comes next (Engert and Baumgartner, 2016).

The last decades have introduced tougher and more restrictive pressure on companies to comply and act towards creating a better environment and different business sectors have to work with separate goals and opportunities regarding their environmental strategies (Azzone and Bertelè, 1994). The traditional view of environmental problems consists of a more rational and simplistic idea. Problems were handled with in relation with them being regulated. This reactive approach still exists in a lot of companies but have been accompanied by a wider range of strategic stances that companies use (Azzone and Bertelé, 1994).

Azzone and Bertelè (1994) as well as Hunt and Auster (1990) have developed two similar frameworks including these strategic stances; both including five steps that companies are seen to use as approaches to environmental challenges. The current situation of environmental policies and actions make reactive strategies obsolete in many cases and these two frameworks highlight the situations and conditions where different strategies apply.

As stated earlier in this chapter, different situations tend to introduce different strategies which were a critical component of the work of Azzone and Bertelé (1994). This fact leads into the five categories shown in Table 4.

Table 4, Approaches to environmental challenges, (Azzone and Bertelé, 1994)

	Stable	Reactive	Anticipative	Proactive	Creative
Industry Norms	Does not exist or are stable	Does evolve by time but the time to adapt products take too long.	Evolves frequently but the time needed to implement new technology exceeds the time available	Discontinuous evolution	Discontinuous evolution
Public opinion					
Interest in environmental problems	Very low	Low	High	Very high	Very high
Sections interested in environmental issues	None	Workers & Green movements	Workers & Green movements	Consumers, Green movements, Workers	Consumers, Green movements, Workers
Technology					
Pace of innovation	Low	Low	High	High	Discontinuous
Kind of	-	Process	Process	Product	Process/product

Azzone and Bertelè (1994) argues that the transition from low consumer interest and public opinion into the categories that merge with being proactive and creative depend a lot on the current state of the product. If the product can bear the costs of the green technology, i.e. the consumer is ready to purchase the product despite a premium cost, the company or industry can also evolve its strategy to be more proactive (Azzone and Bertelé, 1994). In addition to this, a reactive approach to environmental problems can be impossible due to an increased rate of legislation. The time needed to adapt the business to new standards will exceed the time-limit of the introduction. If the company uses a reactive approach in a situation similar, they can end up in a situation where they cannot conduct business in an effective way thus legislation may force companies to be proactive (Azzone and Bertelé, 1994).

The proactive or reactive approach is also seen as a way to reduce risk through a managerial system. Hunt and Auster (1990) describes the characterisation of companies' environmental work as a five step ladder similar to the one seen in Table 4. In this case it is characterised as Beginners, Fire Fighters, Concerned Citizens, Pragmatists and Pro Activists whereas the stages explain the amount of protection each stage gives towards anticipating and avoiding environmental problems in the organization, ranging from No protection to Maximum protection (Hunt and Auster , 1990).

Stage one, Beginners, is described as smaller companies where environmental problems are considered a low priority and where the responsibility of environmental actions is delegated to managers or workers

inside the organisation. This means that there is a lack of strategy from the top level to perform action towards being more environmentally aware (Hunt and Auster, 1990).

Stage two, Firefighters, introduces a higher awareness in the company where the possibility of an assigned team towards these issues are higher (Hunt and Auster, 1990). This team is often used to deal with urgent situations and crisis regarding these issues, hence the name "firefighters". Since the stage describes companies typically using environmental strategies as a last resort and a way of dealing with sudden problems, the typical company would be small or medium sized organisations dealing with dangerous goods or sensitive procedures (Hunt and Auster, 1990). Yet they are not big enough to have introduced a deeply founded program to handle the sensitive natures of their business.

Stage three in the model of Hunt and Auster (1990), Concerned Citizens, is equal to the anticipative industry norms of table 4. In this scenario, the awareness of the environment has increased although the organisation may not have reached the same level or lacks the power to execute the strategies decided (Hunt and Auster, 1990). This means that there is a gap between what the management thinks and what is actually done. Although the most important aspect of this stage is that the mind-set of the organisation appearing in this stage is different and that the environment is looked upon as a problem that will grow and needs to be handled with (Hunt and Auster, 1990). Where media has increased the attention of environmental problems and has put the spotlight on companies, many exist in the position of concerned citizens as they have assigned departments towards having better strategies, but lack the actual power to conduct change to a full extent (Hunt and Auster, 1990).

Stage four of the ladder describes companies that are proactive in another extent than seen before, Pragmatists, due to their continuous work with environmental policies and issues (Hunt and Auster, 1990). The environmental problem is not seen as a suddenly occurring dilemma rather something they have worked with for a long time and are up to speed with. The procedures and strategies are well founded inside the walls of the company and work effortless (Hunt and Auster, 1990). This means that a lot of effort and money are put into these actions which may mean training, education and other efforts necessary to keep this profile. However, to reach this kind of stage, Hunt and Auster (1990) means that the nature of the business sector in most cases has to include very strict regulations and a strong influence by public opinion. This is why they describe a chemical company as the most evident example of a stage four company.

The last stage, the Proactivists, are characterised by a very strong environmental policy where the full extent of the company is influenced by an environmental image (Hunt and Auster, 1990). This image is linked inside all functions and divisions of the company creating shared goals and visions to be the top player regarding environment management strategies (Hunt and Auster, 1990).

The models developed by Hunt and Auster (1990) and Azzone and Bertelè (1994) both describe the foundations of environmental strategies and the importance of business sectors and actual regulations of the sector at hand. Reaching a proactive behaviour in a company includes a vast amount of parameters to be successful. Crant (2000) also stresses the importance of organisations today to reach a level of proactivity as a mean to not only extinguish fires or gain public image, but to reach a higher effectiveness in the organisation. Proactivity is a way of taking initiative to reach new and more effective and favourable situations. This is what drives evolution in a company that seeks opportunities to change and to impact its surroundings (Crant, 2000). As seen in the previous models, there are several degrees of how proactive a company is which is important when studying different patterns. Being proactive can be seen as a kind of problem solving skill of a company which means that it may be crucial to look

outside the common borders of the organisation to find solutions to the problems (Irvine and Kaplan, 2001). Irvine and Kaplan (2001) means that not only experience and knowledge affect the proactiveness and strategies of a company but rather their possibility to see new challenges and accept small experiments to reach new levels of solutions to problems that may not directly affect the organisation, but create a larger good.

2.3.4 Proactivity in the automotive industry

Azzone and Bertelè (1994) exemplifies their model (seen in Table 4) through the automotive industry. This is an industry characterised by products and manufacturing that have a large environmental impact which has driven both legislation, but also evolvement to be tougher and more rapid (Azzone and Bertelé, 1994). Since the mid-80s the public opinion on the automotive industry has been getting tougher and tougher and hence the manufacturers have been forced to meet new standards and expectations from their surroundings (Azzone and Bertelé, 1994). Both NO_X and Carbon emissions that are allowed have been radically lowered meaning constant new challenges in the product design and manufacturing process (Azzone and Bertelé, 1994). The speed of new regulations and standards hitting the automotive industry created a boom in new innovations and solution reaching the market such as: electric cars, alternative fuels and alternative manufacturing materials which all have helped the industry to reach and apply to the current standards (Azzone and Bertelé, 1994).

Today this legislative evolution continues and new goals and focuses are set in the industry. Bergek and Berggren (2014) describes it as a focus on global greenhouse emissions which has become actual in the transportation sector. In the case of the automotive industry, the public opinion and spotlight on the industry has created a very good evolution of both legislation and innovation which has created the situation we see today. The regulatory system that contributed to this was the reduction of tailpipe emissions required by the Clean Air Amendment Act (CAAA) that was passed in 1970. The reduction in emissions required by this act created a snowball effect and has been revised several times later to extend the pressure on the manufacturers to achieve lower emissions by their products (Bergek and Bergren, 2014). The manufacturers first responded by resisting the change and criticising it for no leading to improvements. Despite this it has directly lead to some of the ground-breaking innovations we see today in the industry (Bergek and Bergren, 2014). The example of how long term work with creating awareness and proactivity regarding environmental issues show that regulations and incentives are very important. Today the car industry drives much of its own innovation since the customer demand for these types of products is very high and a requirement for the manufacturer (Bergek and Berggren, 2014).

3. Methodology

Since strategies are often complicated and involves most aspects of operations in a business our chosen methodology needs to pick up data to a sufficient level to correctly address and characterize the nuances. Therefore, a more in-depth interview study has been chosen. Throughout the chapter the aim is to present the thematic analysis performed on transcription of each interview as well as justifications and ramifications of this choice. Additionally, sampling methods, information on the respondent's companies and philosophical assumptions will be presented.

3.1 Approach and design

An exploratory research is used when researching a topic or problem previously uncharted. Rather than testing an existing theory or hypothesis, the exploratory research approach designs a new one for future testing (Collis and Hussey, 2004). A typical way of conducting such research is through case interviews and usage of qualitative data which later is assessed in relation with existing data and theories. This study was aimed at investigating previously researched concepts in a new way and setting. The design was created so that the previously researched concepts where tested in relation to a larger scope. This required an open approach to gather data and to discuss the data.

3.2 Interviews and sampling

As primary data, interviews was performed with seven individuals who have an understanding and knowledge of the company strategy and how it might evolve. Further down is a breakdown of the segments which interviewed persons' companies belonged to and to what extent the respondent's company was operating in the SECA/NECA area. In some cases, the persons work for companies involved in more than one segment which will in such instances be noted. The individuals and companies participating will be kept anonymous to ensure that they can speak without constraint.

