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How and why will the oil refining industry change in the EEA until year 2025

Will these changes influence the demand of intermediate tankers?

Master´s thesis in the Nordic Master Maritime Management Programme

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Gothenburg, Sweden, 2016

REPORT NO. X - 16:339

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Cover:
Furetank Rederi, 2015

Printed by Chalmers
Gothenburg, Sweden, 2016

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Abstract

The oil refining industry in the EEA faces future challenges. Some of these challenges are competition from non-EEA refiners, increased import of petroleum products to the EEA and unsophisticated technology of existing refineries. If the oil refining industry in the EEA will change in the future, what impact will these changes have on the intermediate product tanker segment trading in the EEA? These possible future changes in the refining industry are essential for ship-owners' decision making in regards to efficient operation of intermediate product tankers in the EEA. The purpose of this study is to investigate how and why the oil refining industry in the EEA will develop until year 2025 and how these changes will affect the intermediate product tanker segment. To fulfil the purpose, a case study has been performed. The primary information for this study has been retrieved by conducting ten interviews with semi-structured questions. The result from this study shows that the refining industry in the EEA faces several future challenges. Increased competition from non-EEA refiners and increased import of petroleum products have been highlighted as the main challenges for the refining industry in EEA. This study also shows that the intermediate product tankers still are expected to be needed for regional transportation within the EEA. However, the intermediate product segment faces competition from larger segments and therefore it is important that the segment keeps its flexibility compared to larger segments to not lose its market shares. The size of existing intermediate product tankers is appropriate and therefore the size should retain in order to keep the segment´s flexibility.

Keywords: Oil-refining, petroleum products, EEA, intermediate-tankers

Acknowledgments

The author wants to thank Martin Larsson, the supervisor of this study who at an early stage was clear with expectations and has provided valuable guidance through the study process and for arranging interviews. The author also wants to thank all respondents which have spent their time for providing information to this study. Finally the author wants to thank Furetank Rederi and Stefan Magnusson with team at Furetank Chartering for their assistance, introduction to the intermediate product tanker segment and the possibility to get in contact with interviewees.

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Abbreviations

BP – British Petroleum
ECA-Emission Control Area
EEA- European Economic Area
FCCs- Fluid catalytic crackers
MR tanker- Medium range product carrier
OECD – Organisation for Economic Co-operation and development
OPEC – Organisation of Petroleum Exporting Countries
SECA- Sulphur Emission Control Area

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1 Introduction

1.1 Background

The global oil refining industry changes and the capacity is expected to increase. The increase in capacity will particularly take place through projects located in Asia with emphasis on China and India. Meanwhile, the refining capacity decreases in Europe since refineries are closed. Refineries are mainly closed in Europe due to increased competition from refiners primarily located in Asia and due to stricter environmental legislations inside the OECD region. (Rex, Thorsen, Liere Rasmussen, Nielsen, & Möller Kristensen, 2013).

The global consumption pattern of oil and oil products is expected to change. The main increase in demand of oil is expected to take place in developing regions instead of regions with advanced economies. Meanwhile, a change in global supply of oil takes place as well and is mainly driven by shale oil production in the United States. (British Petroleum, 2014a).

The import of crude oil to the United States has decreased as the country has started to produce oil from its shale oil reservoirs. With shale oil, the United States has potential to become a crude oil exporting country. However, a ban of exporting crude oil, in force since 1975 does not allow for export of crude oil. Therefore, domestically produced crude oil is refined within the country and petroleum products are exported to the global market. (Oil and Energy Trends, 2014).

Changes in traditional trading lanes for crude oil and petroleum products are expected to occur as the global oil market is shifting. Changes are driven by new oil production locations, increased demand of oil in certain regions and the location of oil refineries. (Journal, Pipeline & Gas, 2014).

Product tankers are used for transporting petroleum products between refineries and consumers. Typical consumers of petroleum products could be the power industry or the transport sector. Petroleum products are divided into two main groups, light products and heavy products. Kerosene and gasoline are examples of light products. These products are categorized as middle- and light- distillates. Heavy products are products extracted from heavy distillates, e.g. residual oil. (Stopford, 2009).

During the 1950s, economies in the Western Europe became more dependent of oil. Therefore it was decided that new oil refineries had to be built. New constructed refineries had capacity to produce enough specific petroleum products which the Western European market demanded. (Stopford, 2009). During the 1950s, it was common that petroleum products were shipped long distances from oil refineries to the market where the products were consumed. However, in the 1960s the global market for petroleum products developed and oil refineries were built closer to consumers. In addition to more refineries, refineries were technically improved and became able to produce products specified according to regional demand. (Stopford, 2009). As a result of more and improved oil refineries, the costs for transporting the products were reduced. This since long-hauls was performed with large volumes of crude oil instead of smaller quantities of petroleum products. (Stopford, 2009).

Despite large investments in oil refining capacity in Europe during the 1950s, the region is still dependent on importing petroleum products to meet the demand. The import of petroleum products to Europe increases due to three main factors according to Stopford (2009). These factors are:

- Increased competition from oil refiners located in oil producing regions.
- The produced mix of products does not correspond to the market demand. Due to this, surpluses of production are exported to markets with shortage outside Europe.
- Local regions may have demand of petroleum products that exceeds the oil refining capacity.

Beside a decreasing market for refined petroleum products in Europe, European refiners are subject to competition from export-orientated and highly sophisticated refineries in the Middle-East, Asia and the United States (Kent & Williams, 2015).

Shipments of refined petroleum products are mainly carried out by using ships with cargo carrying capacity of between 6.000 and 60.000 tonnes. Tanks used for carriage are to be clean and are usually coated with epoxy. (Stopford, 2009). Different factors contribute to the size of product tankers:

- Since many hauls involved with refined oil products are relative short, possibilities of economy of scale are limited. (Stopford, 2009).
- Reception facilities may restrain due to size restrictions of ship. (Stopford, 2009).
- In general, oil companies do not trade larger volumes of petroleum products. However, it should be noted that even if the common size of product tankers is between 6.000 and 60.000 tonnes, larger vessels are hired for carrying out shipments. (Stopford, 2009).

The “intermediate” product tanker size is common for transporting petroleum products within the European Economic Area (EEA). Intermediate product tankers typically have capacity to carry between 10.000- and 20.000-tonnes. (Intermediate operator No.1)

1.2 Purpose

The purpose of this study is to give a holistic overview of how and why the oil refining industry in the EEA may change until year 2025 and what impact these changes will have on the intermediate product tanker segment.

Since shipping companies have to do large investments in specialized tonnage for entering a specific market (Jenster & Solberg Soilen, 2009), it is important that shipping companies invest in tonnage that corresponds to the demand. Therefore, the intention of this thesis is also to investigate what kind of intermediate product tankers which will be demanded in the EEA until year 2025.

1.3 Research questions

To fulfil the purpose of this study, the study is based on the following three main research questions:

- How and why will the oil refining industry in the European Economic Area change until 2025?

- If the oil refining industry in the European Economic Area change, how will the demand of intermediate product tankers in the area develop until 2025?

1.4 Delimitations

The study has been limited to the oil refining industry and the intermediate product tanker market in the European Economic Area. The intermediate product tanker segment includes ships with cargo carrying capacity between 10.000- and 20.000 tonnes.

2 Theory

2.1 Global energy demand

The increased population of the earth is a major reason to why the demand of energy is increasing. However, the growth in population is almost stagnant in the industrialized regions, but is increasing in emerging countries. The overall population growth leads to an increased use of energy and other commodities. This has probably led to the end of the "cheap energy" era. This since new energy has to be extracted in areas which are hard to access, located in sensitive environments or in regions which are politically unstable. (Mohite, 2014).

The global energy demand is expected to increase until year 2035. The largest increase is expected to take place in emerging markets where countries as China and India are represented. The total demand of energy in the world is expected to increase by 41% between year 2012 and 2035. 95% of the increase is expected to come from emerging markets (Journal, Pipeline & Gas, 2014).

Developed economies in Europe, North-America and Asia as a unit, is expected to have a very slow growth in demand of energy. Due to a general effectiveness when it comes to use of energy resources, the growth in energy demand will be less compared to previous decades (Journal, Pipeline & Gas, 2014).

The average annual increase rate for global energy demand is expected to be 1.5% until year 2035. The highest increase will take place until 2020, where the annual increase rate is expected to be 2%. India and China are expected to represent half of the increased energy demand. The other half is represented by countries outside the Organisation for Economic Co-operation and development (OECD) (Journal, Pipeline & Gas, 2014).

While the United States is expected to be self-supportive of energy, the demand of importing energy is expected to increase in India, China and Europe. The Asian region is expected to be the largest importer of energy until year 2035 (Journal, Pipeline & Gas, 2014).

2.2 Consumption of oil in year 2014

The global oil consumption per day in year 2014 was 92,086 million barrels (British Petroleum, 2015). Figure 1 below indicates the share of oil consumption by geographic region.

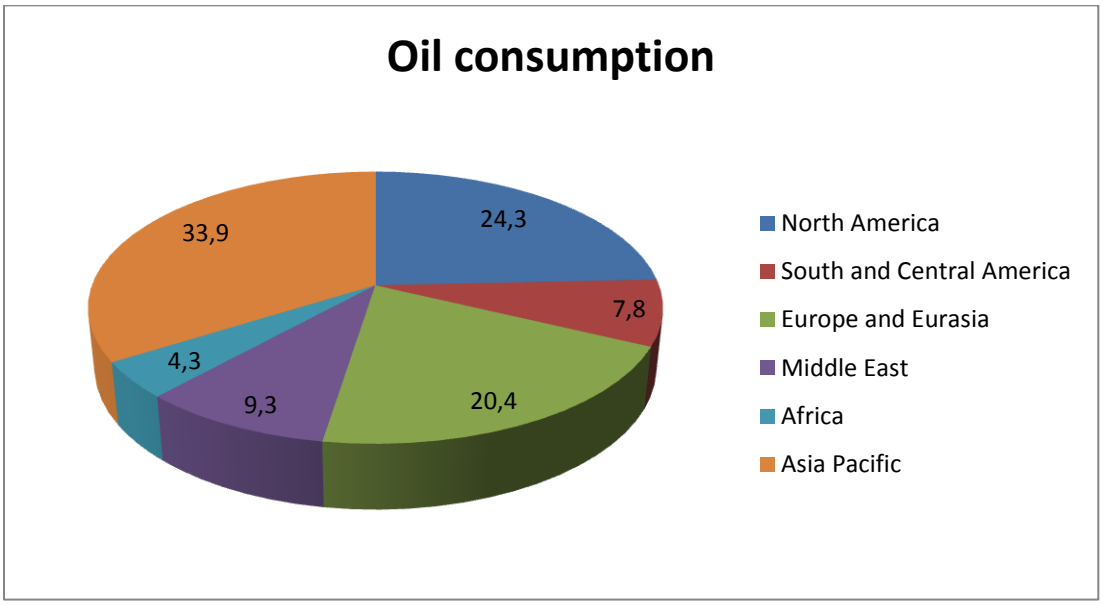

Figure 1. Share of total oil consumption per day (compiled from BP, 2015).

2.3 Future global demand of oil

Since the financial crisis in year 2008, emerging economies have developed and advanced economies have been recovering from the crisis. This has led to an increased demand of oil in the emerging economies due to industrialization and a continued belief in fossil fuels. Meanwhile, the demand of fossil fuels in advanced economies is stagnant or is decreasing. This since these regions become deindustrialized and transform into service providers instead. (Mohite, 2014)

The global use of oil as source of energy is expected to grow by 0.8% annually until year 2035. Oil as source of energy has the lowest annual growth rate compared to other sources of energy. With an annual growth rate by 0.8%, the global demand of oil is expected to increase by 19 million barrels per day until year 2035 compared to year 2012. China, India, and the Middle East, (all countries outside the OECD) are expected to represent almost the whole increase in net demand of oil until year 2035 (Journal, Pipeline & Gas, 2014).

By year 2040, every two thirds of the oil traded on the global market is expected to be bought by Asian countries. The increased demand of oil is expected to be supplied by countries in the Middle-East (International Energy Agency).

The total global demand of petroleum products is expected to have an annual increase rate of 1.1% to 1.4% until 2030. Two thirds of the increased demand is expected to be driven by the transport sector. However, the transport sector has to adjust and rely more on cleaner fuels as a result of tougher environmental legislation. (Mohite, 2014).

According to Mohite (2014), the annual growth rate until year 2030 for different petroleum product segments are expected to be as follows:

- Gasoline: +0.8%
- Middle distillates: +2.2%
- Heavy fuel oil: -0.3%

2.3.1 *Alternative fuels*

Biofuels and gas to liquids (GTL) are the main substantial competitors to petroleum products. However, it is only production of GTL that may affect the volumes produced by the oil refining industry. Biofuels, such as biodiesel and bioethanol, are only promoted in North-, Latin-America and Europe. The demand is expected to grow and in year 2030, it is expected that biofuels have 10% of the total diesel and gasoline road-fuel market. (Mohite, 2014).

The GTL technology has technological benefits compared to conventional oil refining. Other factors that increase the competitiveness of GTL is that regions with large gas reservoirs may use cancelled or unexplored gas resources for producing GTL. The GTL production has advantages compared to conventional oil refining as it produces cleaner products with less sulphur levels and the product range does not include heavy fuel oils. However, it should be mentioned that GTL refining is more expensive than conventional oil refining and it is only a limited number of oil refining companies which possess patents for the technology. (Mohite, 2014).

The use of renewable energy sources is increasing globally. However, the primary global production of energy is still based on non-renewable energy sources. If a source of energy is to be totally replaced, this includes high switching costs. Some industries and power plants are able to change their fuel mix to some extent. However, if the source of fuel is to be totally changed at power plants, this need total reconfiguration of the plant as well. Some industries are totally dependent on fossil fuels and are expected to be so even in the future. (Marketline, 2014).

2.4 Oil reserves

According to BP (2015) total oil reserves of conventional oil constituted of 239.8 billion tonnes. However, the resources of heavy oils (unconventional resources) are four times bigger than the conventional resources of oil. Canada´s bitumen reservoirs alone; contain twice as much oil compared to the world´s resources of conventional oil (Mohite, 2014). Percentage of global conventional oil reserves by world geographic regions can be seen in figure 2 below.

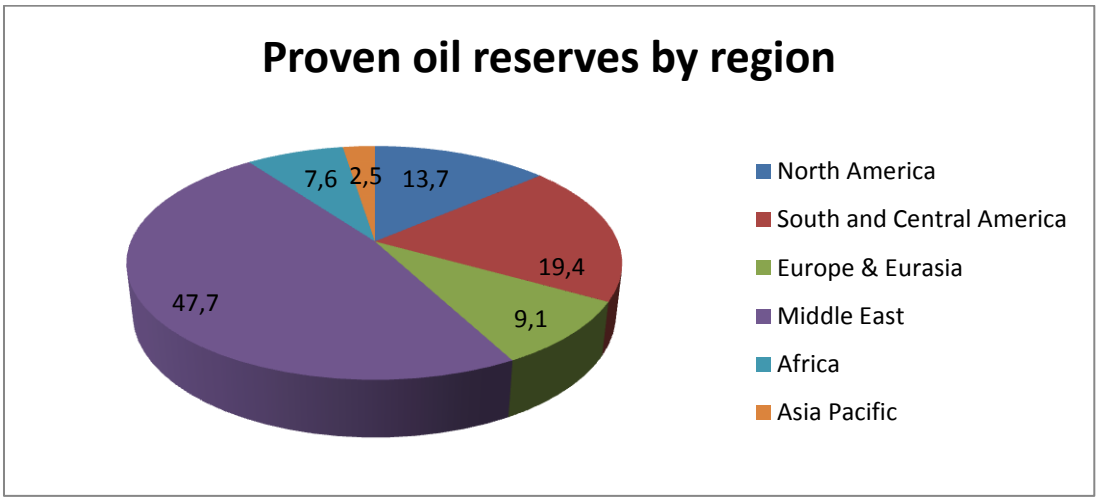

Figure 2. Share of total proven oil reserves by regions in per cent. (Compiled from BP, 2015).

2.5 Supply of oil

The total global production of oil in year 2014 was 88,673 million barrels per day (British Petroleum, 2015). The total oil production by regional areas in year 2014 can be seen in figure 3 below

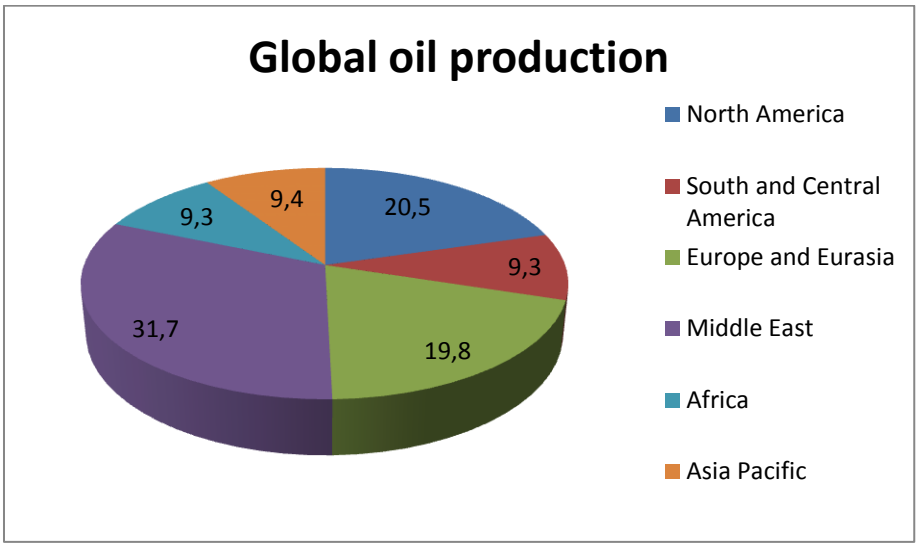

Figure 3. Share of total oil production in per cent. (Compiled from BP, 2015).

2.6 Increasing oil production

The International Energy Agency predicts that the supply of oil will increase by 14 million barrels per day to become 104 million barrels per day until year 2040. (International Energy Agency).
The Americas and the Middle East regions are assumed to represent the largest share of growth in supplying oil liquids until year 2035. More than half of the global oil production will in year 2035 come from countries outside the Organisation of Petroleum Exporting Countries (OPEC). (Journal, Pipeline & Gas, 2014).

The amount of oil produced in non-OPEC countries is anticipated to increase until the mid-2020s (International Energy Agency). This since the oil production in the United States, Canada and Brazil is expected to increase (International Energy Agency). The United States is expected to increase its production of shale oil, Brazil will supply oil from Brazil´s deep-water resources and Canada is expected to extract oil from oil-sand resources (Journal, Pipeline & Gas, 2014).