The interviews were performed in a semi-structured manner. While a structured approach is preferred to ensure that each interview is performed in a manner where they can be controlled and compared it is preferable to use semi-structured interviews when investigating concepts and ideas (Bryman and Bell, 2007). For qualitative research using to a structured interview could indeed lead to missing vital data or restricting the interviewee with negative results for the research. Due to the very different segments in our study this could lead to nuances and depth being lost since answers and new information would not be followed up on in a satisfactory manner. Therefore, our interviews will contain six main questions asked of each participant. To ensure accountability in the interviews, prepared follow-up questions was written out depending on the answers given. If it was necessary, the interviews went outside these prepared questions to thoroughly capture a point.

The sampling was out of necessity something close to convenience sampling. A convenience sample is by Bryman and Bell (2007) described as a sample chosen due to the accessibility to the researcher. There is a limited number of Swedish shipping companies which means the population is restricted. Most of these companies which was identified were contacted for interviews. Additionally, to perform our study we needed to interview personnel who had an understanding and knowledge of both current strategy of the company but also how it might evolve. The in-depth interview is also time-consuming. These factors meant that those who conformed to our needs and who were willing to be interviewed by us also was interviewed. It is understood that this must be taken into account when drawing our conclusions. It is

possible that those companies and individuals who chose to be interviewed also have a greater interest in the issue and therefore are skewing the result.

The following is a short presentation of the respondents' companies:

Table 5, Overview of respondents

Respondent	Segment	Main area of operations
1	Industry organization	Not applicable
2	Ro-pax and tankers	Mainly European for ro-pax and worldwide for tankers
3	Tankers	Mainly Europe
4	Ro-pax and tankers	Mainly European for ro-pax and worldwide for tankers
5	Ro-pax	SECA-area
6	Tankers and dry-bulk	European area
7	Ro-ro	Worldwide

The interviews were performed in Swedish. While performing the interviews in English would reduce the risk of us misinterpreting the information while translating it could also lead to the interviewees having a harder time expressing themselves and the strategy when discussing in a language that are not native to them. Translation was performed after the analysis. Translation will be necessary for quotes presented in the text as well as the codes and themes found in the analysis. For each interview a verbatim transcription was performed. Any part of the interview where words or meanings were not clear was marked as such.

A literature review was performed of secondary data. Partly this will cover the legislations affecting the area, environmental impact of shipping as well as the theories incorporated in the theoretical framework. The literature was found in several different ways, searching through databases such as SCOPUS with relevant keywords, searching relevant governmental organizations and international organizations as well as using publications referenced by those articles, reports and books we found. Due to the legislative focus of the report a high emphasis was put on reports published by national governments agencies, international organisations, such as IMO and classification agencies. Where applicable additional information was sought for from research articles.

3.3 Thematic analysis

For the thematic analysis, our analysis of the data will be based on the work of Braun and Clarke (2006). This method was chosen due to offering an easy to perform toolkit while also offering accountability and traceable operations. Its ease of use made it particularly suitable for this thesis. The steps to perform in a thematic analysis is outlined by Braun and Clarke (2006) and will be dealt with in more detail below.

3.3.1 Familiarising with your data

The first stage of a thematic analysis according to Braun and Clarke (2006) is to familiarize with the data. The data should preferable be read through multiple times to ensure familiarity. The reader should, however, go further than that and start the search for codes and patterns already at this stage. The codes and patterns should be written down in order to make later stages easier. For this thesis as has been mentioned the data used is the transcripts for the seven interviews performed. Therefore, the work with the analysis begun with reading through the transcripts and individually write down ideas for patterns and codes.

3.3.2 Generating initial codes

The second phase in a thematic analysis according to Braun and Clarke (2006) is the act of coding the data. It is important that the codes relate to and identify a feature of the data. Each code and which data are placed into it should convey a basic concept in the data that is meaningful. The codes were generated in a fashion that Collis & Hussey (2004) describe as open coding. It means that codes are broken down to conceptualize and categorize the data. In open coding the codes are set from the data rather than data being subjected to predetermined codes. Not using predetermined codes is a large difference between quantitative analysis and qualitative text analysis (Bryman and Bell, 2007).

In this thesis, the software suite Nvivo was used to simplify the process of coding and categorizing. While the software should not, in any harmful way, change the researcher's task when coding it should lessen the time usage due to making it comparatively easier.

Additionally, passages that were found to not be relevant to the research question or any of the sub-questions would not be coded in this stage. This was done in order to lighten up the time spent coding somewhat as well as making an overview of the important parts of the data easier through removing unwanted noise. For this thesis, a total of 112 codes were generated.

3.3.3 Searching for themes

According to Braun and Clarke (2006) when the codes were set, and checked to ensure the meaningfulness, these codes needed to be sorted into themes. These themes represented a common thread throughout parts of the data. If similar concepts were brought up throughout one or several interviews these should be categorized into a theme. Themes could also be brought together in two levels. In other words, if several themes connect to one larger idea these can be categorized as main and sub-themes. Collis & Hussey (2004) states that codes when looking for categories or themes should properties and concepts that are recognizable and similar should be considered when grouping codings. The language used to define these should also be clear and avoid terms and expressions that could cause confusion. This process could also be called Axial coding (Collin & Hussey, 2004).

In this phase each coding should be put into a theme. If any codes do not fit together with other codes, these should be put into a miscellaneous category. This ensures that those are saved going into the next phase. For this thesis, several themes were found both as main as well as sub themes.

3.3.4 Reviewing themes

When the themes were set for the first themes it was time to move to the fourth phase. All of the themes needed to be revisited and reviewed, in line with Braun and Clarke (2006), in order to ensure the integrity of each theme. This means that during this phase each theme needed to have internal consistency. If a theme lacked consistency it was split up or disappeared. Additionally, themes that had too little difference between them to make a usable distinction was merged. In this phase, it was important to re-check every theme, coding and text related so that they were in line and agreement was reached.

3.3.5 Defining and naming themes

The last phase of the analysis was defining and naming themes. According to Braun and Clarke (2006), this phase involves clearly labelling each main as well as sub theme that has been found. These names needs to clearly capsulate a main point that is clear across all codings. It should also make this point clearly understandable to the reader.

3.3.6 Usage of software to assist in analysis

The analysis was performed with help of the software solution Nvivo in order to more easily organize and visualize the data gathered. This, however, did not affect the result negatively since all codes still were manually added and checked by both authors. The software therefore mainly assisted in making the task easier by removing obstacles while not changing the outcome.

3.3.6 Critique of coding as a qualitative method

It should be noted that Bryman and Bell (2007) argues that while coding is a viable option it could also lead to some unwanted consequences. When chopping up the text in small passages related to a specific subject the context of the data could be lost. In this thesis, it has been the aim to counter that problem through the usage of quotes to contextualise the relevant themes and categories. It should be noted that those quotes should not be viewed as the justification for the result but rather a way to contextualise and visualise the data. Another issue confronting the usage of text analysis through coding is to handle the considerable amount of data generated (Collis & Hussey, 2004).

Regardless of these issues thematic analysis was deemed the most applicable method for this thesis due to the ability to illustrate complex themes which was necessary to generate valuable information.

3.4 Reliability, Validity and Generalizability

As part of a scientific study using a qualitative approach there will always be questions regarding reliability and validity. The choice of methodology, sampling and other decisions all affect both reliability and validity (Collis and Hussey, 2004)

Reliability ensures the credibility of the findings and relates to how accurate and precise the gathered data is. If the research were to be repeated, the same results should be found and expected. Ensuring that a research is reliable gives the conclusion and result credibility which also enables additional researcher to add to the research or repeat it (Collis and Hussey, 2004). In the case of doing qualitative research with an interpretivist approach, reliability is less important since the gathered results will stem from interviews with personal opinions and thoughts, however, it is still crucial to ensure that the data

gathering and reasoning can easily be understood and that the process can be repeated (Collis and Hussey, 2004).

To ensure that the data gathered in these interviews were reliable, a well thought through interview process had to be accomplished. Since semi-structured interviews were done with in a convenience sampling scenario, the questions and structure of the interview had to match the wanted outcome. To ensure this, the questions used were the same to all interviewees and follow up questions were planned beforehand.

Validity of a research is a term used to describe in what degree, the measured effect is what the researcher aims to research (Bryman and Bell, 2007). Neglecting concerns of validity in the design of research may lead to errors and bad procedures rendering data unusable and discardable (Collis and Hussey, 2004). When conducting an interview, it is important to ensure that the interviewee is the right person to answer these questions i.e. they have the knowledge required to aid the study (Collis and Hussey, 2004). In the design of the thesis a high validity was strived for through acquiring interviewees in desired positions at the actual companies such as: Environmental policy manager, Sustainability manager, Managing Director and so forth. Making sure that the interviews would produce the desired information before conducting them. The questionnaire was made with regards to the information level available at our chosen companies which also ensured the validity of the results.

Problems with validity could also arise from errors in implementation of the measure in the research (Bryman and Bell, 2007). For example, it is possible that the respondents in this thesis were less than forthcoming in their answers. Additionally, the questions asked could have been misinterpreted. To reduce these issues the transcripts of each respondent was sent if the respondents wanted to clarify any issues. A pilot interview was also performed to test the questions before respondents were interviewed.

Generalizability confirms the extent that the findings can be used to explain a phenomenon or pattern in the chosen field of study which helps the conclusion gain emphasis and depth (Collis and Hussey, 2004). To ensure that this is done, a broad sample and high amount of data is required (Collis and Hussey, 2004). Bryman and Bell (2017) also argues that even when random sampling is used the results cannot necessarily be generalised beyond the population the sample was taken in. This thesis makes no claim that the result is generalizable beyond Swedish shipping.