The importance of oil produced by non-OPEC countries will be significant until the mid-2020s. Beyond 2025, the production of oil from non-OPEC countries is projected to decrease and the demand of OPEC produced oil will increase. Therefore, the long-term supply of oil has to be met by the OPEC. (International Energy Agency).

The United States is expected to overtake Saudi Arabia as the largest supplier of oil liquids in the world since the United States increases its production of shale oil. Due to increased production of shale oil, the import of oil to the United States is expected to decrease by 75% until year 2035 (Journal, Pipeline & Gas, 2014). However, it should be mentioned that production of shale oil is expected to decrease after 2020 (International Energy Agency).

2.7 Petroleum products

Unprocessed oil from production site is called *crude oil* or *petroleum*. Crude oil is classified as a fossil fuel. This since crude oil is the result of natural digestion of living organisms and plants which lived in the oceans several million years ago. (Freudenrich, 2001).

The form and colour of crude oil varies depending on where the oil is produced. The colour may differ from clear to tar-black and the viscosity can be as water, but also almost solid. Crude oil contains different hydrocarbons. These hydrocarbons consist of carbon molecules and hydrogen molecules in different molecular shapes. (Freudenrich, 2001).

Different hydrocarbons have different forms and shapes. The lightest hydrocarbon is methane (CH_4), this hydrocarbon is lighter than air. The heaviest hydrocarbons are categorized as tares and waxes; these are long hydrocarbon-chains. When hydrocarbons contain more than five carbons, they become fluids. (Freudenrich, 2001).

Crude oil has to be processed for extracting petroleum products. This process takes place at oil refineries. Oil refineries distillate and transform crude oil into different hydrocarbon fractions. These fractions can be consumed directly, be further processed or transformed into other desired petroleum products. (European Commission, 2010).

Oil refineries are mainly categorized into two main groups, "specialty refineries" and "fuels refineries" (European Commission, 2010). This study focus in *fuels refineries* where light-, middle- and heavy-distillates are produced. Explanations of the different distillate segments with examples of products included can be seen in table 1 below:

Table 1: Categorization of distillates. (Compiled from European Commission, 2010)

Distillate category	**Product**	**Example of product use**
Light	LPG Naphtha Gasoline	Heating fuel. Used in fabrication of fibres and plastics. Motor fuel.
Middle	Gasoil Diesel Kerosene and jet-fuel	Heating fuel. Motor fuel. Aviation fuel. Kerosene can be used for heating purposes as well.
Heavy	Heavy distillates	Bunker for ships. Heavy fuel oil can be used as fuel in the industry and in power generation.

2.7.1 *The oil refining process*

Processing of crude oil includes three main stages. These are: separation, treating and conversion. Separation is performed in order to separate the crude oil´s different fractions. The main method used for achieving separation is *atmospheric (fractional) distillation*. Atmospheric distillation or fractional distillation means that crude oil is heated to approximately 360° Celsius (European Commission, 2010) by using steam of approximately 600° Celsius. When the crude oil is heated, most of the hydrocarbons become vaporized. These vaporized hydrocarbons are transferred to a fractional distillation column. The hydrocarbons enter the column at the bottom of the column where the temperature is the highest. When the vapour rises higher in the column, it cools down. A fractional column is designed with trays which maximize the time the fractional vapours get in contact with fractional fluids. This contact occurs at different levels inside the column. (Freudenrich, 2001).

Hydrocarbon vapours condensate at different levels inside the fractional column according different fractions´ boiling ranges. Hydrocarbon fractions condensate when the temperature is equal to the fractions´ boiling points. Heavy crude oil products condensate in the lower part of the column and gases get to the top of the column, where the lowest temperatures occur. (Freudenrich, 2001).

Light fractions have lower boiling points than heavier fractions. LPG is an example of a light fraction and gasoil is a heavier fraction. (European Commission, 2010). Fractional distillation is the most important step when it comes to distilling hydrocarbons. Before the fractions can

be sold as pure products, most of them have to be further processed if they are made by fractional distillation. (Freudenrich, 2001).

Hydrocarbon fractions with boiling ranges according to Freudenrich (2001) can be seen in table 2 below.

Table 2: Petroleum products (Compiled from Freudenrich, 2001).

Product	Boiling range in degrees Celsius	Number of carbon atoms and structure.
Petroleum gas (methane, ethane, butane and propane).	Less than 40	1-4, gas. Pressurized gas transformed into liquids is called liquefied petroleum gas (LNG).
Naphtha	60-100	5-9, liquidised.
Gasoline	40-205	5-12, liquidised.
Kerosene	175-325	10-18, liquidised.
Gasoil/diesel distillate	250-350	More than 12, liquidised.
Lubrication oils	300-370	20-50, liquidised.
Heavy gas/fuel oil	370-600	20-70, liquidised.
Residue	600 and above	More than 70, solids.

2.7.2 *Further processing of fractions*

Pure atmospheric distillation is categorized as simple distillation. Atmospheric distillation can be used in combination with hydrogen. If so, the process is called hydroskimming. Simple distillation may be further developed if the process is done with vacuum. Vacuum distillation makes it possible to lower fractions´ boiling ranges. (European Commission, 2010).

To change the product yield of different petroleum products, chemical processing can be used to transform fractions into other fractions. An example is when long hydrocarbons are transformed into shorter hydrocarbons, for instance, turning diesel into gasoline. (Freudenrich, 2001).

Three main methods are used to change hydrocarbon fractions: cracking, unification and alteration. Cracking is when long hydrocarbons are split into shorter hydrocarbons. Unification makes it possible to piece together hydrocarbons to make longer hydrocarbon-chains. By using alteration it is possible to change the molecular components of a hydrocarbon to produce a desired product. (Freudenrich, 2001).

Conversion of hydrocarbon fractions can be achieved by coking-, visbreaking- or cracking-processes. These processes make it possible to extract high-value hydrocarbons out of long hydrocarbon molecules. At a “cracking” refinery, residues from atmospheric distillation are further distilled under vacuum to produce vacuum gasoil (VGO). VGO is processed in a cracking unit which extracts lighter fractions with boiling ranges corresponding to

atmospheric distillation. However, it should be noted that this process leads residues as well. (European Commission, 2010).

Different methods are available for cracking. Thermal cracking is one alternative and means that pressurized hydrocarbons are heated to make additional fractioning possible. This is done to transform ethane, butane and naphtha into ethylene and benzene. (Freudenrich, 2001)

Catalytic cracking is another method to further process fractioned hydrocarbons. Catalytic cracking can be done in three different ways. The first is to use minerals as catalysts for speeding up the cracking process. The second alternative is to use fluid catalytic cracking. This method uses catalysts and hot fluid for the cracking process. By using fluid catalytic cracking, it is possible to extract gasoline and diesel out of heavy gas oils. (Freudenrich, 2001).

Hydrocrackers and fluid catalytic crackers (FCCs) are the types of crackers which are most commonly used. Cracking refineries produce more emissions per processed crude oil unit compared to pure atmospheric distillation refineries. The most energy intensive refineries are deep conversion refineries. These refineries are capable to convert residues from VGO into lighter products. The number of deep conversion refineries increases since the demand for lighter products increases and the demand for heavier products decreases. (European Commission, 2010).

To fulfil quality and specification requirements, separated hydrocarbon fractions may have to be treated. Treating could involve contamination removal of e.g. salt but also desulphurization. (European Commission, 2010). When all hydrocarbons have been separated and treated, they are used as pure products or are blended together to products which can be sold on the petroleum market. (Freudenrich, 2001).

2.7.3 *Refining units*

Oil refineries are constructed with different refining purposes. A description of refinery configurations and units can be seen in table 3 below.

Table 3: Types of refinery units (Compiled from European Commission, 2010).

Refinery unit	Description
Topping	A unit with no treating or conversion capabilities is the simplest refinery configuration and is called a "topping" unit. Topping refineries are able to produce products which can be sold directly after separation. Examples of products produced at topping refineries are: kerosene, naphtha, LPG, heating gasoil (if the crude oil has low sulphur content) and fuel gas. Fuel gas is used as a source of energy at the refinery. A topping refinery cannot produce diesel for the EU market since the refinery is unable to remove sulphur. The residue of processes at a topping refinery is heavy fuel oil. The quality of the fuel oil varies with type of refined crude oil.
Hydroskimming	Hydroskimming refineries perform atmospheric distillation and have naphtha converting possibilities. Hydroskimming refineries are able to convert gasoil into diesel and heating-oil and naphtha into gasoline. The product output mix at hydroskimming refineries considerably corresponds to the yield of the crude oil processed. This since there is no possibility to further process products via catalysts at a topping refinery. Hydroskimming refineries are equipped with necessary treating units.
Hydrotreating	These units are used to remove contaminations and sulphur. Examples of contaminations are nickel and salt. Catalysts and hydrogen are used in the process.
Reforming and isomerization	These units make it possible to modify hydrocarbon molecules of similar size to produce higher-value products. An example is when the octane number in gasoline is raised.
Fluid catalytic cracker (FCC)	By using high temperature and catalysts, FCCs are used for converting atmospheric residue and VGO into mainly gasoline. Small quantities of poor quality gasoil are produced as well.
Hydrocracker	By using hydrogen, high temperature and high pressure, VGO and residues are transformed into jet-fuel and gasoil of high quality. Hydrocracking refineries are more flexible compared to other types of refineries to produce the desired product yield of diesel and gasoline. Large investments have been done in hydrocracking units in the EU since the demand of diesel in the EU has increased. However, there are more FCCs than hydrocrackers in the region.
Coker	Uses heat to break long residual-oil molecules into shorter molecules. The process produces naphtha, hydrocarbon gases and different types of gasoil.

	(European Commission, 2014). Residuals from the process is called petroleum coke (Freudenrich, 2001)

2.8 Global oil refining

The global oil refining industry has traditionally been an industry with low margins and poor profitability. However, large investments have been made into the industry. These investments are the result of strategically decisions rather than economical. Despite the poor profitability in a historical point of view, economical margins have improved during recent years, especially between years 2001 and 2008. (Mohite, 2014).

The traditional global oil market is changing since it has to facilitate oil from new producers. These producers are located in regions which traditionally not have been major oil producers. Besides new producers of oil, the global demand pattern for oil changes as the demand increases in emerging markets. The global oil refining industry has changed considerably due to low business margins, volatile crude oil prices, and tighter specifications of fuels and due to the increased production from unconventional oil resources. (Mohite, 2014).

Refiners based in the Eastern part of the world, have better margins compared to refiners located in the Western part. The difference in margins is expected to last during the coming five years. The difference in margins is mainly due to the peak in the demand of oil within the OECD. Meanwhile, the demand increases in the Eastern part of the world. However, the margins in the East may be negatively affected when new and planned refining capacity in the East come into production. New refining capacity additions in the East could also lead to reduced margins for refiners in Europe and the United States and lead to closures of refineries in Europe and the United States. (Mohite, 2014).

The global oil refining industry has capacity to refine 96.514 million b1arrels per day (British Petroleum, 2015). Oil refining capacity by each region can be seen in figure 4 below. The European Union has 14.7% (14.218 million barrels per day) of the world´s total oil refining capacity (British Petroleum, 2015).

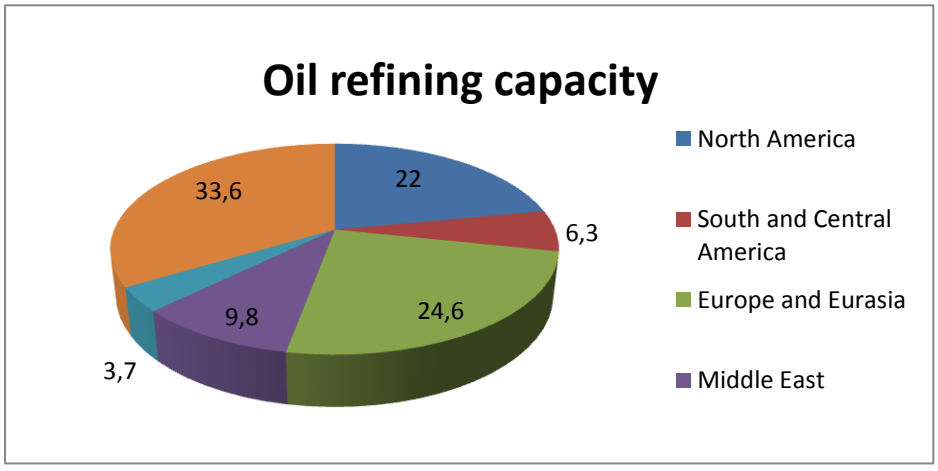

Figure 4: Global oil refining capacity in percentage (Compiled from BP, 2015).

Oil refineries located in the EU produced an average of 11.122 million barrels per day in year 2014. This led to a utilization rate of 78.2%, compared to the global utilization rate of 79.6%. (British Petroleum, 2015).

Refiners have to adopt and invest significantly if they want to stay competitive on the global market. Upgrades of existing oil refining facilities are crucial for extracting as many value-adding products as possible and to improve the total refining efficiency. (Mohite, 2014).

Substantial changes in the oil market and with surplus of gasoline production within Europe, means that oil refineries configured to produce gasoline are expected to struggle with their economical margins. Meanwhile, substantial changes occur in the United States, a country that traditionally has relied on oil imports and imports of gasoline but now occasionally has become a net exporter of petroleum products. (Mohite, 2014).

The global oil refining industry faces several future challenges. The demand for oil refining capacity globally, is expected to grow by 1.1% to 1.4% annually until year 2030. It is expected that the supply of crude to the refineries is sufficient However, the oil refining industry´s capability to handle different qualities of crude oil will be challenging. These challenges are mainly to handle crude oils with higher level of sulphur levels as feedstock. To achieve this, more capacity in cracking and hydro-processing is needed. (Mohite, 2014)

Planned capacity additions of global oil refining projects are higher than the capacity reduction through closure refineries. New projects globally will increase the global oil refining capacity with 24 million barrels per day during the next 20 years. However, new refineries may have advantages for producing products aimed for economies with intention to reduce the use of carbons. In the long-term, new refineries may also have advantages for producing diesel and gasoline which contain less than 10ppm of sulphur. (Mohite, 2014).
Despite poor profitability since the end of the 1980s, large investments have been made into the oil refining. The oil refining industry has had a continuous surplus capacity during the last 30 years. One large contributing factor has been that companies seek economy of scale benefits. This has led to larger oil refining facilities and also capacity additions. This has especially contributed to the capacity additions in India and China. (Mohite, 2014).

Notwithstanding the risk of having oil refining projects which operate with financial losses, there are several countries which have promoted private- and state-owned companies to invest in oil refineries. The substantial element to these investments has been that countries want to retain as much financial resources as possible. Moreover, refining crude oil within the country is cheaper than importing products. This also creates more employment which contributes to financial growth. (Mohite, 2014).

Different incentives have been used by countries for attracting investments relating to oil refining. Examples of such incentives are can be that taxes are added on imported petroleum

products or that products are banned if they are produced by foreign producers. (Mohite, 2014).

It is not only local legislations and incentives which have led to poor margins in the global refining industry. Deteriorated margins are also due to discrepancy between how the refineries are constructed and what products the market demands. Furthermore, the technology configuration is not correct. (Mohite, 2014).

The conversion process of heavy oils into desired products can only be performed by a limited number of refineries. If heavy oil refining will expand in the future, it will depend on the refinery margins and available technology. However, the interest in extracting heavy oils is increasing since the production and access of conventional oil are decreasing. (Mohite, 2014).

The oil refining industry faces challenges for producing the future demand of petroleum products. These products will be tightly specified and cleaner. Meanwhile, the refining industry itself struggles with lower economical margins. The refining industry has to adjust and develop to be able to supply the future demand of petroleum products. These developments and investments include reconfiguring, extended and upgraded capacity but also integration. (Mohite, 2014).

2.9 Refining costs

Several costs affect an oil refinery´s operational margin. However, the largest expense involved with oil refining is the production of hydrogen and the cost for energy used in the refining process. Hydrogen is used in the production of fuels with low sulphur levels. (Mohite, 2014).

If an oil refinery needs substantial energy for its processes, it benefits from availability of cheap energy. An example is when natural gas is available. The cost of energy is essential in refining markets where margins are low. High conversion refineries located in Asia benefits from low cost energy slates since Asia has access to liquefied natural gas (LNG). Asia imports much LNG and the region´s imports are expected to double until 2030. (Mohite, 2014).

It is expected that the middle distillate product segment will be the most important product segment in the future that will affect refiners´ margins. Meanwhile, margins on gasoline are expected to decrease. The future middle distillates are expected to be highly specified, particularly with emphasis on the European ultra-clean diesel market. The global markets are expected to stepwise demand ultra-low sulphur fuels. However, methods used for producing such fuels are expensive and need highly sophisticated technology (Mohite, 2014).

2.10 Demand of oil in the European Union

In year 2014, the average consumption of oil in the EU was 12,527 million barrels per day (British Petroleum, 2015). The consumption according to BP (2015) includes the following products:

- Light distillates: motor-gasoline, aviation-gasoline, naphtha and light distillate feedstock.
- Middle distillates: heating-kerosene, jet-kerosene and diesel/gas-oils.
- Fuel oil: crude oil used as direct fuel and marine bunkers.
- Others: refinery gas, liquefied petroleum gas, petroleum coke, solvents, bitumen, lubricants, refinery fuel and loss and other refined products.
-

The consumption in year 2014 of petroleum products in the EU and categorized by distillate segment type can be seen in figure 5 below. The table is based on an average total consumption of 12,527 million barrels per day in 2014 (British Petroleum, 2015).

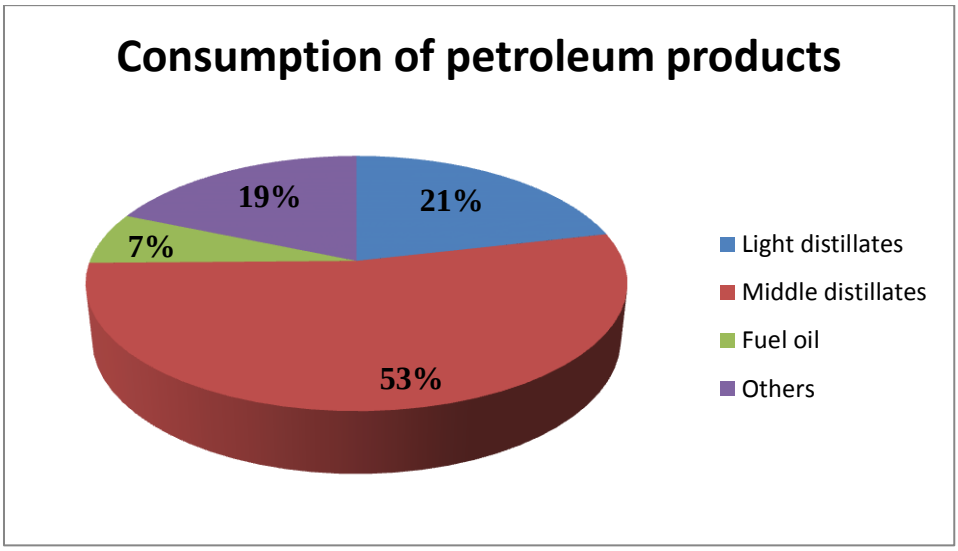

Figure 5. Consumption of petroleum products in the EU in percentage.
(Compiled from BP, 2015).