In the case of this report, an aim to interview as many companies in the Swedish shipping sector was set. Interviews were done with 6 companies which was a sample size big enough to ensure a confidence in the results since the sector is small.

3.5 Limitations

Limitations to this study is the possibility to include more participants in the interviews and that no quantitative data is used to describe the result. It is also important to recognize the convenience sampling done to gather the interviews and the possibility that not all answers gathered may be accurate. To be able to achieve a good result, however, it is assumed that all interviewees and companies speak the truth and that the companies follow directives and legislations that are active. It is impossible to test these claims in any reasonable way

4. Results

In the thematic analysis the top level of analysis is the structure of the framework which will be presented first. As these have been presented each one will be dealt with in more detail. For a more in depth view of the actions performed to achieve these results the section on methodology should be consulted.

4.1 Main framework of results

The results can mainly be divided in three main categories mainly: environmental strategies, practical implementation and critique of environmental legislation.

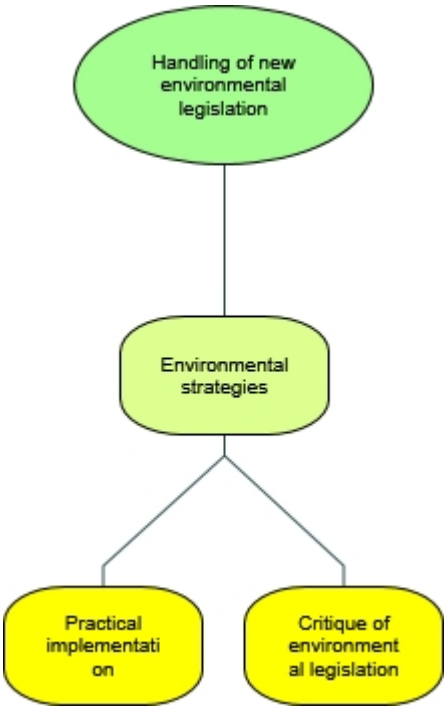

Figure 4, Main framework of results

These categories will not be dealt with only in separation but should be used to form a holistic view of the chosen strategies for Swedish shipping companies. Mainly this will be achieved through determining the internal consistency between the theoretical strategies and the practical implementation and the critique brought forward against current and future legislation. If this consistency is deemed to be low, it would put the result from the theoretical strategies into question. In other words, if the practical implementation of laws or the critique brought forward do not match the theoretical strategies communicated it is questionable how much those will be acted upon in the future.

4.2 Environmental strategies

For each company there were several ways in which they attempted to handle environmental legislation found in the data. In abstraction these can be categorized in the following three categories: *reactive strategy, proactive strategy* and the ambition to *affect legislation* as seen in Figure 5:

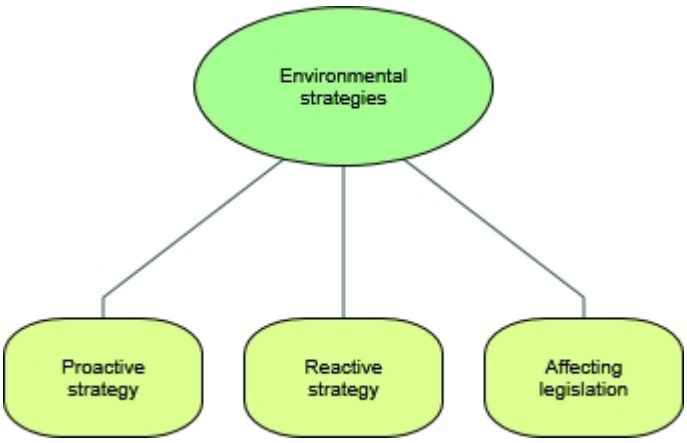

Figure 5, Environmental strategies.

This should not be interpreted that each company exclusively belongs to one of these categories. Each company likely exists on a scale between a proactive strategy and a reactive strategy for each regulatory issue. Each company in the thesis had codes performed corresponding to a proactive strategy as well as a reactive strategy which indicates that they find both drivers and barriers to a more proactive strategy. A company could for example be rather proactive regarding CO_2 emissions but reactive regarding ballast water treatment. Likewise affecting legislation could be a strategy present in companies aligned more towards both a proactive as well as a reactive strategy. Their emphasis and what they would like to affect could differ though. These categories should therefore not be viewed as mutually exclusive but rather that most companies in the study operate with a mixture of these elements. Lastly a reactive strategy is mostly shown through the lack of a proactive strategy. For this thesis it will be assumed that each company at least follow the laws set forth by the relevant authorities. Therefore, for each area where there is no indication of a proactive strategy it should be viewed that a reactive strategy is chosen.

4.2.1 Drivers of a proactive strategy

It is somewhat difficult to categorize everything clearly as a proactive strategy or not. For example, a vessel built for operating on LNG in an ECA should probably be viewed as part of a more proactive strategy before the introduction of NECA compared to after. The difference in cost of operating a ship on HFO to LNG is far larger than the difference between a ship operating on MGO with a SCR compared to LNG. Equally the strategy could be proactive in an economic sense rather than an environmental sense if the company expects the price of MGO to go up but the price of LNG to stay flat.

A number of categories including drivers towards a proactive strategy were found that are presented in Figure 6.

Figure 6, Proactive strategy

There are clear indications that the respondents consider fuel efficiency to be good business and therefore worth doing regardless of other strategy. One respondent argued that *"it becomes a win-win since we save money and make investments that pay back in a couple of years"* (Respondent 3).

Five out of seven respondents also argued that the pace and scope of legislation have to some degree incentivised the shipping companies to be more active or change their way of working with the issue. Respondent 3 said that what has changed after environmental legislation was passed is the focus and concern shipping companies view environmental aspects with: *"I'm a member of sweship that is an industry organization which I joined very early. Earlier there was not a lot of discussion on environment but nowadays there is a lot. Both so that we can show that we are a good transport system from an environmental point but also what we are not good at. The discussion on environmental issues has increased greatly"* (Respondent 3).

There were also some indications that customer was to some degree pushing for a proactive strategy but that it was limited. For example, respondent 6 said that: *"It would have been nice if the customers were more concerned with environmental concerns when choosing than they are"* but also that *"some customers, especially the Swedish tanker market is far ahead in my opinion. They want LNG etc."*.

Three of the respondents also mentioned pressure from the organization, both employees as well as owners and top management as a reason to adapt a more proactive strategy. Respondent 7 said that a large reason for their environmental work was because *"we have an owner who is immensely interested in environmental issues. The owner family to [shipping company] is dedicated to environmental issues and have made large investments and put large focus on it. Something that has been done since the mid 90's"* (Respondent 7).

It was also argued that the private ownership made it easier to perform large projects when other values than shareholders could be put into it: *"There are large benefits to being a privately owned corporation and not have to account to each quarter. It means that you can be more farsighted and interested in how the future looks"* (Respondent 2).

Four of the respondents also made statements to the effect of the life span of a vessel requires the decision to be completely right. Respondent 1 argued that: *"I know that when many make their investments it is 15, 20 or 40 years depending on what kind of vessel it is. Those are gigantic and long investments. What is being ordered now need to last for many, many years. So the decision has to be*

right." (Respondent 1). Respondent 2 also argued that LNG was not a wise decision since *"LNG is more of a quick fix. It gets results quickly in less emissions but it is still a fossil fuel. And shipping is a long-term business. Then [at the end of the life span for the ship] it is 2050"* (Respondent 2).

Lastly one respondent argued that a good track record with environmental issues helped in reaching out to legislators: *"For me to have a good case in IMO and in Brussels we must show that we are willing to do what we say. You cannot go into IMO and be an environmental crook. We need to be a good shipping company"* (Respondent 2).

It should be noted however, that differences can exist in possibilities and barriers between different segments in shipping. For example, respondent 7 said that: *"we are in a segment of shipping where our customers perhaps are more dependent on environmental issues… it is something of a high-end segment and we do not have the same challenges as dry or liquid bulk on that front"* (interview with respondent 7). Respondent 2 also argued that different segments had different possibilities: *"In tanker business you can almost look up your rates in tables because they are so dependent. Therefore, running different fuels do not pay for itself. But on the ferries, we have all the costs our self and therefore it is easier*" (interview with respondent 2).

Below is a breakdown of each category as well as the coding each contains:

Table 6, Coding; Proactive strategy)

Category	Coding	Respondents mentioning
Pressure from own organization	Pressure from owner and employees to be better	2
	Private ownership makes it easier to perform large projects	4 & 7
	Ambitions of the owner drives environmental policy	7
Proactive strategy due to customer demand	Some customers ready to take responsibility	1, 6
	Environmental concerns can be self-preservation	2
	Long contract can include more detailed specifications	2,3 & 6
	Can handle future developments better if the company have already made changes	6 & 7
	Using sustainability in marketing	2,4 & 5
	Consumers are becoming better at taking responsibility for the environment	6
Easier to speak with legislators with good track record	Easier to speak with legislators with good track record	2
Fuel efficiency is good business	Fuel efficiency is good for the environment and good for business	2,3,4 & 7
	All shipping companies want to be fuel efficient	2
Long investments require forward planning	Non-fossil fuels are the future	2, 7
	The life span of a vessel requires the right decision	1, 2, 3,
Legislation is incentivising companies to become active	Became more active due to new legislation	1, 2, 4 & 5
	Changed way we work due to legislation	7
	Working proactively to avoid future legislation	2

4.2.2 Instances of proactive strategies

In table 6 the measures and investments that each respondent brought up as instances of a proactive strategy is presented.

Table 7, Instances of proactive strategy

Respondent	Instances of proactive strategies
1	Person from business organization and therefore not applicable
2	- Developing and testing methanol as marine fuel in pilot project higher targets for release of foreign subjects into the water - For example, no release of greywater from ferries in Scandinavia - Working towards no plastics on ferries - Reducing vapour emissions from tankers - Investing and development of technology for battery propulsion
3	- Slow steaming - Fuel reducing measures - Fuel optimizing system adjusting RPM with propeller pitch - Lessening tank flushing - Future ships will be LNG
4	- Developing and testing methanol as marine fuel in pilot project - Investing and development of technology for battery propulsion - Fuel reducing measures such as gauging telling fuel consumption very accurately - Fuel reducing goals each year
5	- Steady decline in fuel used per nautical mile year by year - LNG ship - No release of greywater or blackwater overboard
6	- Several LNG ships and new in order - Fuel reducing measures both in design and operation
7	- Operations on MDO for a period before SECA legislation - A maximum average of 1.5% sulphur content in fuel over a year - Two LNG vessels on Europe trade - Performance monitoring system used for fuel efficiency and data for designing more fuel-efficient ships in future - Developing and using ballast water cleaning systems

Three out of five companies have invested in LNG to varying degrees with another company expecting to build LNG ships for the future ships. In other words, only one of the companies interviewed had considered LNG but deemed it too expensive. The same company, however, invested in and tested methanol for usage as a marine fuel which in line with LNG will emit less sulphur and NO_X compared to HFO and MDO/MGO. According to respondent 2 it could also potentially be fossil free in the future.

There was some scepticism towards abatement technologies such as scrubbers and only one of the companies were investing in such technology. The company of respondent 2 and 4 were currently using and investing in more scrubbers in anticipation of future stricter global legislation on sulphur emissions.

In addition to alternative fuels and abatement technologies all respondents' companies were working with fuel efficiency either through operational or technological measures. Examples of operational measures are slow steaming while examples of technical measures are optimization of RPM and propeller pitch as well as performance monitoring systems. Respondent 7's company also had a system in place for collecting of data that would lead to being able to design more energy efficient ships at different draughts and speeds.

Additionally, the two ferry operators had stricter internal handling of discharging greywater or blackwater overboard than any legislation requires.

4.2.3 Reactive Strategy

The barriers for a proactive strategy could also be categorized as drivers for a reactive strategy. As such those problems that were brought up which hinders the development of a more proactive strategy will be categorized here. Figure 7 presents the cases that were found regarding the theme reactive strategy.

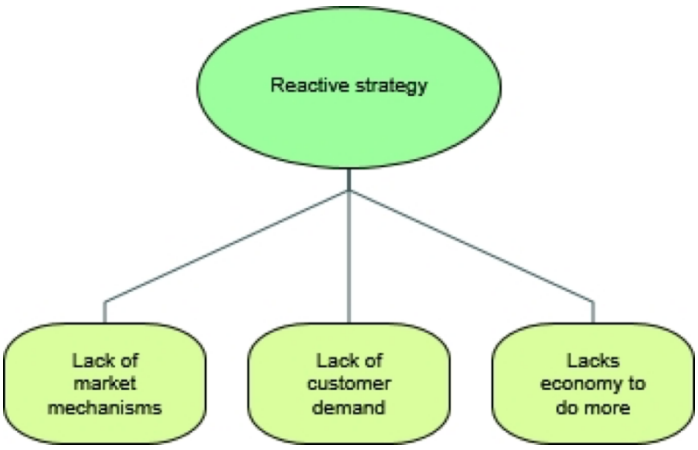

Figure 7, Reactive strategy

Regarding the drivers of a reactive strategy there was a clear consensus that there was a lack of customer demand and additionally that the customer demand was growing slow or not at all. Respondent 2 said that it was likely that consumer demand would grow in the future but that the progress is very slow: *"Of course the answer is yes in the long term but it is progressing very slowly. We have close to no customers today that asks for our environmental performance at all, unfortunately. We make sustainability reports and everything. We are good and we want people to notice. But to be totally honest it is not customer driven"* (Respondent 2).

Four out of seven respondents also found that there was a lack of market mechanisms to properly price in external effects. In some cases, there was even a view that the market mechanisms were supporting the very opposite such as spot market pricing where it was the respondent's view that more fuel-efficient ships not being economically weighted correctly in the buying process. Respondent 6 argued that external costs needed to be internalised: *"For example our LNG-vessels. They have external costs that*

no one is paying for so they end up as someone's else tax somewhere in the form of hospital costs due to sickness for example. But if you look at the LNG-vessels it is roughly 1.5 million euro per year that you save compared to using another fuel [in external costs]. And if that cost had been a factor when in competition with other vessels we would have had a much better situation and then environment improvement would see more investments." (Respondent 5).

Respondent 1 argued that even when investments were made in installations of abatement technology it was not always used on the spot market due to increased costs: *"On the spot market it absolutely does not work. Absolutely not. It is only, only price. Nothing else. And the example we usually use is that we have a couple of catalysts that are installed on several vessels that received a large investment support by the Norwegian NO_X fund. The catalysts are up to 70-80% paid for by the fund. When the vessels in question was in charter along the Norwegian coast, the catalysts were in use, but since they left the charter and entered the spot market all of them have been turned off"* (Respondent 1).

Lastly there was also a sentiment that while each respondent would like the company to do more there were no economy in doing so. Respondent 7 said that: *"we are all slaves under the economy and presently it is not like it is raining money over us. It is tough market right now which limits our ability to act undoubtedly. So of course, we would like to do more but it has to be done in balance with the economic conditions"* (Respondent 7).

Following is a breakdown of each category, its corresponding coding and in which interviews these codings were present.

Table 8, Coding; Reactive strategy

Category	Coding	Respondents mentioning
Lack of market mechanisms	More fuel-efficient vessels do not give more spot contracts	1, 2
	Low oil price hinders development of alternative fuels	2
	Cannot run ahead of competitors	2,3 & 4
	External costs must be internalised	6
Lack of customer demand	No customers ask for sustainable practices	2,3 & 4
	The development of customer demand is slow or non-existent	2, 4 & 7
	End customer not affected	6 & 7
	Customer asks for sustainable measures but are not ready to pay	6
Lacks economy to do more	Alternative fuels more expensive	2 & 4
	Not enough money	7

4.2.4 Affecting legislators

For effecting legislators there were two categories. Below is a breakdown of these categories as well as the coding belonging to each.

It is important to notice that not all respondents were talking about affecting legislators for either less nor more legislation. Neither was there a clear trend regarding wanting more thorough or more lenient regulation.

There was, however, a consensus that organizing in a business organization could help them in daily work and reaching the right person to articulate their frustrations. There were also 3 shipping companies that more directly mentioned an effort to affect legislators. Respondent 7 argued that it was essential to affect legislators so that the legislation was aimed at the right effort. While criticising EEDI he argued that: -*" ...Partly we have tried to affect legislation to suit us. But sometimes you should differ between, and that's where I think many get it wrong, you should differ between the purpose of the legislation and what it does. If the purpose of the legislation is to lessen the energy consumption, there are many other ways to do that. Now the purpose of this became to have a legislation that mentions energy efficiency at all."*

Respondent 5 argued that the Swedish shipowners association (Sweship) is very active in the debate: *"our shipowners association and Swedish shipping is very active and they speak for us. They are represented in London in IMO and other places rather often"* (Respondent 5).

Table 9, Coding; Affecting legislators

Category	Coding	Respondents mentioning
Cooperation between shipping companies help in affecting legislation	Cooperation is more important for small companies	2 & 6
	Cooperation between shipping companies is a benefit	5
	Working through industry organizations helps in environmental work and lobbying	4, 6 & 7
Affecting legislator	Having a dialogue with legislators is important	2
	Affecting legislators to form the best legislation for the environment	7

4.3 Practical implementation

In the implementation of solutions regarding legislation four themes were apparent. Implementation was mainly done through abatement technologies or alternative fuels. Hedging risks were also a present strategy were not one dominant strategy was used since it could lead to overreliance. There was also a category of operative solution to solve some of the issues dealt with in the legislation.

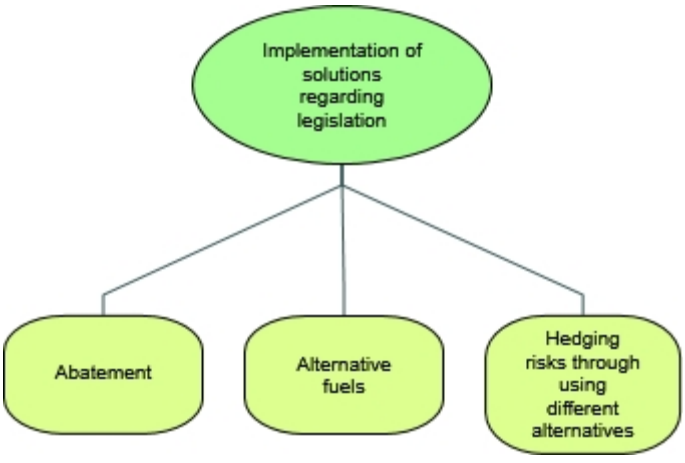

Figure 8, Practical implementation

Each of the ways that the shipping companies that the respondents represented will be laid out in more detail in the following sub-chapters.

4.3.1 Abatement

The following categories were found concerning abatement technologies.