2.11 The European Union´s energy market and strategy

One fifth of all energy produced in the world is consumed within the European area (Europeiska Kommissionen, 2015). The European Union (EU) imported 53% of its consumed energy in year 2014. 90% of the crude oil used in the EU was imported from countries outside the EU. The energy consumption and the demand of importing energy from countries outside the EU are increasing (European Commission, 2015). .However, in year 2014 more than 50% of the energy produced within the EU came out of methods which not produce greenhouse gases (European Commission, 2014).

The annual value of imported oil and gas to the EU is more than 350 billion Euros. This value is steadily increasing. The EU´s ambition is to reduce the use of energy produced by methods creating greenhouse gases. By reducing the use of fossil fuels when producing energy, the dependence on oil imported from countries outside the EU is reduced as well (European Commission, 2014). Since resources of fossil fuels within the EU decrease, the EU has to household with its consumption of fossil fuels and try to develop alternative fuels. (Europeiska Kommissionen, 2015).

2.11.1 *Strategy*

The EU works towards a reduction of energy consumption. If the use of energy is reduced, different positive side-effects such as: lower emissions into the environment and less dependency of imported energy are gained (European Commission, 2015).
One of the EU´s most important environmental targets is to reduce the energy consumption by 20% until year 2020 compared to reference levels in year 1990. (European Commission, 2015). According to the European Commission (2014), the use of fossil fuels has to decrease, especially with focus on the transport sector. However, the European Commission (2014) argues that it is important that the EU has a well-functioning oil refining industry. Moreover, the EU should be able to take care of its crude oil stocks in an effective and flexible way (European Commission, 2014). It is also essential that the European Union has oil refining capacity that meets the EU´s future domestic demand (European Commission, 2014).

2.12 Oil stocks

The risk of high fluctuating prices in an energy crisis can be reduced by having oil stocks. The EU´s member states are obliged to keep crude oil- and petroleum product-stocks. The countries should have stocks enough for covering their consumption of oil and petroleum products for 90 days. In year 2014, the EU´s member states had stocks covering the demand for 120 days (European Commission, 2014). The size of oil stocks is stipulated by the International Energy Agency (European Commission, 2014).

2.13 Legislation in the European Union

The EU has developed common rules with regards to energy consumption. The purpose of this legislation is to secure energy availability to reasonable prices for the EU´s member states. However, the purpose of the legislation is also to reduce emissions (European Commission, 2015).

The EU´s energy policy involves different main areas. The policy should work to secure energy supplies within the EU. However, the purpose is also to keep energy prices at levels which do not affect the EU´s competitiveness in productivity and to reduce impact on the environment. (European Commission, 2015).

2.13.1 *Diesel/Gasoline balance in Europe*

Refiners in the EU have excess capacity to produce gasoline and deficit of middle distillate production of jet-fuel, diesel and heating-oil. Since the demand of middle distillates is above refiners' production capacity in the EU, the EU is dependent on importing petroleum products form refiners located outside the EU (FuelsEurope, 2015).

Jet-fuel is imported from the Middle East. Heating-oil and diesel are imported from Russia. Considerable volumes of the gasoline surplus in the EU have traditionally been exported to the United States. However, possibility for refiners in the EU to export gasoline is changing. Traditionally, refiners in the EU have been able to export gasoline to the United States. However, the United States´ import of gasoline is in constant decline and the country is not expected to import gasoline in year 2020 (FuelsEurope, 2015).

Refiners in the EU have to seek alternative markets for their surplus of gasoline due to decreasing local demand and limited possibility to export to the United States. If no new markets are found for the gasoline surplus, the production of gasoline has to decrease. There are two main options available to reduce the production of gasoline. The first is to close entire refineries and the second is to disinvest gasoline extracting units (FuelsEurope, 2015).

In spite that refiners in the EU have increased the yield of diesel of their production; the industry has an overcapacity for producing gasoline and an insufficient capacity when it comes to diesel production. One major factor to the changed demand of diesel and gasoline in the EU; is due to changes in tax regulations during the last 20 years. In year 1990 the demand ratio between gasoline and diesel was 2:1. The ratio was 1:2 in year 2014 and is expected to become 1:3.5 in year 2030 (FuelsEurope, 2015).

In figure 6 below, the production yield of petroleum products produced by oil refiners in the EU in year 2007 is compared to the expected demand by year 2030.

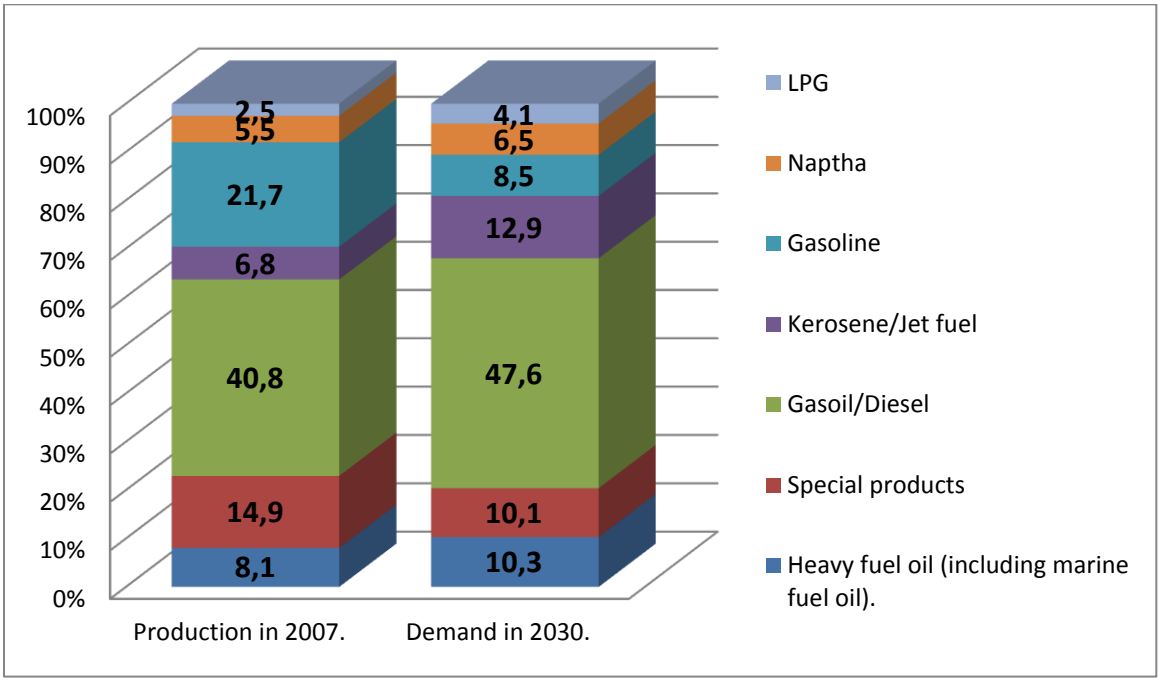

Figure 6. Production in 2007 and demand of petroleum products in 2030 in the EU in percentage. (Compiled from FuelsEurope, 2015).

It should be noted that the demand for gasoline on some local European markets may increase. This as the technology of engines fuelled by gasoline is improved. The improvements have led to reduce fuel consumption to levels which approach diesel engines. This has increased the demand of gasoline in the Southern and Eastern regions of Europe. However, it should be noted that these regions have traditionally been more gasoline- than diesel-orientated. (Mohite, 2014).

2.14 Import of middle distillates to the EU

Refiners in the EU do not have the capacity to produce as much diesel demanded in the region. Therefore, one million barrels per day of diesel is imported. The quantity is expected to increase and reach 1.6 million barrels per day in year 2019, even though the local demand of diesel in the EU is expected to deteriorate. The underlying factor to the increased import of middle distillates to the EU; is closures of refineries in the EU. (FuelsEurope, 2015).

Refineries based in the EU have to adjust to coming market changes if they should be able to continue with their operation. As several new oil refineries are under construction globally and old refineries are upgraded around the world, refiners in the EU will experience harsh competition. The competition will be harsh on both the regional market in the EU but also on the global market. (Oil and Energy Trends, 2014).

Several oil refining companies in the EU plan to reduce their refinery capacity. However, this is not enough to increase the overall margins for the refining industry in the EU. If the margins for the industry should improve, upgrades and heavy investments have to be done in existing refineries as well. Moreover, the refineries have to be upgraded to become able to produce the petroleum products demanded in the EU and on the global market (Oil and Energy Trends, 2014)

Investing in hydrocrackers will increase the possibility for refiners in the EU to produce more middle distillates and to improve their refining margins. Meanwhile, investments have also to be made in technology that increases the production of light distillates out of heavy petroleum residues. (Oil and Energy Trends, 2014).

2.15 Energy trends in the EU until year 2025

The European Commission has issued the publication *EU Energy, Transport and GHG Emissions Trends to 2050 Reference Scenario 2013*. This publication describes how the energy market in the EU is expected to develop until year 2050. The analysis incorporates information relating to energy policies, the development of the EU´s economy, population of the EU and trends in energy consumption. The legislative part of the publication incorporates coming regulations to reduce the use of energy, reduce emissions of greenhouse gases and regulations regarding the development of renewable energy sources (Capros, et al., 2013). Figure 7 below indicates the estimated total demand of oil in the EU until year 2025 based on the 2013 reference scenario.

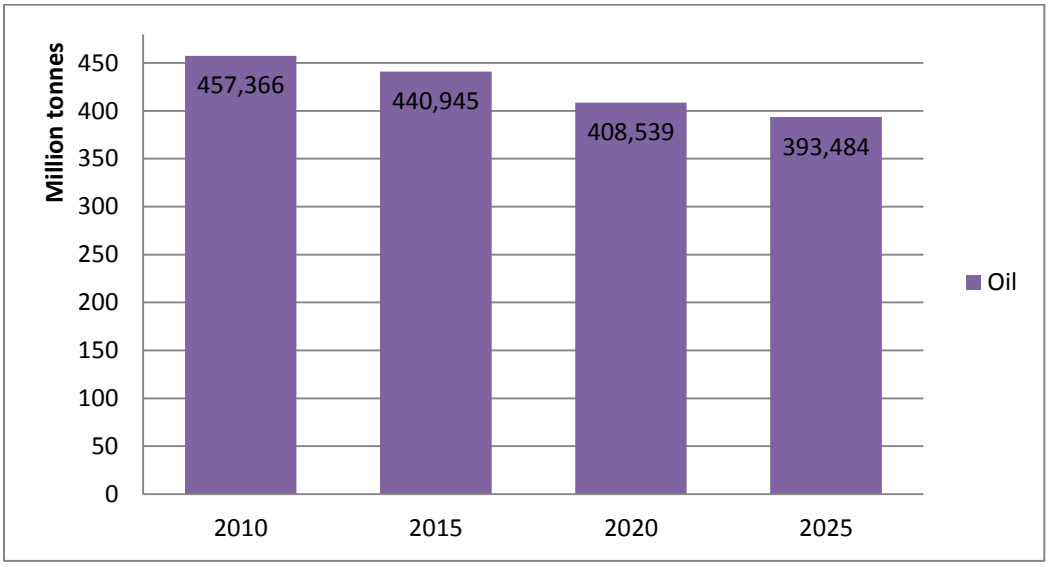

Figure 7. Demand of oil in million tonnes per year in the EU until year 2025. (Compiled from Capros, et al., 2013).

2.15.1 ***Decreasing demand of oil***

The predicted decrease in oil consumption in the EU does not have the same decrease rate for each specific petroleum product. Light distillates represent the largest decrease followed by the decrease in consumption of heavy fuel oil. Strong demand of diesel, has kept the demand for middle distillates stable. However, it is expected that the consumption of middle distillates will deteriorate as well due to expected high diesel prices and poor economic development in the EU (Oil and Energy Trends, 2014).

2.16 Location and capacities of refineries within the EU+2 areas

The total refining capacity in the EU+2 regions was 699.7 million tonnes per year. The capacity is divided on 84 refineries. The location of these refineries according to FuelsEurope (2014) can be seen in table 4 below. It should be noted that there exist another 22 refineries in the EU+2 regions. However, these are categorized as small (capacity of less than 2.5 million tonnes per year) or built for specialty refining and not included in the table below. (FuelsEurope, 2015).

Table 4: Location of refineries in the EU+2 regions. (Compiled from FuelsEurope, 2015).

Country	Number	Capacity, million tonnes per year
Austria	1	10.2
Belgium	3	39.2
Bulgaria	1	5.0
Croatia	2	6.7
Czech Republic	2	8.4
Denmark	2	8.8
Finland	2	13.2
France	8	70.5
Germany	11	102.3
Greece	4	24.0
Hungary	1	8.1
Ireland	1	3.6
Italy	10	84.0
Lithuania	1	10.0
Netherlands	6	66.0
Norway	2	17.2
Poland	2	24.7
Portugal	2	16.0
Romania	3	15.0
Slovakia	1	5.6
Spain	9	70.5
Sweden	3	21.6
Switzerland	1	3.4
United Kingdom	6	65.6

2.17 Crude oil supplying regions

In general, the choice of crude oil depends on crude oil quality, logistical circumstances and geopolitical conditions. Considerable volumes of crude oil processed in refineries within the EU+2 regions during the last 20 years have been light and sweet (low sulphur content). Producers in the North Sea, West- and North-Africa have been the suppliers of this oil. (Calzado Catalá , et al., 2013). The production of oil in the North Sea is decreasing. For compensating the setting oil production in the North Sea, the EU+2 regions mainly increase their imports of crude oil from the Caspian Sea area. (Calzado Catalá , et al., 2013) .Different types of crude oil with their individual characteristics refined in the EU+2 regions are described in table 5 below.

Table 5: Origins of crude oil used. (Compiled from Calzado Catalá , et al., 2013).

Place of origin	Description
North Sea	The production of oil in the North Sea is decreasing as new discoveries do not compensate for setting reservoirs. Usually, crude oil from the North Sea has low sulphur content (0.35%). Most produced volumes are consumed within Europe. However, quantities are exported to the United States as well. The West-European market has benefitted from logistical advantages from crude oil produced in the North Sea.
Africa	Oil from North Africa is mostly used as feedstock in refineries located in Southern Europe. Oil producing countries in North Africa are: Algeria, Libya and Egypt. The crude oil quality varies much. The oil from Egypt contains much sulphur and the Algerian crude oil is light and sweet. Oil from the West-African region is exported to the United States but also to Europe. Nigerian crude oil has a sulphur content of 0.15%.
Middle East	Crude oil from the Middle East is heavy and contains much sulphur. In Europe, this crude oil is used when producing bitumen and base-oils for lubrication purposes. Refineries in Europe, which refine crude oil from the Middle East are equipped with residue conversion units and sulphur removal units. It should be noted that according to Mohite (2014), it is easier in a refining perspective to extract lighter products out of residuals than reducing the level of sulphur in residuals. Relatively light and sweet crude oil from the Middle East has a sulphur content of 1.46% and heavy and sour crude oil has 2.6% of sulphur.
Russia	European countries import oil from Russia. Substantial volumes from Russia are distributed via pipeline systems. The imported oil is of middle quality and contains 1.23% sulphur.
Caspian Sea region	The oil is of high quality (light and sweet) and the sulphur level is 0.35%. The import to Europe of this crude oil increases to compensate the setting production in the North-Sea since crude oil from the Caspian Sea is competitively located..

During the last 20 years, crude oil slates used in refineries within the EU+2 regions has contained 50-55% of low sulphur crude oil. The slate is expected to be the same for the next coming 20 years. This since it is possible to compensate the shortfall of North Sea crude oil and replace it by crude oil from West-Africa and the Caspian Sea region. (Calzado Catalá , et al., 2013).

Expected composition of crude oil slates processed in the EU (excluding Croatia) +2 regions until 2025 is described in figure 8 below.

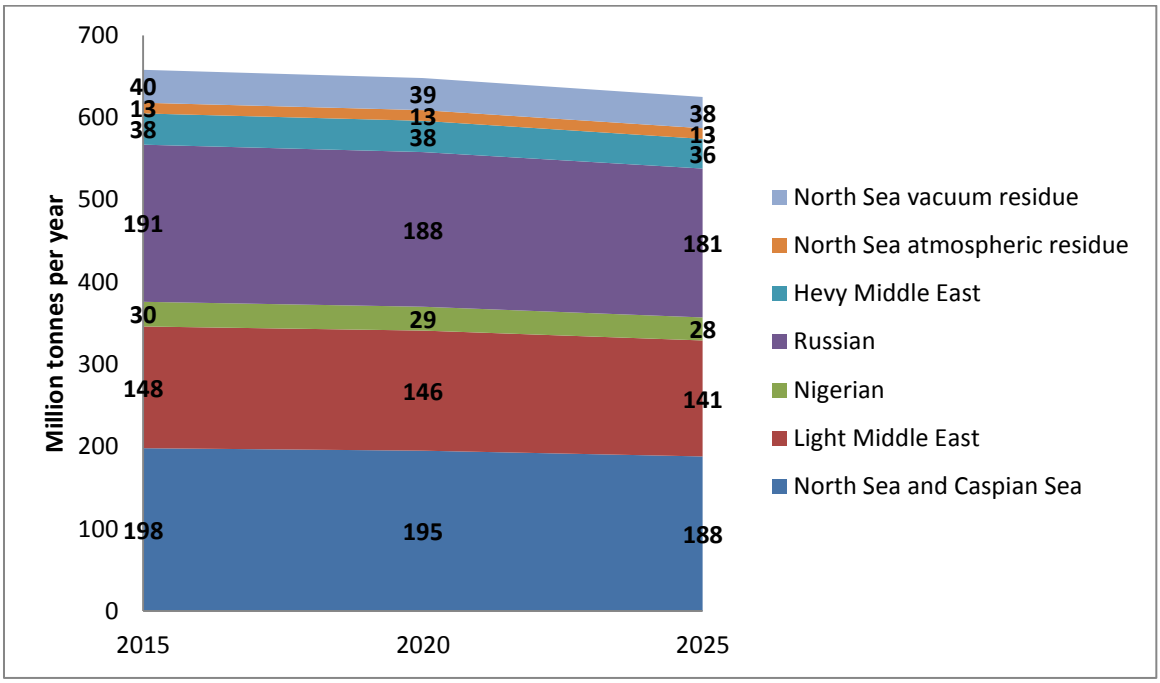

Figure 8: Composition of processed crude oils. (Compiled fromCalzado Catalá , et al., 2013).

2.18 Competition to refiners based in Europe

Refiners in the EU compete on a global market rather than regional (European Commission Directorate-General For Energy, 2014). Due to an expected global geographical change in oil consumption, change of oil supply and change towards an increased use of alternative energy sources, the global oil refining industry has to change and adopt. The oil refining industry in EU is expected to have difficulties with adjusting to coming changes and assumed to operate with overcapacity (International Energy Agency).

2.18.1 *Refining margins*

In the years between 2006 and 2012, refiners in the EU had constantly less net margins than refiners located in other regions and 50% of the least productive refineries in the EU, performed considerably less than the international average. The major reason for this was that refiners in the EU had higher operational costs. The higher operational cost was mainly due to

higher energy prices. Moreover, the price of energy has increased more in the EU compared to the rest of the world. (European Commission Directorate-General For Energy, 2014). If the global oil refining industry is divided into thirds when it comes to net cash margins, European refiners were in the top third in the years between 2000 and 2008. This has changed and between year 2008 and 2012, European refiners were placed in the bottom third (Oil and Energy Trends, 2014).

Several refineries located in the EU have high cost-bases. Oil refineries which have high cost-bases are typically small, old, unsophisticated and located in high cost inland locations without possibility of crude oil supplies by sea. Such categorized refineries in Europe have an approximate refining capacity of between 1.5 and 2 million barrels per day. If the oil refining industry in the EU should operate without economic losses, ineffective refineries have to close (Oil and Energy Trends, 2014).

Despite poor competitiveness in general for the refining industry in the EU, 50 per cent of the best performing refineries in the EU had better net refining margins between year 2006 and 2012 compared to the average margins of international competitors. (European Commission Directorate-General For Energy, 2014).

Refiners in the EU are interested to continue their refining operations in the EU market. This since the market is substantial despite a falling regional demand in the EU for petroleum products. However, it is important that the industry has long-term regulations which allow for refining operations and do not reduce the refining industry´s competitiveness. According to oil refiners in the EU, the region will demand petroleum products beyond year 2030. Therefore, it is important that competitive refining- and distribution-systems are maintained to be able to deliver competitive products to customers. (European Commission Directorate-General For Energy, 2014).

According to the European Commission Directorate-General For Energy (2014), it is strategically essential to have a refining industry in the EU. It is also important that equilibrium is accomplished between fulfilling the EU´s environmental objectives and conditions which allow for refining operations. (European Commission Directorate-General For Energy, 2014).

2.18.2 *Substitutes*

Oil companies in Europe are exposed to substitutes to their products. Substitutes may be products or other companies. Competitors placed in other parts of the world may want to sell their oil products on the European market. However, substitutes may also be substitutes to petroleum products (Jenster, 2009). The possibility of substitutes to the oil and gas market in Europe is moderate (Marketline, 2014). Substitutes to oil companies´ products are especially identified as renewable energy sources. The increasing demand of renewable and sustainable sources of energy in the European oil and gas market is a factor that increases the possibility

for substituting products. Meanwhile, to change sources of energy takes time and is also costly (Marketline, 2014).

2.18.3 *Competition*

Due to recent high oil refining margins and forecasted future demand of petroleum products, large investments have been made in the global oil refining sector. These investments are mainly located in India, China, The Middle East and the South East Asia (FuelsEurope, 2015). New refineries in South-East Asia and China are mainly built for supplying their own domestic markets. However, some of the new planned refineries in India and the Middle East, are constructed to produce petroleum products which correspond to fuel specifications in the United States and the European Union (FuelsEurope, 2015).

Oil refining companies located in the EU are sensitive to competition from non-EU refiners. This applies to both the local- and global-markets. (FuelsEurope, 2015). The oil refining industry in Europe is an example of a market with very high exit barriers. Moreover, an exit from the market leads to big losses of invested recourses. Several oil companies built oil refineries in Europe during the early 1970s. Despite the decreased demand for oil, refineries were completed and run into the 1980s. The BP was the first company to close refineries (Jenster & Solberg Soilen, 2009).

With high exit barriers, companies may be forced to operate with losses. During such periods the competition will be harsh and suppliers have to focus on covering as much of their costs as possible (Jenster, 2009). The competition on the European oil and gas market is strong. The main competing companies perform similar operations and have similar models for carrying out their business. Several companies on the European oil and gas market are large companies. These companies operate globally and are highly integrated with operations, including oil exploration, refining and distribution. These companies gain advantages from economy of scale. (Marketline, 2014).

Different companies may intend to enter the European oil refining market. Examples of new companies are companies based in other geographical areas and which perform similar business activities. Other examples may be companies operating in the European area which perform similar services (Jenster & Solberg Soilen, 2009).

Threat of new entrants to the European oil and gas industry is assessed as moderate. The need for large investments contributes to an increased barrier for entry. As the leading oil companies on the European oil and gas market are large companies which are integrated in different market segments, these companies gain economy of scale. New entrants which intend to compete on the market have to establish operations within different market segments, to gain the same advantages as the leading companies (Marketline, 2014).

Beside the threat of new competitors regionally to European oil refiners, European refiners are exposed to competition from refineries located in the United States, Asia and the Middle-

East. Meanwhile, European refiners are also directly affected by regional decreased demand for refined petroleum products. During year 2014, the demand for refined petroleum products declined by 2% compared to 2013 and is expected to decrease additionally due to energy efficiency regulation laws and taxes (Kent & Williams, 2015).

The production of shale oil in the United States and planned refining projects globally will lead to a surplus of petroleum products on the global market. Therefore, prices of petroleum products will be under pressure and oil refining companies will operate with lower margins. Some of these companies will be non-profitable (Oil and Energy Trends, 2014).

2.18.3.1 Increased shale oil production in the United States

The price of United States´ shale oil is relative cheap compared to other crude oils as only small volumes of crude oil are exported. Most of the exported oil is exported to Canada. The ban for exporting crude oil from the United States has been in force since year 1975. The rules were formed during the oil crisis with purpose to secure the United States´ supply of energy. However, several oil producers within the United States want to change the regulations and increase the export of crude oil. The companies argue that if the profit of selling crude oil should be maximized, it has to be possible to sell the oil on the global market. For now, there is a surplus of domestic oil in the United States which reduces the price. However, oil refiners want to keep the regulations since they secure availability of oil (Oil and Energy Trends, 2014).

Due to the ban on exporting crude oil from the United States, focus is in exporting petroleum products. Canada and the Latin America have traditionally been the main destinations for refined products from the United States. However, larger volumes of petroleum products now head for the European market (Oil and Energy Trends, 2014).

The extraction of shale oil in the United States is increasing. Shale oil in the United States is relative cheap compared to other crude oils. The increased production of shale oil in the United States has an impact on the global market for petroleum products. (Oil and Energy Trends, 2014). EU refiners compete with competitive refiners in the United States. Several of these refiners have sophisticated refineries and access to cheap crude oil and gas. Refineries located at the Gulf coast is an example, these refineries export large volumes of gasoline to Mexico, Latin America and West Africa and ultra-low sulphur diesel to Europe (European Commission Directorate-General For Energy, 2014).

Most shale oil in the United States has high yield of gasoline, jet-fuel and gasoil and low level of sulphur. Refiners in the United States save between 10 and 15 dollars per barrel when they refine domestic shale oil instead of imported crude oil of similar quality. Several oil companies define shale oil as "*Advantageous crude"* as this crude oil is of high quality and has a competitive price. Several oil refiners in the United States increase the share of "advantageous" oil as feedstock in their production. (Oil and Energy Trends, 2014).

The production of shale oil has resulted in investments of new refineries and also reopening of old refineries located at the United States´ east coast. Substantial investments have also been made into the domestic railway infrastructure to increase the transport capacity of oil by train (Oil and Energy Trends, 2014).

Surpluses of produced light distillates in the EU have previously been exported to the United States and global markets. However, the United States has occasionally become an exporter of gasoline instead of being an importer. The United States has different alternatives to export surpluses of petroleum products. The European market is one alternative. A second option is the market in Africa where refiners from the EU traditionally have been major players. (Oil and Energy Trends, 2014).

To adjust the production to suit the global demand of petroleum products, refiners in the United States may have to reconfigure their refining units to produce more middle distillates. This can be achieved if fluid catalytic crackers (FCCs) and other secondary equipment that increase production of gasoline are removed. FCCs can be replaced by hydrocrackers to increase the production of middle distillates. (Oil and Energy Trends, 2014)

2.18.3.2 Russia

Refineries in Russia are continuously upgraded. This is done to increase Russia's export of higher value products. Ultra-low sulphur diesel aimed for the European market is one example of product produced for export. (European Commission Directorate-General For Energy, 2014).

2.18.3.3 New refineries in China

China´s strategy to become self-supportive of motor fuels has led to large investments in refining projects in the country. China started an extensive programme to increase China´s crude oil distillation capacity by five million barrels per day between year 2013 and 2020. The programme involves construction of new refineries and upgrades of existing refineries. Upgrades will mainly be done in small existing refineries to increase the production of middle distillates and to improve the quality of gasoline. However, the construction of new refineries in China will lead to production capacity that exceeds the domestic demand. In year 2013, the excess capacity was calculated to be 1.5 million barrels per day. This capacity can be used for export purposes of petroleum products (Oil and Energy Trends, 2014).

It should be mentioned that oil refining companies in China look for refining facilities located outside China as well. However, this capacity is primarily aimed to supply China´s domestic market. (FuelsEurope, 2015). Diesel is produced in China and exported to Vietnam and Singapore. However, it is expected that volumes could be exported to the European market as well (European Commission Directorate-General For Energy, 2014).

2.18.3.4 South East Asia and the Pacific

New refineries are mainly built in the South East Asia to reduce the dependency on imported petroleum products. However, the capacity of the planned projects exceeds the local demand and therefore results in exporting potential. Between year 2014 and 2019, the oil refining capacity in the regions is expected to expand by 3.045 million barrels per day (Oil and Energy Trends, 2014).

More than 50% of planned new refining capacity globally is located in the Asia-Pacific region. (Mohite, 2014). Until 2020, the Asia-Pacific region has potential to export petroleum products. Beyond year 2020, surpluses are expected to be consumed within the region. (Mohite, 2014).

2.18.3.5 India and the Middle East

The refining capacity in the Middle East is expected to increase by 1.3 million barrels per day between year 2014 and 2019. With planned projects, the Middle East region is expected to become a net exporter of gasoil instead of being an importer of gasoil (Oil and Energy Trends, 2014). The Middle East has potential to produce more high-value products out of the regions´ present surplus of naphtha, liquefied petroleum gases and condensates. Such products are produced by cheap feedstock and could potentially be sold on the international market besides the internal market. (Mohite, 2014).

The Middle East is expected to gradually become a long-term exporter of both crude oil and petroleum products. (Mohite, 2014). European oil refining companies are expected to face competition from oil refining companies based in the Middle East and India. Low cost labour, low cost of energy as well as tax incentives, are factors which make oil refining companies located in the Middle East and India competitive to European refiners (FuelsEurope, 2015). Refiners in the Middle East do also have access to cheap crude oil (European Commission Directorate-General For Energy, 2014).

India is the second largest country after China where large investments have been made into new refining capacity. In the years between 2013 and 2021, India´s oil refining capacity is expected to increase by 1.9 million barrels per day. India´s refining strategy is to build refining capacity that exceeds India´s own demand. Product surpluses have mainly been exported to the Asian- and East African-market. (Oil and Energy Trends, 2014). Diesel comprises the largest share of products exported from India (European Commission Directorate-General For Energy, 2014).

It is expected that oil refining companies from India and the Middle East may purchase logistical- and market-assets in the EU. This is done to further increase their competiveness on the European market (FuelsEurope, 2015).

The competition to European refiners from oil refiners in India and the Middle East is expected to be temporary. This since the demand of high quality fuels is expected to increase on the domestic markets in the India and the Middle East. (FuelsEurope, 2015).

3 Methodology

3.1 Research design

To fulfil the purpose of this study, which is to investigate how and why the refining industry in the EEA will develop until year 2025 and how these changes will affect the intermediate product tanker segment, a case study has been performed. A case study is appropriate when it comes to answering research questions which include "how" and "why" when exploring an existing social phenomenon (Yin, 2006/2007).

The analysis strategy in this study is based on "following theoretical propositions". Furthermore, to challenge the propositions which are the basic ideas for the study. "Following theoretical propositions" is the preferable analysis strategy when it comes to case studies (Yin, 2006/2007).

The main theoretical propositions used as a base for the research questions in this study are:

- Oil refineries may close in the EEA due to decreased demand of oil, increased competition from oil refiners located outside the EEA, poor profitability and old oil refining facilities.
- If less oil is refined in the EEA, will oil companies import oil for supplying the market in the EEA?
- The use of intermediate product tankers may change if the distribution patterns for oil in the EEA market are changed.

The analysis of data collected from interviews has been done by matching patterns. This means that the collected data has been compared with predicted outcomes. "Pattern matching" has been used as it is the preferable analysis method when a case study is done and it contributes to increase the internal validity (Yin, 2006/2007).

The data has been compared by using a matrix where information from the different interviews has been summarized. By categorizing and summarizing the information, it has been possible to match patterns which lead to the results (Yin, 2006/2007).

The research unit has from the research questions been defined as: How and why the oil refining industry will change in the EU until year 2025 and what impact these changes will have on the intermediate product tanker segment?

By designing the study as a case study, it has been possible to create a holistic view of the subject and to explore the subject in-depth. This is possible as the case study design allows the researcher to use different methods for collecting information (Yin, 2006/2007).

3.2 Data collection

Interviews have been used for collecting primary data. A literature study and statistical records have been used as secondary data and to build the theoretical framework. By conducting several interviews for collecting primary data, it has been possible to establish a more secure result as the data can be compared and categorized. (Denscombe, 1998/2009). Respondents have been chosen from both oil companies and shipping companies for creating an overview of the subject. The respondents act within management levels in the companies. Respondents from the management level have been chosen since they could provide valuable market forecast information (Debra, et al., 2014). The secondary data has been used for supplementing the primary data in the discussion part of this study. (Denscombe, 1998/2009).

Triangulation has been used to compare data from the interviews. The purpose of using triangulation in this study has been to establish a more complete overview of the subject. Triangulation can be done to either create a more complete overview or to establish a more secure result (Denscombe, 1998/2009). A description of how the method has been used can be read below.

3.3 Interviews

Ten interviews have been conducted to gather interview-based information. Yin (2006/2007) argues that interviews are one of the most important information sources when it comes to case studies. By conducting interviews, it may be possible to get information about companies´ current and coming needs, such information is important when investigating a market (Debra, et al., 2014).

By conducting interviews, it has been possible to gather information based on individuals´ personal knowledge and belief. This is of particular importance when investigating subjects relating to how the future is expected to develop (Denscombe, 1998/2009).

Focusing questions have been the ground for the interviews. By using *focusing questions* it has been possible to retrieve information that directly can be compared to other sources of information but also the interviewees´ personal apprehension of the subject. This contributes to the holistic approach of the study. Furthermore, the answers have been explained and discussed during interviews (Denscombe, 1998/2009). By using *focusing questions* it has been possible to use the respondents more like informants since the answers have included personal ideas and knowledge (Yin, 2007).

The questions used during the interviews have been formed out of a “how” basis. However the main purpose of the questions has been to investigate “why” the case is expected to develop in a certain direction. The reason for this is to avoid “why” questions since such questions may raise resistance by the respondents to answer the questions (Yin, 2007).

The questions asked have not been leading questions. This as answers formed out of leading questions cannot be handled as separate data. This means that the data cannot be compared to other sources of information (Yin, 2007).

In a market analytical point of view, interviews are very good sources for determining the market, as the information is formed out of a discussion (Debra, et al., 2014). Debra, et al. (2014) insists that interviews used for a market analysis should include questions relating to how the current market looks like and questions which may identify coming demands. The questions used in this study focus mainly in identifying coming developments and demands.

The respondents have been chosen based on their knowledge about the subject. It is essential that the respondents have appropriate and sufficient knowledge about the topic, especially when it comes to defining how the future is expected to develop (Debra, et al., 2014). Respondents used in this study were active within: two intermediate-shipping companies´ chartering departments, a shipping analysing company, an independent maritime professional, a commercial operator in a company that operates MR tankers in the EEA, a trading manager in a company with refining operations in the EEA, a manager for planning and optimization in a company with refining operations in the EEA, a manager for physical management in a company with refining operations in the EEA, a manager for the shipping division of a company with refining operations in the EEA and a manager for product trading in a company with refining operations in the EEA.

All questions asked during the interviews were sent to the respondents before the interviews were held. This was done to clarify any uncertainties regarding the interview questions (Debra, et al., 2014). The questions asked during the interviews can be seen in appendix A.

The interviews commenced by introducing the persons involved followed by a description of why the interviews were held. Before the questions were asked, a background introduction to the subject was given. This makes it easier for the respondents to answer and understand the aim of the questions (Debra, et al., 2014).

Ten interviews were conducted in total and eight of those were undertaken by physical meetings and two interviews were done by telephone. The two interviews via telephone were done with the shipping analyst and the independent maritime professional. All information collected during the interviews was recorded on tape. Recorded material was transcribed after the interviews. Transcribed information in total consisted of 32 pages. This information was separately sent to all respondents for verification and approval before the information was used in the study. The information must be approved before it is used by the researcher and this also contributes to increase the validity (Debra, et al., 2014).

3.3.1 *Analysis of information*

Information from interviews has been transcribed, categorized and explained. The categorization has been done by using a matrix where the different answers have been summarized for each question. The results are further explained in the ”results” chapter where

pattern matching has been done. Furthermore, the theoretical propositions have been compared with the information gathered from the interviews. Pattern matching is the preferable method for analysing information in a case study (Yin, 2007).

3.4 Statistical data

Statistical records have been used in this report to gather information regarding consumption of petroleum products, oil refining capacities and modelled predictions. The information has been collected from official statistical sources and from literature. Statistical data is handled as quantitative data and includes figures, volumes and statistics. All statistical data has been used as secondary data with purpose to supplement the results in the discussion part of the study (Debra, et al., 2014).

3.5 Literature

Beside statistical data, literature has been used for collecting quantitative secondary data. Articles and documents from specific branch orientated publishers have been used for retrieving industry information. By using branch orientated publishers, it has been possible to collect new and updated information (Denscombe, 1998/2009). The literature review has been the base for developing the questions asked during the interviews. This contributes to increase the quality of the questions (Yin, 2007). Information from the literature review has been used together with statistical data to supplement and to verify the result data in the discussion part of the study.