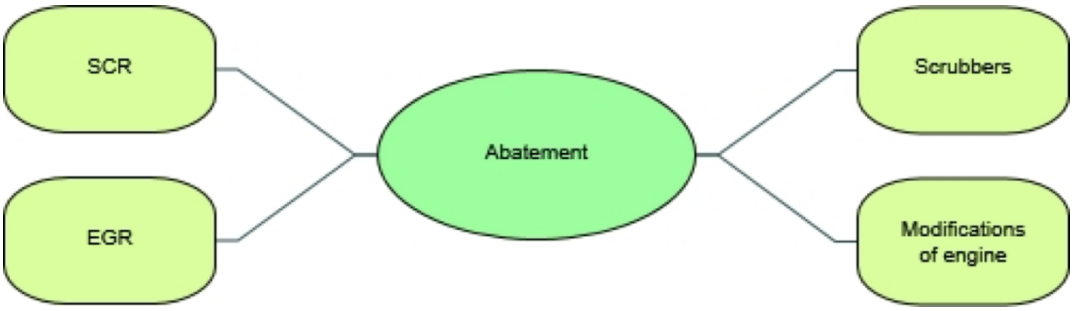

Figure 9, Abatement technologies

The figure above is based on the following themes and categories that were found regarding usage of abatement technologies during the interviews. Four abatement methods were discussed as potential

The coding performed showed that only one of the shipping companies had a generally positive view of scrubbers. Even respondent two argued that there were problems concerning operating scrubbers together with SCRs: *"So when we make new-builds now, we think it is really hard to combine scrubbers and SCRs. Every engine manufacturer says that there are no problems but there is"* (Respondent 2).

One of the respondents also considered that there were economic reasons not to use scrubbers: *"The first time we considered scrubbers there was a spread of 600 dollars per ton between MG and HFO and then the payback is quite quick on a scrubber as well. But right now, it takes too long to get a return so we are not considering it"* (Respondent 6).

One of the respondents also argued that it was possible that scrubbers would be prohibited in certain areas in the future. Respondent 7 argued the main problems with scrubbers was that it did not remove the source of the problem: *"we should attack the source of the problem and not clean up afterwards. The source of the problem concerning SECA is the sulphur in the fuel. An upstream solution to that is to choose a fuel with less sulphur. To install a scrubber, we think is a bad idea. From an environmental perspective it is not a good solution"* (Respondent 7).

EGR was considered an option for one of the respondents (7) which also had used modifications of the engines to create better NO_X performance. While respondent 7 did admit that there were some difficulties of reaching Tier 3 levels of NO_X emissions the respondent believed it could be possible: *"For new ships we have a rather clear picture of what we think the solution is and just like with scrubbers a catalyst is something of a cleaning machine and does not solve the source of the problem. There are some doubts as how far down an EGR can reduce NO_X emissions. But there are indications that Tier 3 levels should be possible with an EGR. So, that is what we think is the solution for the future"* (Respondent 7).

Below is a breakdown of the categories and codes and in which interviews these were present regarding abatement technology.

Table 10, Coding; Abatement technologies

Abatement technology	Code	Respondents mentioning
SCR	SCR does not remove cause of problem	7
	SCR and Scrubbers are hard to run together	2 & 4
EGR	EGR should be able to handle Tier 3 levels	7
Scrubbers	Harder for bulk boats	2
	Scrubbers does not remove cause of problem	7
	Potential that scrubbers will be prohibited	5
	Global prohibition on sulphur in fuel could lead to cheap fuel for vessels with scrubbers	2 & 4
	Scrubbers too big for some ships	3
	Scrubbers not a better technology	5 & 6
	Will not retrofit vessels mainly operating outside ECAs	4
	The payoff time for scrubbers became too long when oil prices decreased	6
Modifications of engine	Modifications of engine can reach Tier 2 levels	7

During interviews each respondent was also asked what abatement technologies the companies they represented had used in reaching compliance. Following is a breakdown of their answers.

Table 11, Examples of abatement technologies

Respondent	Abatement used or considered
1	Industry organization person and therefore not applicable
2	- Scrubbers - SCR used on ships due to differentiated fairway dues - Considering how to solve NECA and making space for abatement technology - Building and planning with ships with room for instalment of SCR and scrubber later
3	- No use of abatement technologies
4	- Increasing scrubbers in SECA area - Potentially increasing usage of Scrubbers after introduction of 0.5 % limit on sulphur in marine fuel - Engine manufacturers will solve NECA - Building and planning with ships with room for instalment of SCR and Scrubber later
5	- No abatement technologies - Planning to cope with NECA regulation through usage of LNG - Considered that if fuel prices became to punitive scrubbers could be a possibility.
6	- No abatement technologies - Building LNG-vessels - 5 of 7 ships in order is LNG
7	- Older ships: Engine modification such as water injection into valve reaching Tier 2 - Plan for NECA: EGR

The result from the interviews performed show that the respondents' companies were by and large sceptical of Scrubbers for various reasons while respondent 5 also acknowledging that a too large gap in fuel prices could lead to instalment of scrubbers even though it was considered a suboptimal solution. Only one of the companies considered Scrubbers a viable option. Part of the reason mentioned was that as oil prices sank the break-even point for a scrubber moved further into the distance making an installation harder to justify. An increase in the difference in price between HFO and the other fuels could therefore make the scrubber a far more lucrative option. Regardless several of the shipping companies had a view that scrubbers had operational and environmental deficiencies and therefore did not provide an appealing proposition. For example, respondent 5 said that *"There are not that many scrubber installations in the world that actually works fully. Scrubbers is actually also just washing the exhaust fumes with sea water and if using open loop, you discharge the pollutants in the water instead of in the air" (Respondent 5)*

Additionally, several of the companies had no comprehensive formulated strategy concerning NECA. For shipping companies with no ships planned which will be affected by the legislation that is understandable. While several companies were installing LNG on some new ships this was necessarily not affecting all their future new builds. Respondent 2 and 4 said that the company was making room in the ships for both scrubbers and SCRs and how the prices developed would influence their choice later.

The most common solution to SECA for four of the respondents for older ships has been replacing HFO with MGO or low sulphur HFO.

4.3.2 Alternative fuels

Alternative fuels will firstly be considered as all fuels that are not HFO which have for a long time been the industry standard. In the future this could likely change due to environmental legislation taking effect. Beyond that it should be mentioned that MGO and MDO are both distillates that have does not offer better environmental performance compared to HFO in other areas than sulphur emissions. Neither emissions of NO_X, CO_2 or particles are expected to be reduced when switching to MGO. Additionally, most of the usage documented was a response to legislation on sulphur except respondent 7's company that had run operations on MGO years before the legislation but had found it too expensive to continue. Therefore, while both are technically an alternative fuel compared to HFO it cannot be viewed as a part of a proactive strategy, with exception to the brief attempt by respondent 7's company. Those considerations also hold true for low sulphur HFO.

Since MGO, MDO and low sulphur HFO mainly is a response to sulphur emissions these will be treated as a single entity. While it is likely that factors such as price, viscosity and usability in a marine context could vary, these considerations bear little to no impact on this thesis and is therefore not considered.

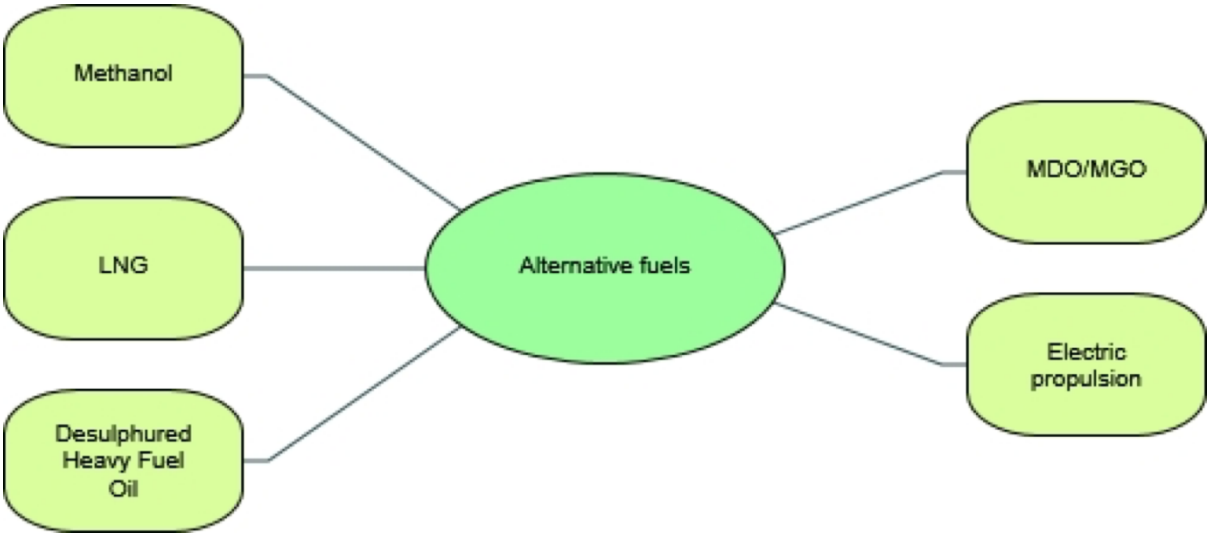

Figure 10, Alternative fuels

Alternative fuels were by the respondents one of the most common ways of handling environmental legislation. The five alternative fuels mentioned during the interviews were: *Methanol, LNG, Low Sulphur HFO, MDO/MGO and Electric propulsion (Figure 10).*

Following is a breakdown of what alternative fuels each company was interested in or using.