Different company reports and annual information has been used for retrieving oil industry information. The reports have been used for estimating coming volumes and markets (Debra, et al., 2014). The information has been used as secondary information. However, reports have been used for preparing the analysis itself by supplementing the theoretical propositions (Debra, et al., 2014).

4 Results

The following chapter gives a thorough explanation and a summary of answers given by the respondents to each question. However, a categorization matrix of the answers can be found in appendix B.

4.1 Total demand for oil in the EEA until 2025

Nine respondents have answered question one, ***"How will the demand of different petroleum products develop until 2025 in the European Economic Area?"***. Sub-questions focus in light distillates, middle distillates and heavy fuel oil.

4.1.1 *Stagnant or decreasing demand*

Seven respondents out of nine believed that the demand for oil in the EEA until 2025 will be stagnant or decrease. One respondent base the prediction on that more efficient vehicles are to come. However, the improved energy efficiency may be counteracted by a growing number of energy consuming units and increased use of them (Intermediate operator No.2).

A comment from one respondent …In general, the demand for energy in Western Europe has decreased and is now stagnant. Only small changes may occur when it comes to the total demand… (Shipping analyst).

According to one respondent, the consumption ratio between diesel and gasoline may change within Europe and the EEA. Within the region, diesel has become the preferred fuel for transportation purposes. This applies to both private and industrial use. However, combustion of diesel versus gasoline leads to more emissions of nitrogen gases. However, combustion of gasoline leads to more CO_2 emissions. Due to this, discussions presently take place whether local emissions of nitrogen gases or emissions of CO_2 should be reduced. If focus will be in reducing emissions of CO_2, diesel cars will be promoted. If CO_2 is to be reduced, cars fuelled by gasoline will be promoted. It should be noted that engines in small cars fuelled by gasoline have been and are continuously improved when it comes to fuel consumption efficiency. Due to this, the consumption ratio between diesel and gasoline in the EEA may change if the consumption of gasoline grows. (Manager, trading). The respondent also said that … Within the EEA, the consumption of oil is expected to be stagnant since the region strives to reduce the use of fossil fuels. Therefore, the consumption will not be allowed to grow…

According to another respondent, France as an example has decided that difference in price between gasoline and diesel should be harmonized. Moreover, diesel has had lower taxes compared to gasoline. The difference will stepwise be equalized with start in year 2016 and continue through 2020. (Manager, product trading).

According to one respondent, the demand of diesel in the EEA has until now been expected to increase. However, there are factors which counteract further increased demand for diesel. One factor is that diesel may not be the cleanest fossil fuel used in the transportation sector.

Another aspect is that when diesel is produced out of crude oil; this process will always lead to produced gasoline as well. This may balance the demand difference between gasoline and diesel in the long run. (Manager, physical management).

One respondent believed that biofuels are expected to capture market shares, particularly with emphasis on diesel and heavy fuel oil. This respondent also mentioned that natural gas may challenge the demand for liquidized petroleum gas (LPG). For now, the price is higher for natural gas compared to LPG. LPG is much used in the petrochemical industry. (Manager, optimization and planning).

One respondent believed that consumption of heavy fuel oil, with emphasis on bunker for ships; depends much on coming bunker specifications. Moreover, the maximum allowable level of sulphur in marine fuels will become 0.5%. Time for ratification is expected to be in year 2020 for ships trading within Europe and 2025 for ships in global trade. (Manager, physical management).

The respondent also said that there are different alternatives are available to handle coming specifications for marine bunkers. Ships could be equipped with scrubbers and heavy fuel oil may potentially be upgraded. However, it is hard to predict which method that will become the most favourable. The use of scrubbers is a question of in which segment of shipping they will be used. (Manager, physical management).

The respondent said that several analyses have been performed regarding the future price of heavy fuel oil and there are no clear indicators of collapse in the price of heavy fuel oil. However, the demand for heavy fuel oil will be reduced if heavy fuel oil is replaced by middle distillates. (Manager, physical management).

The same respondent said that generally, there will always be need for transportation within the EEA region. The economy is based on available and relative cheap transportation. In the EEA, diesel is the preferred fuel in the transport sector. In the United States, gasoline is used more for transportation purposes compared to the EEA. (Manager, physical management).

According to another respondent, naphtha is used as feedstock when producing gasoline and petrochemicals. For the time being, it is expected that the demand for petrochemicals is strong for years to come. In this segment, refiners have good margins. It is hard to predict how the demand will develop beyond 2020. However, the global demand for petrochemical products is expected to be strong and grow if the economy in emerging markets grows. (Manager, product trading).

4.1.2 *Increasing demand*

Two respondents out of nine believed that the total demand for petroleum products in the EEA will increase until year 2020 and then level off. Both respondents base their predictions on an increased business activity within the EEA. According to one respondent … demand is in relation to the business activity. If the activity increases, the demand for petroleum products

increases as well…. The increased activity is based on economy growth but also due to economic recovery in Portugal, Greece and Spain (Intermediate operator No.1).

The respondent also explained that crude oil price affects the demand for petroleum products. Due to the substantial crude oil price reduction from above 100 dollars per barrel to between 40 to 50 dollars per barrel (in year 2014-2015); this has had impact on refiners´ margins. When the oil price was relatively high, refiners only produced the amount demanded by the market since margins were poor. However, with lower crude oil price, refiners have gained improved margins. This makes it possible for refiners to a greater extent to lower the product price to increase their sales. As an example, a reduced price of diesel and gasoline has contributed to increased use of cars. (Intermediate operator No.1).

4.1.2.1 Summary of results

- *Seven respondents out of nine* believed in a stagnant or decreasing demand.
- *Two respondents out of nine* believed in an increasing demand.

4.2 Demand of light distillates in the EEA until 2025

4.2.1 *Stagnant or decreasing demand*

Five respondents out of nine believed the demand of light distillates to be stagnant or decreasing. However, according to one respondent, consumption may change between different products within the segment. An example is the consumption ratio between liquefied petroleum gases (LPG) and naphtha. These products are used in the petrochemical- and manufacturing-industries for similar purposes. Therefore, difference in price affects the demand (Intermediate operator No.2).

According to one respondent, the demand for gasoline may grow in relation to diesel. France as an example has decided that the differential in price between gasoline and diesel should be harmonized. Moreover, diesel has had lower taxes compared to gasoline. The difference will stepwise be equalized, with commencement in year 2016 and continue through year 2020. France has traditionally been the "front-runner" for dieselization in the EU. However, the trend is now shifting and cars fuelled by gasoline grow in numbers. It should also be noted that France invests much in recharging stations for electrified vehicles. (Manager, product trading).

4.2.2 *Increased demand until year 2020 and then level off*

Two respondents out of nine believed the demand to increase until year 2020 and then level off. One of these respondents explained that an economic growth in combination with increased population in the region drive the development. Several naphthenic compounds are used directly in the manufacturing industry and the demand will grow with increased business activity (Intermediate operator No.1).

4.2.3 *Still be demand*

One respondent answered that …there will still be a demand for light distillates…. (Manager, physical management).

4.2.4 *Stable or slightly increase*

One respondent answered that the demand for clean petroleum products will be stable or slightly increase. However, efficiency gains and behavioural changes by "old" consumers in the Western part of the EEA are counteracted by increased demand in the Eastern EEA and population growth. (Independent Maritime Professional).

4.2.4.1 Summary of results

- *Five respondents out of nine* believed in a stagnant or decreasing demand.
- *Two respondents out of nine* believed in an increased demand until year 2020 and then level off.
- *One respondent out of nine* believed that there still will be a demand.
- *One respondent out of nine* believed in a stable or slightly decreasing demand.

4.3 Demand for middle distillates in the EEA until 2025

4.3.1 *Stagnant demand*

Five respondents out of nine believed in stagnant demand. One of these respondents said that the demand for middle distillates is stable due to high consumption of diesel. According to the respondent …the main driving factor is the consumption of diesel. Diesel is a popular fuel in the EEA and is expected to continue to be popular… (Intermediate operator No.2).

Another respondent explained that the consumption balance between of light-distillates and middle-distillates may change if e.g. the aviation industry decides to evaluate other fuels. This could potentially lead to a decreased demand for middle-distillates and an increased demand for lighter distillates (MR operator).

Even though answers indicated stagnant demand for middle distillates, there were respondents which believed in a possible increase beyond year 2020. One of these respondents' meant that consumption of diesel will depend on political incentives. For the time being, discussions take place in the EEA if the use of diesel should be reduced in London and Paris. (Manager, optimization and planning). Another respondent believed that consumption of middle distillates may increase after year 2020. This if middle distillates are more used in marine bunker purposes. (Manager, physical management). The last respondent mentioned a possible slight increase due to increased consumption in the Eastern Europe that counteracts decreasing demand in Western Europe. (Independent Maritime Professional).

4.3.2 *Increased demand*

One respondent believed in increased demand until year 2020 and then level off until year 2025. This as the demand of diesel grows in the EEA. (Intermediate operator No.1).

4.3.3 *Slightly increased demand*

One respondent believed the demand to slightly increase. The development is driven by an increased demand for diesel. The demand for diesel has increased due to established emission control areas (ECA) in the North- and Baltic-Sea. The demand for diesel is also increasing due to a growing number of diesel cars. (Shipping analyst).

4.3.4 *Demand depends on political incentives*

One respondent said that …demand has increased during recent years but further development depends on political incentives. (Manager, trading).

4.3.5 *Decreased demand*

One respondent expected decreased demand. However, in the eastern part of the EEA, the consumption of diesel is increasing and in the western EEA, the consumption levels off. Due to the price reduction of crude oil in 2014 and 2015, the consumption of diesel and gasoline has increased by five per cent within the region. If the crude oil price stabilizes at present levels during year 2016, the consumption within the EEA will level off and decrease in the longer run. This because political incentives and environmental legislations are expected to lead to reduced consumption. (Manager, product trading).

4.3.5.1 Summary of results

- *Five respondents out of nine* believed in a stagnant demand.
- *One respondent out of nine* believed in an increasing demand.
- *One respondent out of nine* believed in a slightly increased demand.
- *One respondent out of nine* said that the demand depends on future political incentives.
- *One respondent out of nine* believed in decreasing demand.

4.4 Demand of heavy fuel oil in the EEA until year 2025

4.4.1 *Decreasing demand*

Eight respondents out of nine believed in a decreasing demand. Two respondents based their expectation on decreased use of heavy fuel oil for heating purposes and in shipping. In shipping, this is driven by establishment of Emission Control Areas (ECA) in Europe (Baltic Sea and the North Sea). In ECA areas, ships are allowed to use fuels with 0.1% sulphur only. This has resulted in less use of heavy fuel oils and increased use of marine gas oils (Intermediate operator No.2).

The limit of sulphur in marine fuels will change generally in the EEA. Moreover, the maximum allowable level of sulphur will become 0.5% outside ECA areas. Ratification is

planned to be in year 2020; however, the subject will be reviewed in year 2018 with option to postpone ratification until year 2025. Access to new fuels and solutions will have impact on time for ratification. (Manager, product trading)

According to one respondent, different solutions are available to fulfil coming bunker specifications for ships. If the price difference between ECA fuel (0.1% sulphur) and fuel with 0.5% sulphur differs substantially within the EEA region, there is incentive for ship-owners to invest in scrubbers (Manager, product trading). One respondent explained that the demand of heavy fuel oil is decreasing as other sources of energy are prioritized. Biodiesel is one example of replacement fuel instead of using heavy fuel oil. (Manager, optimization and planning).

One respondent said that …the decreasing demand for heavy fuel oil may be reduced due to increased use of heavy fuel oil in power generation... The bunker market is a large factor when estimating the demand. Heavy fuel oil, even if traded in the EU, it is only small volumes which are consumed within the region due to SECA regulations. Considerable volumes of heavy fuel oil are therefore exported. (Independent Maritime Professional).

4.4.2 *Stable demand*

One respondent believed the demand of heavy fuel oil to be stable. The respondent explained that … Heavy fuel oil is a residue from the refining process of crude oil. Therefore, if the demand for petroleum products increases, the production of heavy fuel oil increases as well… (Intermediate operator No.1).

Unprocessed heavy fuel oil is called "straight run" fuel oil. Straight run heavy fuel oil contains petroleum products which have not been extracted. Straight run heavy fuel oil can be used as feedstock at sophisticated refineries where higher value products can be extracted. (Intermediate operator No.1).

4.4.2.1 Summary of results

- *Eight respondents out of nine* believed in a decreasing demand.
- *One respondent out of nine* believed in a stable demand.

4.5 Question two

Nine respondents have answered question two, ***" How will the oil companies supply their products; with own refineries or imported products?***. Sub-questions focused in how the refining industry in the EEA is expected to develop until year 2025, what challenges refiners within the EEA face and how the import of petroleum products is expected to develop to the EEA.

4.5.1 *Additional closures of refineries*

Six respondents out of nine have answered that they expected additional future closures of refineries within the EEA. Most of the oil refineries within the EEA are old facilities and face

competition from refiners based in other regions. Some old refineries may close and be used as storage facilities (Intermediate operator No.1). Refiners which own a small number of unsophisticated refineries only, are the most sensitive to poor margins within the region. These may face total closure (Manager, physical management). Some small refining units are expected to close if they do not have market- or logistical-advantages (Independent Maritime Professional).

According to one respondent, the EEA in general, has refining capacity that exceeds the demand. The configuration of refineries varies within the EEA and so do their margins. As an example, "simple" refineries are initially the most vulnerable type of refinery configuration when it comes to poor margins. However, to improve these refineries´ margins, refiners may choose to reduce costs for maintenance. These refineries are then run until they have to be totally closed. The refining overcapacity in the EEA is estimated to between five and ten per cent (Manager, physical management).

One respondent said that … Due to expected increase of imported petroleum products, some refineries may close… (Intermediate operator No.2). Several refineries have closed within the EEA during the last five to six years. However, additional closures of inefficient, out-dated refineries are expected to come and the development is driven by increased competition from refiners based outside the EEA (Shipping analyst).

According to one respondent, focus is in divestments and closure of refining capacity rather than investing in new capacity. (MR operator). During the last five to six years, approximately ten oil refineries have closed within the EEA. The majority of these refineries have been located in inland locations (Intermediate operator No.2). Import of petroleum products and particularly diesel is expected to increase if old refineries in poor condition close. (Manager, product trading).

4.5.2 *Refineries are divested*

Three respondents out of nine said that refining- and distribution- operations in several large oil companies have been sold to other companies. Instead of oil companies, it may be retail companies which distribute petroleum products. Such companies do usually not own their own refineries and chose suppliers which are the most price competitive and convenient. (Manager, physical management).

According to one respondent ... To a certain extent, the oil industry faces vertical disintegration… Several oil companies have divested their refineries to independent refiners. As an example, BP does not own any refineries in the UK. However, BP is a strong brand in the country and has in some countries large upstream production of oil. (Independent Maritime Professional).

One respondent believed that refining operations to a greater extent will be performed by "independent" refiners. This since some large oil companies has changed their business models. Furthermore, they focus in upstream activities and trade of petroleum products

instead of having own refineries and distribution systems. This has resulted in more "independent" refining companies in the EEA. A few of these companies have performed inadequate and ended in bankruptcy and then been overtaken by other companies (Manager, trading).

One respondent said that …Different players with different company structures compete on the EEA market for supplying petroleum products... As an example, distributors on the EEA market may have access to refining capacity in the Middle East and want to use its own distribution system. Such companies will therefore import products from regions outside the EEA. (Manager, product trading).

4.5.3 *Industry upgrades*

Two respondents out of nine said that they expected upgrades within the industry. According to one respondent … Refineries which have competitive locations and are in relative good condition may be upgraded… (Intermediate operator No.2). However, the development is expected to be slow due to challenging finances (Shipping analyst).

According to one respondent …profitable refineries are expected to be profitable even in future... However, these refineries have to be upgraded. More precisely, increased ability to upgrade heavy fuel oils or also known as the "bottom of the barrel". This is the next phase for the industry to be able to produce more environmental friendly products. It should be noted that timing is essential for such investments. (Manager, physical management). The rate of utilization could increase on remaining refineries in the EEA if total capacity is reduced (Intermediate operator No.1).

One respondent said that unsophisticated refineries which have not been upgraded can survive if they focus in production of a specific product, e.g. biodiesel. In such case, the location of the refinery is of high importance. (Trading manager).

4.5.4 *No new refineries*

Two respondents out of nine did not expect any new refineries in the region. One respondent explained that … incentives for constructing new refineries are low… Considerable refining capacity has to close before it is interesting to construct new refineries. During recent years, refiners within the EEA have been struggling with poor margins (with 2015 as exception). (Manager, trading).

4.5.5 *Stable production*

One respondent expected stable production. This since several planned non-EEA refineries are not yet complete. The region requires petroleum products and local refineries are demanded for delivering the products. (Intermediate operator No.1).

4.5.6 *Refining capacity has to reduce*

One respondent said that the total refining capacity has to be reduced. This since there is overcapacity within the EEA. The refining capacity has to be reduced if the region should produce volumes which correspond to the regional demand. This will also lead to improved refining margins. (Manager, trading).

4.5.7 *High refining capacity*

One respondent said that … The oil refining capacity is high within the EEA. The high capacity is expected to remain even in future. Several refineries have closed within the region and today, the question is if more refinery closures are to come... (Manager, optimization and planning).

The import of refined products and especially diesel from the United States, Middle East and Asia to the EEA is expected to remain. The import is driven by the market structure. If the product price is higher in Europe, volumes will flow to Europe until balance in price between different markets occur. (Manager, optimization and planning).

4.5.8 *Excess capacity of gasoline production and deficit of diesel production*

One respondent said that …The region has excess production capacity when it comes to gasoline. Meanwhile, the region has deficit of diesel… Substantial growth in demand for gasoline is needed until the production corresponds to demand. Despite recent and coming closures of refineries within the region, refiners within the EEA are expected to be able to supply the demand of petroleum products; however the region still has to import middle distillates. (Manager, product trading).

4.5.9 *Consolidation*

One respondent said that … Some consolidation is expected… (Independent Maritime Professional).

4.5.9.1 Summary of results

- *Six respondents out of nine* believed in additional closures of refineries.
  Three respondents out of nine believed that refining operations are divested.
- *Two respondents out of nine* expected upgrades in the industry.
- *Two respondents out of nine* did not expect construction of new refineries.
- *One respondent out of nine* believed in a stable production.
- *One respondent out of nine* said that the refining capacity has to be reduced.
- *One respondent out of nine* said believed in a high refining capacity.
- *One respondent out of nine* said that the refining industry will have a surplus in gasoline production and a deficit of diesel production.
- *One respondent out of nine* believed in consolidations.

4.6 What challenges does the refining industry face in the European Economic Area?

4.6.1 *Tough competition from non-EEA refiners*

Seven respondents out of nine answered that refiners based within the EEA are expected to face tough competition from refiners based outside the EEA. Non-EEA refiners are able to produce petroleum products with lower price (Intermediate operator No.1). These refiners are expected to produce more products aimed for the EEA market. However, the EEA needs imported volumes since the region has deficit of middle distillates (MR operator). The competition is also driven by global oversupply of refining capacity (Independent Maritime Professional).

According to one respondent, new refineries are built outside the EEA region. The main purpose of this new refining capacity is to reduce countries´ local dependency on imports of petroleum products. Another factor is that these refineries are strategically built to capture more of the value chain. Instead of exporting crude oil only, petroleum products can be exported as well. As an example, new refineries are built in China, the Middle East and in Saudi Arabia. (Manager, trading). Refiners based in the United States have benefitted from the United States´ ban on crude oil export. This has contributed to good margins for the country´s refiners and production of large volumes of gasoline and diesel. Most of the gasoline has been domestically consumed and surpluses of diesel have been exported, to e.g. the EEA market. Beside the United States, India has exported diesel to the EEA as well. It is expected that imports from Saudi Arabia are to come. (Manager, trading).

According to one respondent, the United States has become one of the largest exporters of petroleum products during the recent three years. Refiners in the EEA have traditionally been internationally competitive. However, the global refining industry changes and refiners in the EEA face increased competition from non-EEA refiners. Non-EEA refiners produce products specified for the European market. This will increase the competition and challenge EEA´s refiners in a macroeconomic perspective. Refiners located in the EEA are expected to struggle if it will become more lucrative to import petroleum products to the EEA from non-EEA refiners. (MR operator).

The respondent also said that refiners based in the EEA are expected to face increased competition from non-EEA refiners on the global market, especially from the United States but also from refiners based in Asia. (MR operator). This competition will be specifically harsh on the gasoline market since refiners in the EEA have surpluses of gasoline which have to be exported (Manager, trading). If refiners in the EEA should perform with positive margins, they have to seek for new export markets. The African market could be one alternative (MR operator).

One respondent explained that, for the time being, the production of shale oil in the United States has put pressure on refiners based in the EEA. Instead of being a large importer of

petroleum products, the United States occasionally has become a net exporter. (Intermediate operator No.2).

4.6.2 *Environmental restrictions*

Three respondent out of nines said that environmental restrictions may be challenging. If regulations become more stringent, the interest for upgrading old refineries will be limited. However, if such requirements come in place, the transitional period is expected to be long. (Intermediate operator No.1).

The respondent also said that …beside environmental requirements, odour and noise creation may constrain refineries locally... (Intermediate operator No.1).

According to one respondent, the EEA is in front when it comes to environmental legislations. An example is taxes on CO_2 emissions. If an industry produces much CO_2, it has to pay corresponding fees. These fees may get higher due to political intentions. However, for not putting too much pressure on certain industries, there are volumes free of taxation. The intention within the EEA is to further reduce CO_2 emissions. This will be challenging to refiners in the region. For the time being, the price is eight Euros for every tonne of CO_2 emitted. However, there is political intention to increase the fee to become 25 Euros. (Manager, trading). Such incentives will put additional pressure on refiners' margins within the EEA and lead to higher competition from refiners based in e.g. India, the Middle East and China. The refining industry in the EEA would be more competitive if rules were globally uniformed because that contributes to cost neutrality. (Manager, physical management).

4.6.3 *Harsh competition on the market for diesel*

Two respondents out of nine believed that the competition on the diesel market in the EEA is expected to be harsh and refiners will have weakened margins on diesel. This since it is expected that much diesel will be produced globally (Manager, optimization and planning). Competitors to refiners in the EEA are based in the United States, The Middle East and Asia. These refiners look for export alternatives for their surpluses of diesel. New refineries in Asia and in the Middle East are highly sophisticated and produce low yield of heavy fuel oil. These refineries will be competitive to refiners based in the EEA, especially when it comes to production of middle distillates. Despite the demand of importing middle distillates to the EEA, margins for refiners in the EEA will be under pressure (Manager, product trading).

4.6.4 *Low margins*

Two respondents out of nine said that low refining margins will be challenging. The refining industry´s profitability is a major concern. This is mainly due to a mature market and competition from The Middle East, India and the United States (Shipping analyst). The industry is also sensitive to low refining margins due to low complexity and limited upgrading capacity of the "bottom of the barrel" (Independent Maritime Professional). Refiners´ margins

may improve within the EEA if additional refineries are closed (Manager, physical management).

4.6.5 *Overcapacity*

Two respondents out of nine believed that the industry will operative with overcapacity. The high capacity is expected to remain even in future and is estimated to be five to ten per cent (Manager, physical management).

4.6.6 *Limited possibility to upgrade heavy fuel oil*

One respondent said that one challenge is the industry´s limited ability to upgrade heavy fuel oil and transform it into products of higher value. (Manager, physical management).

4.6.7 *Increased use of renewable energy sources*

One respondent expected that increased use of renewable energy sources will capture market shares from petroleum products. However, the use of renewable energy sources relative to fossil fuels is expected to be low until year 2025. (Intermediate operator No.2).

4.6.8 *Decreasing local demand*

One respondent believed that a decreasing local demand for petroleum products will be challenging. (Manager, trading).

4.6.9 *Changing product mix*

One respondent said that …that a changing product mix demand will be challenging… (Shipping analyst).

4.6.10 *Surplus of gasoline and heavy fuel oil*

One respondent expected the industry to operate with surpluses of gasoline and heavy fuel oil. Much of the heavy fuel oil surplus is exported to the Asian region since the EEA is unable to absorb these volumes. The future trend is that the EEA will have surplus of heavy fuel oil. Prognosis-institutes expect that it will be hard to get profitable margins out of gasoline in the EEA due to the surplus of gasoline. The surplus has traditionally been exported to the United States. Some volumes have also been exported to Africa and South America. However, exports from the EEA to South America may become less since investments in the region´s refining industry take place. (Manager, optimization and planning).

4.6.11 *Old refining technology*

One respondent explained that the refining technology in the EEA is older than the technology of competing non-EEA refiners. This is a challenge (Manager, product trading).

4.6.11.1 Summary of results

- *Seven respondents out of nine* said that they expect a tough competition from non-EEA refiners.
- *Three respondents out of nine* said that environmental restrictions are challenging.
- *Two respondents out of nine* said that the competition on the diesel market in the EEA will be harsh.
- *Two respondents out of nine* believed in low refining margins.
- *Two respondents out of nine* believed that the refining industry will operate with overcapacity.
- *One respondent out of nine* said that the refining industry has limited capacity to upgrade heavy fuel oil.
- *One respondent out of nine* believed in increased use of renewable energy sources.
- *One respondent out of nine* believed in a decreasing local demand.
- *One respondent out of nine* believed that a changing product mix would be challenging.
- *One respondent out of nine* expected that the refining industry will produce surpluses of gasoline and heavy fuel oil.
- *One respondent out of nine* said that the old refining technology is challenging.

4.7 How will the import of petroleum products to the European Economic Area develop?

4.7.1 *Increased import*

Five respondents out of nine believed that import of petroleum products will increase. The import is influenced by the situation in the United States with the country´s ban on crude oil export (Manager, physical management). Large product tankers are expected to be used for carrying out the transportation of petroleum products to Europe. The import is expected to come from the United States through reopened refineries and new refineries in India and China. Several of these new refineries are able to produce products specified for the global market. Since these refineries have capacity exceeding their regional demand, they will put pressure on refiners in the EEA when their surpluses are traded on the international market. (Intermediate operator No.2)

One respondent said that import of petroleum products from the Far East and the United States to the EEA are expected to increase. This will increase the competition to refiners in the EEA and could potentially lead to additional closures of refineries within the EEA. (Intermediate operator No.2). Import of middle distillates will particularly increase (Manager, product trading).

According to one respondent the import will increase because ...due to lack of supply of certain products… (Shipping analyst). In the short-term the import is mainly driven by middle distillates. However, the import of light distillates may increase in the long run. This as the

United States, with its resources of tight oil and shale gas, has capacity to produce and export "cheap energy". Compared to refiners based in the EEA, refiners in the United States have access to cheaper feedstock of crude oil and energy. In total, with transportation included, products produced in the United States are price competitive in the EEA. (Shipping analyst).

4.7.2 *Stable or possibly increase*

Three respondents out of nine believed the import to be stable or to possible increase. The import of petroleum products to the EEA is expected to be stable and increase if the business activity within the region grows. If refiners within the EEA cannot supply the demand of petroleum products, the import of products will increase. The import of petroleum products may also increase if refiners in the EEA are not price-competitive to non-EEA refiners. This factor is much influenced by the crude oil price. If the oil price is relative low, refiners within the EEA are more competitive. However, with a relative high crude oil price the production may move to more sophisticated refineries outside the EEA. (Intermediate operator No.1).
According to one respondent, the EEA´s import of petroleum products and particularly diesel is expected to continue. Gasoline has to be exported from the EEA to e.g. Africa, Asia and occasionally the United States. In the longer run, it is hard to expect import of gasoline to the EEA since the region has surplus production of gasoline. According to the respondent…This applies even if there is access to price competitive gasoline from the United States... (Manager, optimization and planning).

One respondent said that import of petroleum products is much influenced by the situation in the United States. This may lead to imbalances in product flows within the transatlantic region. Globally, crude oil trading patterns have changed due to the United States´ production of shale oil. For the time being, there are refineries in India, Saudi Arabia and the United States which are able to produce products with export purposes. If prices on products are higher in the EEA compared to other regions, the import will increase. Due to this, refiners´ margins within the EEA will only be allowed to reach a certain degree, until products will flow from producers outside the EEA. Import to the EEA may decrease if local demand of petroleum products increases in India, South-East Asia and China. (Manager, physical management).

The respondent also said that the demand of imported petroleum products in relation to products produced within the EEA; is expected not to grow. It is more a matter of give and take and a balance will occur between imported and domestically produced products. Despite a relative low price for transporting petroleum products, there is a cost involved. This cost counteracts import of products. (Manager, physical management).

Finally, the respondent explained that the refining industry within the EEA has capacity to supply the region with products but the industry has to produce price competitive transportation fuels to reduce the competition from non-EEA refiners. It is expected that refiners within the EEA are able to do this. In the future, refineries located in the EEA may be used for production of products aimed for the African market. This since the demand for

petroleum products is expected to grow extensively if the economy in Africa grows. (Manager, physical management).

4.7.3 *Influenced by pull/push situation*

One respondent said that … The import will be much influenced by the pull / push situation. It is difficult to predict how the import will develop given the dynamics involved… (Independent Maritime Professional).

4.7.3.1 Summarized results

- *Five respondents out of nine* believed in increased import.
- *Three respondents out of nine* believed the import to be stable or to possibly increase.
- *One respondent* said that the import will be influenced by the Pull/Push situation.

4.8 Question three

Seven respondents have answered question three, "***How will the intermediate product tanker segment be used in the distribution system for oil products in the European Economic Area?"***. Sub-questions focus in how the intermediate product tanker segment will develop with emphasis on hauls and if the hauls will increase or decrease in distances to the EEA.

4.8.1 *Regional transportation*

Four respondents out of seven answered that the segment is and will be used for regional transportation. The demand for intermediate ships is expected to continue, this since there still is a regional demand for transportation (MR operator). The use of intermediate product tankers depends on trading patterns for petroleum products and storage capacity in the EEA. For now, the use of intermediate product tankers is not expected to change considerably. However, during recent years, substantial volumes from the Baltic region to Europe´s North-western continent; have shifted from the intermediate segment to MR tankers and larger ships. This trend is expected to continue. (Intermediate operator No.1).

According to one respondent, the use of intermediate product tankers depends on the infrastructure for oil. In Sweden and in the United Kingdom as examples, storage cisterns for petroleum products are located along coast lines. The capacity of those is usually 8.000-, 10.000- or 15.000-m^3. To handle such quantities, intermediate product tankers are preferred instead of larger ships. The intermediate segment is well established and suits reception facilities and quays. With a recognized segment for carrying out the transportation, many cargoes are produced in quantities which correspond to the size of the ships. (Intermediate operator No.2).

One respondent explained that the intermediate product tanker segment is a part of the regional distribution system and is not primarily used for import purposes to the region. MR

ships are used for transporting the EEA´s import and export of petroleum products. Initially, the MR segment is not expected to capture market shares from the intermediate segment in the EEA. (MR operator)

The respondent added that several distributors and traders seek alternatives to reduce transportation costs through economy of scale. An example of this can be if two intermediate cargoes are loaded on one MR ship. This scenario/development has occurred in other segments, e.g. one very large crude oil carrier (VLCC) is used instead of two Suez-max carriers. (MR operator). The competition of MR tankers to intermediate ships could grow if the flexibility of MR tankers increases. Furthermore, a MR ship may be used for an intermediate voyage if it is possible to simultaneously load other cargoes for optimizing the cargo space. (MR operator). The intermediate segment is established in the distribution system but distributors continuously look for economy of scale which may increase the use of larger ships. (MR operator).

The respondent also said that, refineries in the EEA will probably become larger. This can lead to increased size of produced batches. In such a scenario, the size of intermediate tankers could in some occasions not be sufficient and larger vessels will be used for transportation instead. (MR operator). In general, larger batches are expected to be transported when the demand for petroleum products increases. Petroleum products are handled in distributional schemes, however, a new trend is that traders have become more flexible and they constantly look into new logistical schemes to improve the overall efficiency. (MR operator).

4.8.2 *Competition from larger ships*

Two respondents out of seven mentioned that larger segments may capture market shares. A few years ago, large volumes were transported from Russia on ships with cargo capacity of 20.000 tonnes. This has changed and today, ships with capacity of 40.000 tonnes are used instead. The general trend for the area is that larger ships are used. However, there will always be a demand for smaller ships, e.g. ships with capacity to carry 10.000 tonnes. (Manager, product trading).

One respondent said that if several refineries are closed in the EEA, the import will increase and the use of MR ships for regional transportation may possibly increase. (MR operator).

4.8.3 *No major changes*

Two respondents out of seven did not expect any major changes.

4.8.4 *Part of the infrastructure*

Two respondents out of seven explained that the segment is a part of the infrastructure.

4.8.5 *Demand for short hauls*

One respondent said that there always will be a demand for short hauls in the region between remaining refineries and consumers. (Shipping analyst).

4.8.6 *Transport unchanged or falling volumes*

One respondent expected the segment to transport unchanged or falling volumes. (Shipping analyst).

4.8.7 *Changed infrastructure*

One respondent said that … terminal infrastructure may change if the freight gets too expensive due to size restrictions... Furthermore, if the terminal only is able to receive ships with capacity of 10.000 tonnes, it may be more lucrative to use a larger ship to call a nearby terminal. The last transportation leg is then performed by trucks. It should also be mentioned that if the consumption of petroleum products reduces, the number of terminals will probably reduce. (Manager, product trading).

4.8.8 *Continue to renew tonnage*

One respondent said that …it depends on if owners continue to develop and renew tonnage… The advantage intermediate product tankers have compared to larger vessels (in terms of benefits for the customers) is efficiency, flexibility and access to more berths. Number of vessels in the area is an important parameter for "flexibility". (Independent Maritime Professional).

The responded continued as explained that a future growing threat to the intermediate segment in general, is the low rate of building new ships. Furthermore, the new-building rate is low for vessels specifically designed for trade in Northern Europe. The incentive is low for investing in new ships without profitability in sight and in theory; second-hand vessels are still cheap compared to new ships. However, it is difficult to estimate costs for wear and tear which could affect future operational expenses, nor possible future regulations or emission control measures. (Independent Maritime Professional).

4.8.8.1 Summarized results

- *Four respondents out of seven* said that the intermediate product tanker segment will be used for regional transportation.
- *Two respondents out of seven* said that they expect competition from larger segments.
- *Two respondents out of seven* did not expect any major changes.
- *Two respondents out of seven* said that the segment is a part of the infrastructure.
- *One respondent out of seven* said that there will always be a demand for short hauls within the region.

- *One respondent out of seven* said that the infrastructure may change if it gets too expensive to use small ships.
- *One respondent out of seven* said that it is essential that ship-owners continue to renew tonnage.
- *One respondent out of seven* expected the intermediate segment to transport unchanged or falling volumes.

4.9 How will the use of intermediate product tankers develop with emphasis on hauls?

4.9.1 *May increase*

Five respondents out of seven answered that the length of hauls may increase if the import of petroleum product to the EEA grows and the number of reception facilities is reduced. If the import of petroleum products increases and these volumes are handled in hub-ports, the hauls performed by intermediate tankers are expected to increase in lengths. Moreover, hub-ports located outside the SECA area may be used as distribution points where distribution to customer is carried out by e.g. intermediate product tankers. (Intermediate operator No.1).

One respondent said that …The length of hauls is expected to increase. This since the number of loading/discharging locations is expected to be reduced… Less storage facilities will lead to longer hauls. (Intermediate operator No.2).

According to one respondent, the production of petroleum products within the EEA decreases and this will lead to additional closures of refineries. Therefore, the total number of cargoes may reduce and the transportation lengths could potentially increase. (MR operator).

The respondent also said that …if the intermediate segment continues to be a part of the distributional system, possible closures of refineries may affect the segment in a positive way… Moreover, this could lead to increased lengths of laden voyages. The combination of long laden voyages and short ballast legs are beneficiary for the segment. (MR operator).

According to one respondent, the length of hauls may increase if the import grows. Moreover, the extreme scenario in this respect is that large volumes of petroleum products arrive with large product tankers to the EEA. These volumes are expected to be handled at central storage facilities since several ports and terminals have size restrictions or are unable to handle large volumes of petroleum products. Further transportation from storage facilities to consumer is expected to be carried out by smaller vessels, e.g. intermediate product tankers. An example of this scenario could be: instead of having six to eight refineries to supply a region with petroleum products, the supply is handled by four to five refineries and a central storage facility. If the distribution patterns develop like this, the lengths of hauls could potentially increase. (Shipping analyst).

One respondent explained that if refineries are closed within the EEA, it may hypothetically lead to longer hauls. Initially, it is not expected that large ships, e.g. MR tankers will overtake the role of intermediate product tankers for distributing petroleum products between producers and end consumer within the EEA. (Manager, shipping division)

One respondent said that …In general, it is hard to predict how the length of hauls will develop within the region since both long- and short-characterized hauls are performed. Again, hypothetically, the hauls may increase if several refineries are closed. (Manager, shipping division).

4.9.2 *Unchanged lengths*

Two respondents out of seven answered that they expected unchanged lengths. One respondent said that length of hauls is not expected to increase since voyage costs should be kept at a minimum. The respondent also said that the use of trucks may increase if terminals are closed. Denmark is an example where several depots have closed during the last ten years. Depots are closed mainly because customers and suppliers do not want to store their products. (Manager, product trading).