Table 12, Alternative fuels

Respondent	Alternative fuels used or considered
1	Industry person
2	- Methanol in pilot project - Low sulphur heavy fuel Oil in SECA - Interested in electric propulsion - No interest in LNG
3	- Low sulphur heavy fuel oil in SECA - LNG in future projects
4	- Methanol in pilot project - Interested in electric propulsion - Low sulphur heavy fuel Oil in SECA
5	- One ship with LNG - Low sulphur heavy fuel oil in SECA - LNG for future ships - Interested in methanol
6	- LNG and MGO for SECA - A majority of new ships in order right now is LNG
7	- LNG in two ships operating mainly in European waters - mainly MGO in SECA - Interested in methanol

These five fuels differ greatly in price, output of pollutants, which pollutants are present in exhausts, cost of instalment and present infrastructure. Therefore, the choice of which fuel to use in a ship could be categorized both as an economic strategy as well as an environmental strategy. The aim of this thesis is neither to perform a life cycle analysis of these fuels or measure their impact on the environment. The scope is far too small. Additionally, it has been done previously. Therefore, no rating of these fuels will be performed. Nevertheless, there is important information to gain knowing rationales behind the decisions for these choices.

Among the respondents, low sulphur HFO or MGO is clearly the most common way to deal with SECA regulation with all shipping companies using it to some degree. As has been mentioned earlier LNG was also a clear option with three out of five companies operating at least 1 LNG ship and an additional company considering building LNG ships in the future. The last company instead focused on Methanol as a fuel and was testing and developing this technology. Two of the other respondents were clearly interested in the development of methanol as well.

Lastly the company of respondent 2 and 4 were investing in testing electric propulsion and viewed this as a potential future fuel. While there are electric ferries indicating that the technology is viable it is not yet used extensively commercially. Therefore, it is not in the focus of this thesis. Regardless it is an interesting technology.

4.3.3 LNG

LNG was a part of most of the respondent's company's strategies at least to some degree. During the interviews it was clear that many of the companies had many thoughts regarding LNG and its usage and it was therefore deemed appropriate to dive slightly deeper into this issue.

For many of the shipping companies there were both advantages and disadvantages to the usage of LNG in marine environments. What was clear, however, was that the economy of LNG and the operational aspects was clearly dependent on which type of vessel, the size of the vessel, area of operation and whether the ship was new or old. The categories found regarding LNG is presented in figure 11.

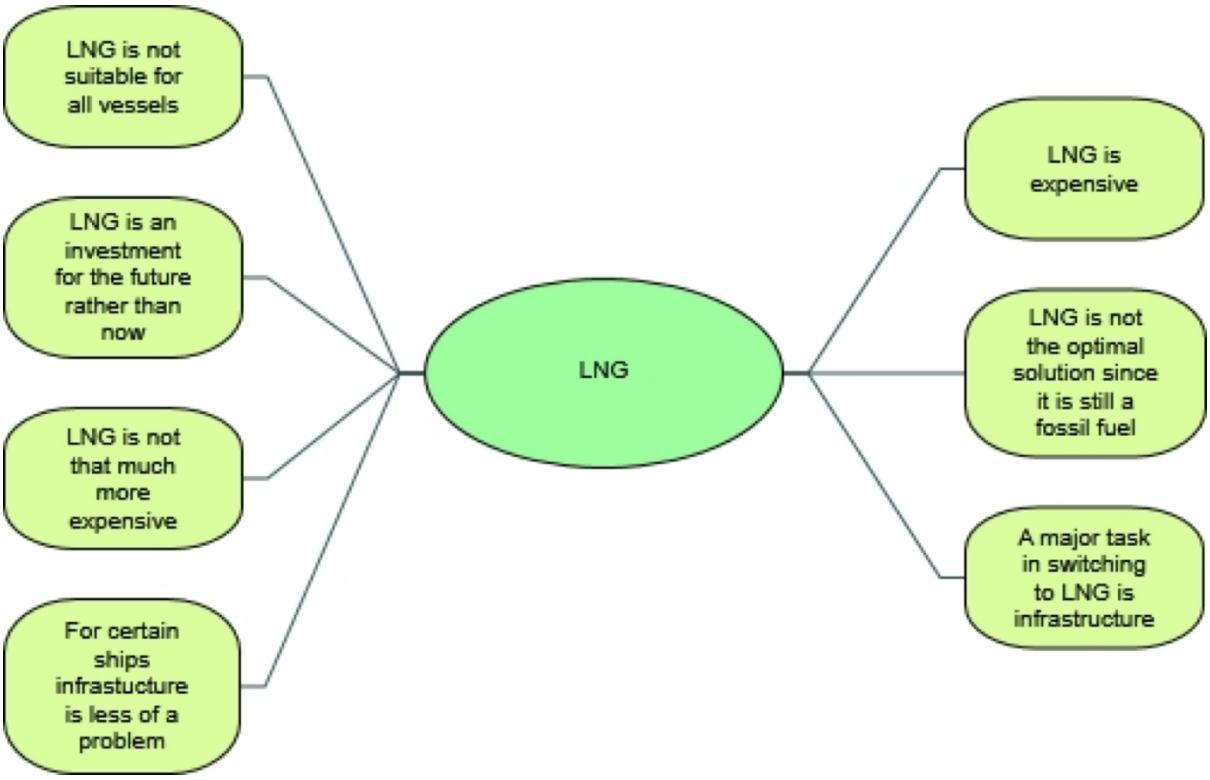

Figure 11, LNG

The figure above is based on the following themes and categories that were found regarding usage of LNG as a marine fuel during the interviews.

LNG was, as described earlier, the most popular alternative fuel except MGO/MDO. There were, however, also several misgivings about LNG as future fuel. One was centred around the price of LNG partly in installation and partly in handling. Respondent two argued that the expensive handling would offset any potential benefit from a low price on raw material: *"Small scale LNG handling is the most expensive thing you can do. To drive around with small bunker barges with LNG, -163 degrees and all that. It is crazy expensive. So even if the gas is cheap the handling is really expensive"* (Respondent two).

LNG was also considered an investment which could pay off later rather than sooner. Respondent 6 argued that the cost of LNG would be recuperated: *"The costs of building LNG ships is several millions extra [compared to convential ships]. We think that investment is good for the environment, but also that it is the economically sound thing to do"* (Respondent 6). Respondent 6 also argued that the

calculation could improve when the global sulphur cap is implemented: *"We do not know what happens to the MGO price then. So maybe the calculations for LNG becomes even better"* (Respondent 6).

Additionally, infrastructure was mentioned as a problem with both respondent 2, 3 and 5 arguing that it was still a problem to be solved. Respondent five also argued that passenger shipping was not dependent on such infrastructure and was therefore not concerned. Additionally, respondent 3 argued that while infrastructure might be a problem now it would solve itself when more shipping companies invested in LNG vessels.

There was however a broad consensus with five of seven respondent bringing up cases where all ships were not suitable for LNG. 3 respondents considered it too expensive to retrofit LNG in old ships while respondent 6 considered it too expensive for small vessels arguing that: *"If it is small vessels, like our dry bulkers then they are too small for the LNG investment to be perfect. Partly because of the small dimensions since LNG equipment is large but also because it weighs a lot" (Respondent 6)*

Table 12 contains a breakdown of the categories, codes and which interviews these were present.

Table 13, Coding: LNG

Categories	Codes	Respondents mentioning
LNG is not suitable for all vessels	LNG is too expensive to retrofit in old ships	3,4 & 5
	LNG is too expensive in small vessels	6
	Availability of LNG in all parts of the world a problem for ocean going vessels	7
LNG is an investment for the future	LNG could be a more rational decision if MGO prices increases	6
	LNG a good investment over the whole lifespan of the vessel	3
LNG is not that much more expensive	LNG is not that much more expensive	3
For certain ships infrastructure is less of a problem	Smaller vessels can be served by semi-trailers available everywhere	6
	Passenger ships are not dependent on bunkering infrastructure	5
Infrastructure is a major task in switching to LNG	Money is being invested into LNG infrastructure	6
	LNG requires new infrastructure	2,3 & 5
	Infrastructure will be built when more ships are being built	3
LNG is expensive	LNG comes with expensive handling	2
	Costlier to build LNG ships	6

4.4 Critique of environmental legislation

During the interviews many of the respondents were critical to some of the legislation having been passed and that will be passed. Which legislation were critiqued, however, differed between the respondent while some main themes did emerge. Following is a breakdown of the categories found in the analysis.

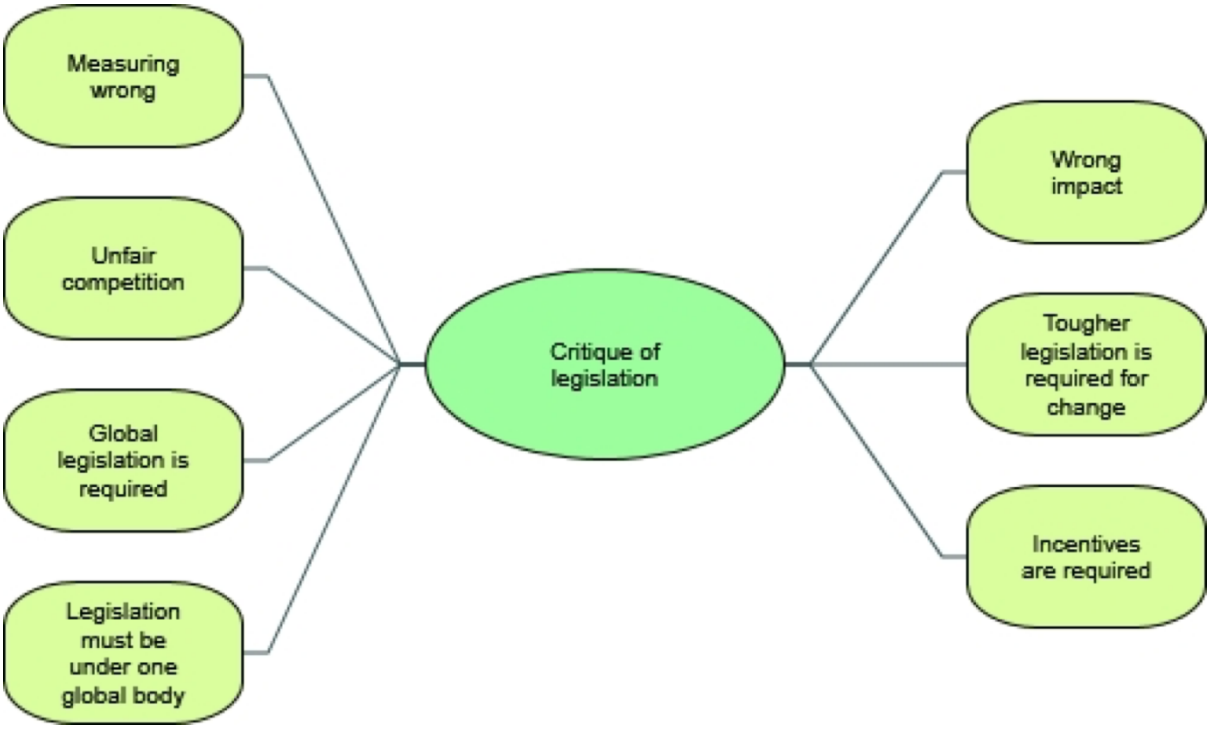

Figure 12, Critique of legislation

The clearest result in terms of uniformity of view is that all respondents considered global legislation the way to go forward. Regional legislation was by several respondents argued to lead to unfair competition, high costs for industries in their customer's countries and have weird effects on the market of buying and selling ships. Respondent 2 argued, however, that regional rules such as SECA and NECA could be good for shipowners operating solely in these areas as it would create barriers of entry that could be hard to overcome for other shipowners.

Several of the respondents also called for tougher legislation in certain areas such as a fuel levy or that fuel producers should pay a penalty. 3 of the respondents considered a global fuel levy (or something similar) a way to achieve progress. For example, respondent 3 argued that a penalty on bunker would be a good way to produce results: *"There is legislation on way that will apply a penalty on bunker as well. I'm positive towards similar legislation since it will drive environmental work forward."*

Respondent 2 argued that *"rules of market economy should be used. And then it is a levy really. It should be expensive to use more fuel than is necessary" ... "Sometimes it could be effective to speed fast to another place because you win something else"* (Respondent 2). This view was shared by respondent 7: *"I think the best way to solve the CO_2 issue is to use economic incentives. Put fee for CO_2 in place. Simply make the fuel more expensive, that is a solution. Make it really expensive to use, then everyone will consider other solutions"* (Respondent 7).

Respondent 3 also considered tougher legislation necessary in order to progress since there is no customer demand: *"Our customer do not ask for this at all which is rather weird. They are not interested in what emissions we have and asks nothing about our ballast. Nothing of what we have been talking about. So really legislation is necessary if we want to progress"* (Respondent 3).

Four of the respondents also felt that some legislation was measuring wrong especially with regards to EEDI. Respondent 7 put it in the following way: *"EEDI is an incredibly failed legislation. It is diluted to a point to make it politically viable. I don't think it will have much of an impact and the industry have been given to much power to affect it and choose how the systems will look. It creates unfair competition between different segments in shipping since there are different demands between a container vessel and a car carrier even though they can carry practically the same cargo" (Respondent 7).*

There were also among many of the respondents a clear consensus that incentives were an important and necessary step to drive change. Incentives could come in the form of differentiated fairway dues but also through measures aimed at increasing investment in technology such as the Norwegian NO_X fund.

Three of the respondent argued cases where they felt that the legislation lead to unfair competition. For example, respondent 6 argued that NECA could lead to less investments in new ships in the region and therefore punishing companies seeking a young fleet: "*Is the date of laying the keel really the best way to decide [who needs to comply]. It leads to our NECA area becoming an area for old ships if something else is not done as well because old ships will have a greater advantage"* (Respondent 6).

Respondent 1 and 2 both argued that regional rules would lead to unfair competition. Respondent 2 mentioned NECA as a good example of this: *"what we do not like with the NECA-legislation is that it is one more local legislation that affects us up here. So, if we want to bring one of our ships that have been on the Irish sea we now need to put a catalyst onto that vessel because otherwise we cannot do that [move the ship]. And that costs a lot of money. And reversed as well. If we build a ship for the Baltic sea and then want to sell it to the Mediterranean we will never get paid for that catalyst since it is not needed there. And therefore, we do not like it"* (Respondent 2).

Table 13 contains a breakdown of the categories, codes and which interviews these were present in.

Table 14, Coding: Critique of legislation

Categories	Codes	Respondents mentioning
Measuring wrong	EEDI is a good concept but not perfect technically	1
	EEDI measures the wrong thing	2 & 7
	EEDI tries to understand the reality but fails	6
	Legislators only concentrates on design	2
Unfair competition	SECA could increase the costs for Swedish industry significantly	6
	Regional rules make the market of buying and selling ships function poorly	1 & 2
	Regional rules leads to unfair competition	1 & 2
	Regional rules can be good for shipowners only operating in these areas	2
	Modal backlash is a danger	6
	Legislation affecting only new ships could lead to reduced investments in new ships	6
	Legislation that affect old ships could lead to scrapping	6
	EEDI leads to unfair competition	7
Legislation must be under one global body	Legislation with only regional impact is not a problem if the decision was taken at a global level	7
Wrong impact from legislation	EEDI does not provide a positive impact	2
	Ballast water management allows transportation from different oceans while regulate some from the same	6
	Aim should be to lower CO_2 not mention energy efficiency	7
Tougher legislation required for change	Legislation on existing ships could be needed for rapid change	7
	Penalty on bunker is good	3
	Regional legislation can drive progress	7
	Tougher legislation is good if it is uniform across the world	3

	Existing ships should be affected by NECA	7
	Fuel producers should pay a penalty	7
	Legislation should take care of the early movers	1
	Aim should be to lower CO_2 not mention energy efficiency	7
	Legislation is needed for change due to lack of customer demand	3
	A global fuel levy is better for the industry	1,2 & 7
	HFO should be forbidden	7
	Global cap on sulphur content to 0.5 % is good	3 & 6
	Making the fuel more expensive is required	7
Incentives are required	Incentives are required since there are no customer demands	2
	Incentives are required	1
	Differentiated fairway dues have been effective	2,3 & 4

5. Discussion

This chapter aims to connect the empirical findings from the previous chapter with the framework developed in chapter 2. This to elaborate and create a basis for the conclusions and answers to the research questions at hand.

The theoretical framework did not pose strategy as existing in binary states of proactive or reactive (Azzone and Bertelé, 1994). Rather there is a continuum where each position contains it own set of opportunities and limitations. Additionally, this continuum could also be seen as different strategies to reduce risk by creating managerial tools as suggested by Hunt and Auster (1990). The findings from the thematic analysis does show instances where the respondents companies go beyond what is required from legislation in terms of environmental practices. The high propensity to use and strategize about future use of alternative fuels such as LNG and methanol is an indication of a proactive stance with only a small percentage of world shipping being performed on these ships and MGO being the most common compliance method in SECA (DNV GL, 2016).

To what degree these instances of proactiveness can be attributed to customer pressure, a genuine wish of the company to do better or a strategy not to get locked in when new legislation is presented is hard to ascertain. The thematic analysis, however, found that consumer pressure was not considered an important driver of their environmental strategies. Many of the respondents were hopeful that consumer demand would develop in the future but found that the pace of change was slow or non-existent currently. Legislation and owner interest were found to be some of the main drivers of the development. Additionally, there was a concern that the life span of ships was too long for companies to not incorporate future development in the decision of what to buy. This indicates that there is a degree of risk aversion present.

The framework by Azzone and Bertelé (1994) state that one of the indicators of how companies move towards proactiveness is the sections of the company interested in environmental issues. In a stable business there are no sections interested in environmental issues. As the business moves towards a more proactive strategy it is partly due to more sections being interested. The reactive and anticipative strategy is suitable where employees and green movements have an interest while a proactive and a creative strategy is suitable when consumers have started to find an interest in the issue. The respective stages explained by Hunt and Auster (1990) instead describe the degree of awareness and possibility for change from within the organisation which should be taken into consideration. For shipping the thematic analysis found that consumer interest was low to non-existent according to the respondents. The awareness from within the organisations were, however, in most cases high due to the owner interest.

Azzone and Berelé (1994) also argues that industry norms play an important role in which strategy a company should adopt. If the industry norms do not change or evolve at a fast pace there is less need to be proactive. When the time needed to implement new technology is shorter than the time available or there is a discontinuous evolution more proactive strategies are instead preferable. The several legislations which have been introduced and several legislations still considered indicates that the shipping business are seeing increasing pressure to comply with legislation especially in those areas affected by SECA and NECA. Regarding the sulphur global cap there have also been several actors arguing that the time frame is too short for actors to act (Platts, 2016). The thematic analysis found that the respondents in large expected new and tougher legislation to appear. Additionally, legislation was a clear reason for many respondents to change their working methods and conduct their work in a more environmental manner.