According to the second respondent …In general, a limited change is expected; however this is of low relevance. More important factors for the segment are: to what extent the segment is used to trade to more distant ports outside the EEA, port turnaround times and delays... These are important factors for trade in the North-western Europe. (Independent Maritime Professional).

4.9.3 *Volumes have shifted to larger segments*

One respondent said that several "long-hauls" in the EEA, previously performed by intermediate-ships have shifted to larger segments, e.g. MR. (Intermediate operator No.1).

4.9.3.1 Summarized results

- *Five out of seven respondents* said that the length of hauls may possibly increase in length.
- *Two out of seven respondents* said that the length of hauls will be unchanged.
- *One respondent out of seven* said that volumes have shifted from the intermediate segment to larger segments.

4.10 Will the hauls increase or decrease in distance?

4.10.1 *Increased or potentially could increase*

Four respondents out of seven believed in an increased or potential increase in lengths. One of these respondents said that … hypothetically, the hauls may increase if several refineries are closed… (Manager, shipping division).

4.10.2 ***Unchanged***

Two respondents out of seven answered that they expected unchanged lengths. According to one of these respondents, transportation costs should be kept at a minimum and the use of trucks may increase if terminals are closed (Manager, product trading).

4.10.3 ***Decrease for light products and increase for heavy products***

One respondent expected the length of hauls for light products to possible decrease and hauls of heavier products could potentially increase in length. According to the respondent … Hauls have recently decreased in distances and the trend is expected to continue unless the import of petroleum products does increase… (Intermediate operator No.1).

4.10.3.1 Summarized results

- *Four respondents out of seven* believed in increased or potentially increased length of hauls.
- *Two respondents out of seven* believed in unchanged lengths.
- *One respondent out of seven* expected decreased length of hauls for light petroleum products and increased length of hauls for heavy products.

4.11 Question four

Seven respondents have answered question three: *"**What kinds of ships are expected to be demanded for carrying out the transportation within the intermediate product tanker segment?"***. Sub-questions focus in size and capacity, fuel source and loading/discharging capabilities.

4.11.1 ***Present segment fits well in the distribution system***

Three respondents out of seven answered that the segment fits well into the distribution system. The intermediate product tanker segment has appropriate capacity for the cargoes handled today and the segment fits in the trade within the EEA. For the time being, a typical intermediate product tanker has cargo carrying capacity of 16.000 tonnes. (Intermediate operator No.1). One respondent said that …, the "just-in-time" concept is essential and oil companies do not want to keep large quantities of petroleum products stored… (Intermediate operator No.1).

According to one respondent: …until recently, a popular size for transporting petroleum products within the North-western Europe was the "flexi size"... This size has capacity to carry approximately 26.000-27,000 m^3. However, the use of this segment is deteriorating and market shares are overtaken by handy-size ships. Handy-size ships have an approximate loading capacity of 40.000 m3. This segment has captured market shares from both the flexi-size- and the intermediate- segments for transporting gasoil and naphtha from the Baltic Sea region to countries in North-western Europe. However, there are a few ports in the Baltic Sea

which are unable to receive handy-size ships. In these ports, intermediate product tankers are still used for shipments. However, it should be noted that by using larger ships it is possible to reduce the transportation cost per tonne if quantities are optimized. (Intermediate operator No.2).

4.11.2 *Competition from larger segments*

Three respondents out of seven said that the intermediate product tanker segment faces competition from larger segments. According to one respondent, this is more a question of a general demand for the segment. If the segment fits well in the distribution system and continues to do so, the size of the segment does not have to change. (MR operator).

4.11.3 *Just-in-time*

One respondent mentioned the importance of just-in-time and low storage capacity in the EEA. The respondent said that … the "just-in-time" concept is important and oil companies do not want to keep large quantities of petroleum products stored… (Intermediate operator No.1).

4.11.4 *Size restrictions*

One respondent said that … Size restrictions of ships and limitations at receiving facilities form the base of how large intermediate product tankers can become... It is always temptingly to calculate how freight cost can be reduced per tonne (economies of scale) by using large ships. However, there may be restrictions in ports. (Shipping analyst).

4.11.5 *Carry several lots simultaneously*

One respondent expected the same use of the segment, but highlighted the importance of being able to transport several lots simultaneously. The definition of size is more a question of which size within the segment instead of a general size change of the segment. It is the quantity of traded batches that decides. (Manager, shipping division).

4.11.6 *Increased use of "small intermediate tankers"*

One respondent explained that the use of small intermediate product tankers may increase. The general demand for large intermediates may reduce. This has to do with the size of batches exported from Russia. There are still volumes of semi-finished heavy products transported on intermediate product tankers with capacity to carry 15.000 tonnes; however, the number of such voyages is continuously reduced. (Manager, product trading).

According to the respondent, to keep storage at minimum, the frequency of deliveries may change. Moreover, instead of having one ship a month for depot deliveries, a customer may prefer to have two smaller ships a month. However, the length between supplier and customer decides. (Manager, product trading).

4.11.7 ***Ship-owners´ individual business models and targeted customers***

One respondent said that this is more a question of ship-owners´ individual business models and targeted customers… It is a dynamic situation where the demand of ship depends on frequency of the deliveries and economies of scale (freight cost per ton). (Independent Maritime Professional).

4.11.7.1 Summarized results

- *Three respondents out of seven* said that the present intermediate product tanker segment fits well in the distribution system.
- *Three respondents out of seven* expected increased competition from larger segments.
- *One respondent out of seven* mentioned the just-in-time concept´s importance to the size.
- *One respondent out of seven* said that size restrictions in ports and at terminals form the base for the segment.
- *One respondent out of seven* highlighted that it is important that intermediate product tankers are able to carry and handle several lots simultaneously.
- *One respondent out of seven* believed in increased use of "small intermediate product tankers".
- *One respondent out of seven* said that this is a question of the ship-owners´ individual business models and targeted customers.

4.12 With regards to size and capacity?

4.12.1 ***May become larger***

Three respondents out of seven believed that the size of the "typical intermediate" may become larger.

Answers are based on the following three different hypothetical theories:

- One of the respondents said that…The size may increase if the history of development continues. Moreover, the size has continuously become larger… (Intermediate operator No.1).

- Another respondent explained that when it comes to new ships, the cost difference in building a ship with capacity to carry 15.000-16.000 tonnes or 19.000 tonnes is marginal. This also applies to the difference in bunker consumption. The cost for transporting a cargo between two ports will be higher with a larger ship but the possibility to increase the revenue is substantial. (Intermediate operator No.2).

If a new intermediate product will be ordered, it is expected that larger ships are ordered. The respondent said that an intermediate product tanker is built for 20 years of operation and the income potential is substantial compared to the additional cost for building the ship. However, it should be mentioned that the size may not increase if the ship is built according to a specific contract. If so, the contract period has to be very long. (Intermediate operator No.2).

- One respondent explained out of a discussion with the author that a common size used in the EEA within the intermediate segment, is ships having capacity to carry 16.000 tonnes. It is difficult to predict how this typical size is expected to develop until 2025. However, with technical improvements and better utilization of cargo spaces, it may be possible to upscale the capacity. (Shipping analyst).

4.12.2 *Port and terminal constrains*

One respondent said that port and terminal constrains. (Intermediate operator No.1).

4.12.3 *The general demand for the segment*

One respondent explained that this is more a question how the utilization of the segment in general will develop. According to the respondent …If the segment fits well into the distribution system and continues to do so, the size does not have to change… (MR operator).

4.12.4 *Increased use of smaller ships*

One respondent believed that the popularity to use smaller ships may increase as smaller lots are to be distributed. This since batches of specialized fuels is produced more frequently. Such fuels can e.g. be biofuels specifically produced for a certain market. These products are produced according to customers´ individual specifications. This usually leads to smaller batches. Since petroleum products are expensive, both refiners and customers want to keep their storage at a minimum. Therefore, products are produced just-in-time and are transported on smaller vessels. (Manager, shipping division).

The respondent explained that shipments to the United Kingdom as an example; are usually performed by ships having capacity to carry 12.000-15.000 tonnes. For distribution in near coastal areas, smaller ships are used. It is expected that trading with smaller lots will become more popular in the region. This applies to both the supply and production side of the refining process with emphasis on production of biofuels. Specialized fuels are expensive and are traded in small batches. (Manager, shipping division).

4.12.5 *Ideal size*

One respondent gave the following description of ideal intermediate sizes:

The ideal capacity for intermediate product tankers, are ships with capacity to carry 10.000-12.000 tonnes for transportation of middle- and light-distillates within the EEA. This size was popular in the EEA during the 1990s. Customers do not want to store their products; therefore storage is kept at minimum. Instead of having one ship a month for depot deliveries, a customer may prefer to have two smaller ships per month. However, the length between supplier and customer decides. If the voyage's duration is up to two days, ships with cargo capacity of 8.000- 12.000 tonnes are preferred. If the duration is longer, ships with cargo capacity of 15.000 tonnes are frequently used. (Manager, product trading).

The respondent explained that during late 1990s, intermediate product tankers with capacity to carry 15.000-tonnes started to be developed. Earlier, ships with capacity to carry 10.000-12.000-tonnes were commonly used. The major reason to the size upgrade within the segment was probably the increased export from Russia. Another contributing factor may have been that the price difference for ordering a ship with capacity to carry 10.000- or 15.000-tonnes was marginal compared to the income potential. However, an issue when a ship is not fully utilized is if ship-owners want to charge freight corresponding to a fully loaded ship for a partly laden ship. (Manager, product trading).

The respondent added that when it comes to trading purposes, ships with capacity to carry 20.000- instead of 15.000- tonnes are preferred. This since quantities of 20.000-tonnes is commonly traded. (Manager, product trading).

4.12.6 ***Hard to see any trend***

One respondent explained that since there are few ships on order, it is impossible to see any trends. This question is essential for a ship-owner who intends to order a new vessel. However, the market can only "work" with what is on the water. Due to the dynamics in oil trade, it is difficult to predict the ideal cargo capacity in detail. (Independent Maritime Professional).

4.12.6.1 Summarized results

- *Three respondents out of seven* believed that the size of the segment may become larger.
- *One respondent out of seven* said that port and terminals set the size.
- *One respondent out of seven* said that this is more a question about the use of the whole segment compared to larger segments and not a question of size.
- *One respondent out of seven* believed in more use of "small intermediate product tankers" capable to carry and handle several lots simultaneously.
- *One respondent out of seven* gave the follow description of ideal sizes within the intermediate product tanker segment: ships with cargo carrying capacity of 8.000-12.000-tonnes are to be used for voyages with duration up to two days. For durations exceeding two days, ships with capacity to carry 15.000-tonnes of cargo are to be

used. When it comes to ships used in trading purposes, these ships should have cargo carrying capacity of 20.000 tonnes.

- *One respondent out of seven* said that it is hard to see or to predict any trend since there are few ships on order.

4.13 With regards to fuel source?

4.13.1 *Liquefied natural gas*

Five respondents out seven answered that liquefied natural gas (LNG) is a potential future fuel for intermediate product tankers. The future fuel for the segment considerably depends on coming regulations. In North-western Europe, ships have to conform to legislations that form sulphur emission control areas (SECA). With the substantial reduction of the crude oil price in year 2014, different kinds of gasoil became relative cheap compared to earlier. Therefore, the transition process from using heavy fuel oils to middle distillates with 0.1% sulphur went smooth. (Manager, product trading).

According to one respondent, LNG has a great potential to become a future fuel for intermediate product tankers. This since combustion of LNG creates less emissions to the environment compared to other marine fuels. For the time being, the use of LNG is more expensive than marine gasoil. However, during the last five years and before the substantial price reduction of crude oil, LNG has been more competitive in price than marine gasoil and has potential to be so even in the future. (Intermediate operator No.2). LNG is expected to become most popular in the Baltic Sea. (Manager, product trading).

One respondent explained that with present alternatives at hand, LNG is expected to be the future fuel for ships built to trade in North-western Europe. This since the use of other alternatives, e.g. scrubbers, creates residues which are to be disposed or taken care of. With LNG, the technology is cleaner itself and does not need cleaning of exhausts. The additional cost for installing a LNG propellant compared to conventional propellant in a new intermediate product tanker is approximately 3-4 million dollars. Out of a total cost of approximately 35 million dollars of a new intermediate product tanker, the investment is reasonable. However, a reduced emission to the environment is the largest benefit and with a potential low price of LNG compared to marine gasoil, such ship has a potential to become cost effective as well. (Intermediate operator No.2).

One respondent said that for shorter hauls, e.g. regional ones, there is room for investments in LNG propellants. However, since the present price of LNG is relative high compared to marine gasoil, the motivation for investing in LNG is lower. At the other hand, product tankers are built for 20 years of trade. Therefore, the current price of LNG or predicted price for the near term does not only form the decision to invest or not. (Shipping analyst).

One respondent said that until a year ago, LNG was predicted to become a major future fuel for intermediate product tankers. This since LNG is better for the environment and has been

price competitive to other fuels. However, the price has become higher compared to other marine fuels as the crude oil price has been reduced. The price of LNG can be reduced if exports to the global market increase from Australia, Africa and the United States (Manager, product trading).

According to one respondent, the use of LNG is expected to be popular in tanker ships. This as it is possible to arrange e.g. tank for LNG in a manner that does not capture cargo space. During the next ten years, different fuel configurations for ships are expected to be seen in the EEA region. Ships with main trade in the North Sea are expected to use scrubbers. In coastal-, inland- and Baltic Sea-trade, the amount of LNG powered vessels is expected to increase. The increase will mainly occur through new building projects and not through retrofitting. (Manager, shipping division). It is expected that future EU subsidies for environmental improvements in shipping are given to LNG related projects. (Manager, shipping division).

4.13.1.1 Incentives which reduce the interest to invest in LNG propellants

The respondents explained that different factors may reduce the interest for investing in LNG. These factors were described as followings:

- If the price for conventional marine fuels would have been higher, the motivation for investing in new technology could potentially have been higher as well. Although, if a few shipping companies decide to invest in other propulsion systems, other companies may follow. (MR operator).

- Insufficient infrastructure for alternative fuels is a factor that hampers the development. There are not enough bunker stations to facilitate the demand if intermediate product tankers should be totally dependent on LNG. (Intermediate operator No.1).

- If the oil price is relative low, it will affect the will of ship-owners to invest in scrubbers or alternative fuel sources, e.g. LNG. If the oil price continues to stay relative low, the next generation of intermediate product tankers will probably be equipped with dual-fuel engines. These engines are able to combust both traditional marine fuels and LNG. (Intermediate operator No.1)

- In general, few LNG retrofits are expected (Manager, product trading). Existing ships are expected to use marine gasoil or ECA oil (bunker oil that is approved to be used within the ECA). (Intermediate operator No.2).

- LNG has not had the expected breakthrough as many assumed. For the time being, LNG has to be subsided to be of interest. However, the distribution system for supplying LNG within the EEA is expected, especially with emphasis on the Baltic Sea region. If LNG becomes cheaper than marine

gasoil, LNG will be more interesting for ship-owners. (Manager, product trading).

4.13.2 *New technology is available*

One respondent said that … New technology is available; however the majority of new ships built today are equipped with conventional diesel engines... (MR operator).

4.13.3 *A question of ship-owners´ business models ad customers*

One respondent said that …In this respect, this is more a question of ship-owners´ individual business models and targeted customers… (Independent Maritime Professional).

4.13.3.1 Summarized results

- *Five respondents out of seven* answered that LNG has potential to become a future fuel for the intermediate product tanker segment.
- *One respondent out of seven* said that new technology is available. However, the majority of ships built in general, are equipped with conventional engines.
- *One respondent out of seven* said that this is a question of ship-owner´s individual business models and targeted customers.

4.14 With regards to loading/discharging capacities

4.14.1 *Sufficient capacity*

Five respondents out of seven said that the loading and discharging capacity is sufficient. According to one respondent …The main intention is to load and unload a ship as quick as possible… Today, general restrictions in this respect mainly relate to reception facilities. Usually, intermediate product tankers have more capacity to load and unload than the terminal could handle. The loading and unloading capacities of intermediate product tankers are expected to be appropriate for the general demand within the EEA. (Intermediate operator No.1).

One respondent explained that it is unlikely that terminals and quays will be upgraded as this is very expensive. Therefore, focus is in reducing lay-time. One way to do this is to use ships with high loading and discharging capacities and which are able to handle different products simultaneously. (Manager, shipping division).

One respondent mentioned that if a ship is constructed according to a customer´s specification, loading and unloading rates may be higher. (Intermediate operator No.1).

One respondent said that … The capacity seems to be appropriate. However, ships may restrain during loading at refineries, if they are unable to receive high flows… (Manager, product trading).

4.14.2 *Ship-owners individual business model and targeted customers*

One respondent explained that …This is more a question of ship owners´ individual business model and targeted customers… (Independent Maritime Professional).

4.14.3 *No comments*

One respondent did not have any comment.

4.14.3.1 Summarized results

- *Five respondents out of seven* said that the loading and discharging capacity is sufficient.
- *One respondent out of seven* said that it is a question of ship-owners´ individual business models and targeted customers.
- *One respondent out of seven* did not have any comment.

5 Discussion

5.1 Total demand for oil in the EEA until 2025

Developed economies in Europe, North-America and Asia, seen as one unit, are expected to have a slow increase in demand for energy (Journal, Pipeline & Gas, 2014). According to seven out of nine respondents, they believed in decreasing demand of oil in the EEA until year 2025. This expectation is in line and seems reasonable with the prediction made by Capros, et al. (2013), which indicates a decreasing demand of oil in the EU.

According to Oil and Energy Trends (2014), the decrease rate in demand of different petroleum products in the EU are different. Moreover, the decreasing demand of light distillates represents the largest rate followed by the rate of heavy fuel oil and finally middle distillates. According to Oil and Energy Trends (2014), the high demand of diesel has kept the total demand of middle distillates stable. This is something that also has been mentioned by one respondent whom said that diesel has been a popular fuel in the EEA and is expected to be so even in the future (Intermediate operator No.2).

Different factors to why the demand of oil in the EEA is expected to decrease have been mentioned by the respondents. According to one respondent, the demand for energy in Western Europe has peaked (Shipping analyst). Another respondent pointed out that vehicle efficiency is continuously improved. However, this respondent also said that the use of vehicles may increase if they become more energy-efficient (Intermediate operator No.2). According to one respondent, one contributor to a reduced demand of oil in the EEA; is the increased use of biofuels. Biofuels are expected to capture market shares from particularly diesel and heavy fuel oils (Manager, optimization and planning). In general, the answers given by the respondents which indicated a decreased demand of oil in the EEA, where based on the same incentives given in theory. In the respect of both answers given by the respondents and information found in available theory, both primary and secondary data conformed.