The fourth and last aspect of environmental strategy that will be used in this thesis is the pace of innovation in the industry (Azzone and Bertelé, 1994). As an industry increases it proactiveness the pace of innovation becomes more important and exhibits a faster development (Azzone and Bertelé, 1994). Therefore, a stable or reactive strategy would be indicated by a low pace of innovation while an anticipative, proactive or creative strategy would be indicated by a high pace. While it is hard to concretely and precisely argue that shipping belongs in a specific category with regards to innovation the thematic analysis clearly shows that technological improvement is both a necessity as well as a competitive advantage for the respondents. The introduction of LNG as well as the introduction and development of methanol as fuel is in stark contrast to the previously dominant HFO. In addition, the respondents' companies utilized technologies such as scrubbers, fuel management systems, SCR and EGR which in many cases are new technologies as far as marine application is concerned.

The clear indication of these findings are that while consumer demand is likely hindering the successful development of a proactive strategy the regulatory pressures is making an anticipative strategy crucial. It is also clear that the current state requires the companies to be ´Concerned citizens´ regarding risks. This, for example, due to the long investments periods for a ship requires that the ship can maintain profitability for 20-30 years. Therefore, investing in technology that could be obsolete and require expensive retrofits in the coming years if regulatory pressure keeps up could reduce profitability in the future. This, together with operational and legislative questions, could partly explain the lukewarm reception for scrubbers as it does not solve further problems. Vice versa the clear focus on LNG for newly built ships could indicate that shipping companies expect a price difference between MGO and LNG to make these investments comparatively better.

It should however, be mentioned that different segments likely have different possibilities and barriers for implementing environmental strategies. As was shown in the result both respondent 2 and 7 argued that this was the case. There is too little data to support any wider conclusions regarding these differences but they should still be considered.

Through the thematic analysis it can be determined that the main characteristics of the sector today are low customer demand, high level of innovation and high awareness of implications of environmental legislation. This match what was described by Azzone and Bertele (1994) to be in an anticipatory stage.

The critique brought forward in the interviews broadly match the indication of the strategy being anticipative. While critique was levelled on regulation for creating unfair competition and having the wrong impact such as the cases with EEDI and ballast water management. Respondent 5 expressed concerns regarding Ballast Water Management saying that: *"Something has gone wrong when you can take in ballast in Brofjorden and steam to Luleå and discharge in accordance to the Ballast water convention because it is not applicable on a national trip. On the other hand, it is applicable on an international trip, for example between Helsingborg and Helsingör where you can throw a rock between the ports. This was not what the legislator had in mind."*

There was still a concrete expressed opinion that tougher legislation was needed. For example, a fuel levy, penalty on fuel producers or other ways of internalising external costs were considered positive by at least four out of seven respondents. This should indicate that the companies of the respondents feel comfortable handling such requirements. The fact that the companies have already invested in LNG and other means of increasing environmental performance means that they could potentially benefit from tougher legislation, which makes it more problematic to operate as previous, compared to less prepared

competitors. The global sulphur cap could even be considered an equaliser between the SECA region and the rest of the world.

The EEDI, however, collected a fair share of critique. While some considered it a good concept several respondents argued that it was unfair in that it favoured container shipping compared to other forms of shipping. Especially the ro-ro and ro-pax segments were considered in disadvantage due to the large amount of air being transported in these segments. Respondent 5 argued that the ro-pax segment was disadvantaged: "*we transport large quantities of cargo but not a lot of weight. And the calculations done [in EEDI] have a hard time handling a mixture of passengers and cargo. The calculations are based on either cargo or passengers. So, we should be shown as much more effective then we are but that is not how it turns out. A ro-pax has a large gross tonnage due to the large volume but we move very little weight."*

A main result was also that the shipowners considered it important to make environmental work economically beneficial either through previously mentioned internalisation of external costs or through incentives such as differentiated fairway dues. As the Triple Bottom Line suggests having financial incentives in the environmental strategies is crucial and several respondents have reached this stage. Further on the drivers for sustainable management by Epstein and Roy (2001) specifically explains the financial performance as a key aspect in driving these issues forward. Therefore, it is interesting and expected that four out of five respondents explicitly said that fuel efficiency is something they put emphasis on and how it is good for the business.

There is also a low propensity for the respondent's companies to use scrubbers as an abatement method when reaching compliance with SECA. One of the companies (respondent 2 & 4) seemed more likely to adapt scrubbers as part of the strategy due to the new global sulphur cap taking effect in 2020 which they expected would increase the price difference between MGO and HFO which is also what the report from DNV GL (2016) stated. Respondent 2 also argued that it was necessary to have several different methods of compliance to not be too reliant on one: *"Since we have 40 ships so it is very dangerous for us to choose one strategy, instead it becomes a mixture"* (Respondent 2)

The other respondents stated that operational and legislative issues, such as uncertainty legislative future for scrubbers in EU and safe and efficient operation, hindered them from utilizing scrubbers as an abatement method. For many of the other companies, however, LNG seemed to be a preferred method to proceed with which will be compliant with NECA.

The anticipatory status of strategies, however, also contains a conundrum. Since the evolution is driven mainly through legislative efforts the impetus is on continuously stricter legislation. Would IMO fail in its bid to improve sustainability of shipping there is little else to fall back on to provide that drive on a global scale. The respondents considered that there was a lack of market mechanisms driving sustainable change and even that there were some that could be affecting the change negatively such as spot market pricing procedures. There is according to the respondents also little to no consumer demand or as one of the respondents from a ro-pax company said: *"The customers think it is more important with ecological wine… that is more important to the customer than what we release from our chimney. It is tragic but true"*.

The results of the thesis indicated that the respondents expected customer demand to grow in the future. The time frame of that growth, however, was expected to be rather slow by many of the respondents.

Therefore, there is little indication that any sustained global development of sustainability within shipping could be expected, in the short term, without continuous pressure from IMO.

6. Conclusion

The aim of this thesis is to create an understanding of the situation for Swedish shipowners *and to elaborate on the critique and techniques needed to comply with the increase rate of legislation. The underlying market mechanism creating proactive or reactive behaviour is taken into consideration to evaluate why companies behave in a certain way and what is needed to improve the situation.*

6.1 Reflections and contributions

The legislative process of IMO is evolving quickly and several milestone legislations have been enacted in the last few years. The increasing pressure of legislation is affecting shipowners who need to address strategic decisions on which way to comply with present and potential future legislation. Swedish shipowners have largely been and will be affected by all these legislations regardless whether they are global or regional.

What strategies are Swedish shipping companies using to deal with current and future environmental legislation?

Through the theoretical framework by Azzone and Bertelé (1994) it was found that the respondents' companies largely but not exclusively followed an anticipatory strategy aimed at keeping ahead of future legislation enough not to create future problems. There were also clear indications that economical mechanisms were punitive towards a proactive strategy especially the lack of customer demand. The technical solutions used had a high propensity towards alternative fuels such as LNG and Methanol. Using strategies to solve current problems but also create platforms to meet future legislation was said to be important to the respondents. An example is that the investment in LNG could also in the future be rewarded if the global sulphur cap increases prices on MGO in comparison with LNG. While it is hard to forecast the development of fuel prices both earlier literature as well as some of the respondents considered this a clear possibility. This is hence also an indication of an anticipatory strategy.

In addition to the anticipatory strategy many of the respondents mentioned efforts to affect legislators. Partly these efforts were performed through the own organization but many of the respondents' organizations also worked through the Swedish Ship-owner's Association to get better representation.

Does the increasing speed and scope of new legislation force the companies to organise for addressing future legislation more proactively?

Taking all this into account it is clear that the increased rate of legislation affecting the Swedish shipping industry has created a higher activity regarding environmental issues. Most of the respondents in this thesis also acknowledged that environmental concerns had become a larger part of the Swedish shipping sector partly fuelled by legislation. Even though the customer demand for these actions is not that active now a majority of respondents meant that this will likely be a scenario that changes in the future. More customer demands create a possibility for the shipping sector to move towards using more proactive strategies and benefiting from using better technology and practises. In the short term, however, IMO is likely the only organization able to create drive towards more environmental operations in shipping through legislation.

What are the Swedish shipowners attitude towards new environmental legislation?

In addition to the anticipatory the study found that another main ingredient in Swedish shipowners response to increased legislation was an active effort to affect legislators. This process was handled by the individual companies as well as through the Swedish shipowner's Association.
In their critique of current and future legislation there was some clear main trends in that the legislation was considered:

- Measuring wrong - For example EEDI and the difference between segments
- Creating the wrong impact - For Example Ballast water management accepting discharge from North Sea to Baltic in Germany but not Baltic to Baltic when between states
- Creating unfair competition - through for example regional rules or EEDI giving advantages to container shipping

Instead the respondents viewed it as imperative to create a system creating higher incentives for shipping to move towards more sustainable practices either through a fuel levy or other incentives such as differentiated fairway dues.

This thesis contains some limitations in terms of sample size and sampling technique. Regardless the conclusions can be given with some confidence. While it is impossible to say that all Swedish shipowners uses an anticipatory strategy there are clear indications that it is a strategy at least commonly employed by Swedish shipowners. A further study could likely use a quantitative approach in testing and validating the results.

Hopefully this thesis can contribute to an increased understanding of how Swedish shipping companies are suited to the changing environment and what are the relevant strategies to use in this situation. Contributions are also made towards interpreting the effectiveness and limitations of the current legislative efforts have on the Swedish shipping market. This is important to establish to evaluate the future needs and actions of the involved companies.

6.2 Future research

While this thesis has found indications to support a view that Swedish shipowners are moving towards or currently are using an anticipatory strategy there were not enough data to support an analysis of the different segments in shipping. Throughout the interviews, however, it was evident that different segment likely face different opportunities and barriers. Therefore, a study on the possibilities of different segments and the barriers that are unique to them would likely be worthwhile.

Additionally, research on how to create opportunities to move shipping companies from using reactive and anticipatory strategies to proactive strategies to lessen the demand on regulatory efforts seems a highly interesting and important subject.

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