By studying secondary data, the focus in the EEA is to reduce the demand of oil. According to Kent & Williams (2015), energy-efficiency regulating laws and taxes contribute to the declining demand of petroleum products in the EU. The EU works towards a reduction of energy consumption. If the use of energy is reduced, different positive side-effects, such as lower emissions into the environment and less dependency in imported energy are gained (European Commission, 2015). One of the EU´s most important environmental targets is to reduce the consumption of energy by 20% until year 2020 compared to reference levels in year 1990. (Europeiska Kommissionen, 2015). Environmental factors were highlighted by the respondents to why the demand of oil in the EEA is expected to decrease.

According to the European Commission (2014), the use of fossil fuels has to decrease with emphasis to the transport sector. The global focus is to reduce emissions of CO_2. However,

according to one respondent, discussions for reducing emissions of nitrogen gases also take place in the EEA. London and Paris are examples of cities where such discussions take place. (Manager, optimization and planning). If focus will be in reducing emissions of CO_2, it is expected that diesel cars are preferred. However, if emissions of nitrogen gases are to be reduced, the use of cars fuelled by gasoline is expected to increase.

The long term outlook for diesel has during recent years been lucrative and diesel has been expected to be a very popular fuel in the EEA. However, with a possible focus change where it becomes more popular to use gasoline cars instead, this will reduce the demand of diesel. According to one respondent, France has traditionally been a frontrunner for dieselization in the EEA. However, this could potentially change and an essential question is whether the rest of the EEA will develop in the same way or not. France has decided to change taxes on gasoline and diesel as incentive to reduce the price difference between the two commodities. This process will commence in year 2016 and continue through year 2020 (Manager, product trading). If this development spreads to other countries in the EEA, the consumption of gasoline could potentially increase.

According to Fuels Europe's (2015) prediction on demand ratio between diesel and gasoline, the consumption ratio is expected to become larger, from 1:2 in year 2014 to 1:3.5 in 2030. This prediction could be challenged if the use of gasoline increases. Since diesel may not be the cleanest fuel used in the transportation sector, the demand has become stagnant (Manager, physical management). This could increase the popularity of gasoline in the EEA and lower the consumption difference between gasoline and diesel. The popularity of gasoline could in particular grow in the Eastern EEA since this region is more gasoline orientated compared to diesel (Mohite, 2014).

Even though the long term demand of oil in the EEA is expected to decrease, the demand of gasoline and diesel has increased in the EEA by five per cent from October 2014 until October 2015. According to one respondent, the main driving factor has been the substantial price reduction of crude oil that has contributed to lower prices on petroleum products (Manager, product trading). However, the respondent adds that … if the price will be stable at current level; the demand will level off and decrease in the long run…

The increased demand of gasoline during the last year is interesting since both primary data and secondary data indicate a continuous decline. According to one respondent the increase can be explained by seasonal variations. Moreover, the demand of petroleum products is better explained by seasonal terms rather than long term predictions (Manager, optimization and planning). However, the increased demand for gasoline and diesel has lasted for a longer period than seasonal variations.

One explanation to the above situation with increased demand of gasoline and diesel during the years 2014 and 2015; could be refiners´ and distributors´ possibility to use the "push-pull" strategy to increase their sales. According to one respondent, refiners have had access to

relatively cheap crude oil. The price of crude oil fell from above 100 dollars per barrel to between 40 and 50 dollars per barrel (Intermediate operator No.1). With the previous high crude oil price, refiners only produced volumes demanded by the market since margins were poor. However, with a lower crude oil price, the margins have improved (Intermediate operator No.1). With improved margins, refiners and distributors have "pushed" the market by producing more volumes to secure constant supply of petroleum products to consumers. This indicates the high influence the push-pull strategy has over the consumption of oil. Despite actions taken within the EEA to reduce the demand of oil, a low price of petroleum commodities has great impact on the demand and counteracts the targets within the EEA to reduce the demand of oil.

According to two respondents, the total demand of oil in the EEA may increase. Their expectations were based on economic growth within the EEA. This is in contradiction to both primary and secondary data. However, the above discussed push-pull situation has great impact on the demand. If the crude oil price stays relative low, refiners and distributors are able to supply cheap products and the demand will be upheld. However, the author believes that if the demand of oil in the EEA will increase, the demand will only increase occasionally and not generally until year 2025.

Out of the results from the interviews, the demand of middle distillates varies within the EEA. The demand varies within the EEA as consumption of diesel grows in popularity in the Eastern EEA and decrease in the Western EEA (Manager, product trading). According to the respondents, only minor changes in demand of middle distillates are expected and several respondents mentioned a stagnant demand until 2025. However, changes in marine fuel specifications are something that two respondents mentioned as driving factor when they believed in a possible increase in demand of middle distillates. The time for ratification these new bunker specifications is planned to be in year 2020, however this will be revaluated by the IMO in year 2018. According to one respondent, the ratification will be in year 2020 and a driving factor is the global overcapacity of middle distillate refining, since there much be adequate access to replacement fuels which corresponds to new specifications. (Manager, physical management).

The overcapacity is due to an extensive new-building process of refineries which are able to produce high yield of middle distillates. These refineries were planned when prognoses for middle distillates were lucrative. However, the domestic demand of middle distillates, where new refineries have been constructed is lower than the refining capacity Therefore, it is expected that the global refining industry will operate with surpluses of middle distillates during the years to come.

According to Mohite (2014), coming regulations for marine fuels will affect the refining industry but also according to respondents; lead to decreased use of heavy fuel oil in shipping in the EEA. The use of heavy fuel oils has reduced since the enforcement of ECAs in Europe (Intermediate operator No.2). The author believes that unsophisticated refineries will be negatively affected and highly sophisticated units will be beneficiaries. Moreover,

unsophisticated refining units without additional sulphur removing units will be limited to use crude oil feedstock with low sulphur limit to be able to produce heavy fuel oil that corresponds to new regulations. Meanwhile, highly sophisticated refineries will benefit from increased demand of middle distillates but also their ability to upgrade heavy fuel oil and transform it into higher-value products if the demand of heavy fuel oil decreases.

5.2 How will the oil refining industry develop in the European Economic Area

5.2.1 *Closures*

In the EEA, several refineries have closed during the last five to six years (Shipping analyst). Refiners which only own a limited number of refineries are the most sensitive and exposed to closures if they operate with poor margins (Physical management). If the margins are poor, these refineries will experience harsh competition from both regional and international competitors since oil refining is driven by refining margins rather than local demand of petroleum products (Independent Maritime Professional).

Six respondents out of nine believed in additional closures of refineries in the EEA. Different factors were given to why additional closures are to come. According to one respondent, the main factor to why refining capacity is closed in the EEA; is due to the increased competition from refiners based outside the EEA (Shipping analyst). The competition is driven by highly sophisticated refiners located outside the EEA. Competing refineries outside the EEA are highly sophisticated and are able to produce a product yield, which to a greater extent corresponds to the demand than several refineries in the EEA. If the production yield corresponds to the demand, chances for having positive margins are greater.

Even though high competition from non-EEA refiners to refiners in the EEA is highlighted as the greatest factor to why refineries are closed in the EEA, it is the old technology of the refining industry itself that reduces the competitiveness of the industry (Manager, physical management). According to Oil and Energy Trends (2014), several refineries in the EEA have high cost-bases and have low competitiveness. These refineries are typically small, old, unsophisticated and located at high-cost inland locations with no access to crude oil deliveries by sea. According to one respondent, it is expected that closed oil refining facilities could be used for storage (Manager, physical management).

In the EU, refineries with high cost-bases have an estimated total refining capacity of between 1.5- to 2-million barrels per day (Oil and Energy Trends, 2014). Total refining capacity in year 2014 in the EU was 14.218 million barrels per day (British Petroleum, 2015). The overcapacity based on secondary data is between 11 and 14 per cent. This can be compared to one of the respondent´s estimate of between five and ten per cent of overcapacity (Manager, physical management). The development of closures of refineries in the EEA follows the global development where according to Mohite (2014), old and unprofitable oil refineries are closed in developed economies since the local demand of oil decreases.

Despite the general comprehension and belief in additional closures of refineries in the EEA, it is important that the EEA has refining capacity. The EEA has refining capacity that exceeds the regional local demand. The configuration of refineries varies within the EEA and so do their margins (Manager, physical management). If the margins should improve, the total refining capacity in the EEA has to be reduced (Manager, trading). The utilization rate for refineries based in the EU in year 2014 was 78.2 per cent. This can be compared to the global rate of 79.6 per cent (British Petroleum, 2015).

Even though refineries in the EEA are exposed to total closure, it is strategically essential to have a refining industry in the region. It is essential that the EU has refining capacity that meets the EU´s future domestic demand (European Commission, 2014). It is also important that equilibrium is accomplished between fulfilling the EU´s environmental objectives and conditions which allow for oil refining in the region. (European Commission Directorate-General For Energy, 2014). This is something that also is argued by the refining industry in the EU. The refining industry expects that the EU will demand petroleum products beyond year 2030. Therefore, refiners deem that it is important for customers in the EU, that competitive refining- and distribution-systems are maintained. (European Commission Directorate-General For Energy, 2014). With a local refining industry the dependency on importing products is lowered as well.

5.2.2 *Upgrades of refineries*

Out of secondary data, oil refineries in general in future have to be specified and configured in a manner that makes it possible to refine heavier oils, but also to produce fuels with tighter specifications. Tighter regulations do especially apply on fuels for the road-, maritime- and aviation-sector. (Mohite, 2014). With emphasis on the EEA, this is argued by Oil and Energy Trends (2014). Moreover, within the EEA, some oil refining companies plan to reduce their refining capacity. However, this is not sufficient to increase the refiners´ margins. If the refining industry should improve, upgrades and heavy investments have to be done into existing refining facilities. This to produce the mix of petroleum products demanded in the EU, but also on the global market.

Out of the results from interviews, upgrades in EEA´s refining industry are expected to come and this seems reasonable since secondary data indicates this as well. Two respondents expected upgrading of the refining industry in the EEA. One respondent explained that, even though profitable refineries in the EEA are expected to be profitable in future, these refineries have to be upgraded. This is the next stage for the industry in order to be able to produce more environmental friendly fuels. According to the respondent, refineries chosen to be upgraded are expected to have competitive locations and to be in a good condition (Manager, physical management). However, the upgrading process may be slow due to challenging finances (Shipping analyst) and it is essential that the timing for the upgrade is correct. (Manager, physical management).

From primary data, no specific type of upgrade has been mentioned. However, the ability to upgrade the "bottom of the barrel" was mentioned. This is in line with Oil and Energy Trends (2014), where the main focus for technology upgrades in the EU is to invest in technology that increases the production of light distillates out of heavy petroleum residues. This is also argued by Mohite (2014), where investing in hydrocrackers would increase the possibility for European refiners to produce more middle distillates.

5.2.3 *Independent refiners and consolidation*

Several oil companies operate on the European market. These companies operate globally and are highly integrated with different operations. These operations include oil exploration, refining and distribution. Such companies gain advantages from scale operations (Marketline, 2014). However, the structure of several companies active on the EEA market has changed. Furthermore, out of primary data, three respondents have pointed out that several oil companies become more vertically disintegrated. Moreover, instead of controlling the whole product supply chain, including both upstream and downstream activities, some oil companies have divested their refining operations (Manager, physical management). According to one respondent, the company BP in the United Kingdom is an example of a company that has divested its refining operations. Furthermore, BP does not own any refinery in the United Kingdom, but the company is still a strong brand in the country. (Independent Maritime Professional).

According to one respondent, divesting processes have led to more "independent" refiners and retailers of petroleum products in the EEA (Manager, physical management). This development may affect refiners in the EEA if independent retailers chose the most price competitive- or convenient- supplier of petroleum products. This could potentially lead to increased import of petroleum products to the EEA. Distributors may also have access to refining capacity outside the region if they are a part of a large international company. As an example, distributors on the EEA market may have access to refining capacity in the Middle East. (Manager product trading).

5.3 What challenges does the refining industry face in the European Economic Area?

5.3.1 *Increased competition from non-EEA refiners*

Refiners located in the EEA compete on a global market rather than a regional market (European Commission Directorate-General For Energy, 2014). Beside the regional competition between refiners in the EEA, the competition is also high from companies located outside the region. The competition is mainly driven by the global oversupply of refining capacity (Independent Maritime Professional).

Traditionally, refiners based in the EEA have been competitive. They have imported large volumes of crude oil, refined the oil and then relatively successfully sold petroleum products

on the regional- and global-market. However, the global refining industry changes and refiners based in the EEA face increased competition from non-EEA refiners. (MR operator).

Out of primary data, seven respondents out of nine expected the greatest challenge to refiners in the EEA to be competition from non-EEA refiners. According to one respondent, refiners located in non-EEA regions do produce products with export purposes specified for the EEA market. This will increase the competition and challenge EEA´s refiners in a macroeconomic perspective. Refiners located in the EEA are expected to struggle if it will become more lucrative to import products from regions outside the EEA. (MR shipping). The primary data corresponds to secondary data and can be concluded as relevant. Secondary data indicates increased competition from non-EEA refiners to refiners in the EEA.

According to one respondent, refiners located outside the EEA and compete on the EEA market are able to produce products aimed for the EEA market at a lower price (Intermediate operator No.1). In general, in the Eastern part of the world, refiners have better margins compared to refiners in the West and this difference is expected to last during the next five years (Mohite, 2014). Different factors affect the margin, but the most important is the cost of energy. Refiners will benefit if they have access to cheap energy. High conversion refineries located in Asia benefit from low cost energy slates since several of these refineries have access to liquefied natural gas (LNG). Asia imports large volumes of LNG and these volumes are expected to double until 2030. The price of energy is essential especially when refining margins are under pressure. (Mohite, 2014).

According to FuelsEurope (2015), recent high refining margins in combination with a growing forecasted global demand for petroleum products have resulted in large investments into the global oil refining industry. These investments are mainly concentrated to India, China, The Middle East and the South East Asia (FuelsEurope). The purpose of these investments differ, and some investments in e.g. South East Asia and China have been done to supply petroleum products to their own domestic markets and to reduce dependency on imported petroleum products (Manager, trading). These investments are the result of strategically decisions rather than economical. These projects are completed even though they may operate with financial losses. Meanwhile, some projects are done to capture more of the value chain. A description of areas where refiners are expected to increase the competition to refiners in the EEA can be seen below in sub-chapters.

5.3.1.1 Competition from the United States

During recent years, the United States has become one of the largest exporters of petroleum products in the world. This has changed the global market for petroleum products since the United States has become an occasional net exporter of petroleum products instead of a constant importer (Intermediate operator No.2).

According to one respondent, the competition to refiners in the EEA from refiners based in the United States will increase (Intermediate operator No.2). Refiners based in the United

States have benefitted from the country´s ban on exporting crude oil (Manager, trading). The ban was formed in 1975 during the oil crisis with purpose to secure the United States´ supply of energy (Oil and Energy Trends, 2014). Considerable reservoirs of the United States' shale oil have high yield of gasoline, jet-fuel and gasoil and a low level of sulphur. Access to shale oil makes it possible for refiners in the United State to save between 10 and 15 dollars per barrel compared to if crude oil of the same quality as shale oil is imported from other countries (Oil and Energy Trends, 2014).

According to one respondent, large volumes of gasoline and diesel have been extracted out of shale oil in the United States. Most of the gasoline has been consumed within the country, but diesel has been exported to e.g. the EEA. (Manager, trading). Secondary data in this study indicates that refiners in the United States have sophisticated facilities and access to cheap crude oil and gas. Refineries located at the Gulf coast is an example. These refineries export large volumes of gasoline to Mexico, Latin America and West Africa and ultra-low sulphur diesel to Europe (European Commission Directorate-General For Energy, 2014).

According to Oil and Energy Trends (2014), both the United States and Canada have large resources of unconventional crude oil. It is reasonable to expect that the export of products will increase. However, according to Oil and Energy Trends (2014), there is an opposition for removing the ban on crude oil export. This is especially promoted by crude oil producers in the country. These crude oil producers argue that it would be more profitable to sell crude oil on the international market. For now, there is a surplus of domestically produced crude oil in the United States which leads to price reduction. However, oil refiners want to keep the regulations as it secures availability of oil (Oil and Energy Trends, 2014).

5.3.1.2 India and the Middle East

Beside the United States, India and the Middle East were pointed out by the respondents to be major competitors to refiners in the EEA. With planned projects, the Middle East is expected to become a net exporter of gasoil instead of being an importer of gasoil (Oil and Energy Trends, 2014). The region is also expected to gradually become a long-term exporter of both crude oil and petroleum products. (Mohite, 2014). According to FuelsEurope (2015), oil refining companies from India and the Middle East may purchase logistical- and market-assets in the EU to further increase their competiveness. This development corresponds to primary data that indicated oil companies´ divestments of their refining operations.

India has exported diesel to the EEA. It is expected that imports from Saudi Arabia are to come as well (Trading manager). Factors which make these regions competitive are access to low cost labour, cheap energy and tax incentives (FuelsEurope). Refiners located in the Middle East do also have access to cheap crude oil (European Commission Directorate-General For Energy, 2014).

India´s refining strategy has been to build refining capacity that exceeds India´s own regional demand. The product surplus has mainly been exported to the Asian- and East African-markets (Oil and Energy Trends, 2014). Diesel comprises the largest share of products

exported from India (European Commission Directorate-General For Energy, 2014). This strategy differs compared to refining projects in Asia, which have been constructed to supply regional markets.

The Middle East has a potential to produce more high-value products out of the regions´ present surplus of naphtha, liquefied petroleum gases and condensates. These products are produced by a cheap feedstock and could potentially be sold on the internal market, but also exported to other markets.. (Mohite, 2014).

The competition from refiners based in the Middle East to EEA-refiners, is expected to increase (Intermediate operator No.2). However, the competition may be temporarily if the local demand where the refineries are stationary increases (FuelsEurope, 2015). However, the author believes that if the competition to refiners in the EEA should decrease, a balance has to occur between global refining capacity and global demand of petroleum products. Since the refining industry is driven by margins and not the regional demand of petroleum products, products will always head to the market where the best profits are gained.

5.3.1.3 Russia

Refineries in Russia are continuously upgraded. This is done to increase Russia´s export of higher value products, e.g. ultra-low sulphur diesel aimed for the European market. (European Commission Directorate-General For Energy, 2014). Refiners in Russia are expected to increase their competition on the EEA market when it comes to different gasoil products. (Manager, product trading).

5.3.1.4 South East Asia and China

In China, large investments in refining projects have been done since China intends to become self-supportive of motor fuels. The main strategy is to increase China´s crude oil distilling capacity. The programme commenced in year 2013 and involves both construction of new refineries and upgrades of existing refineries. Upgrades will mainly be done in small existing refineries. This will contribute to higher production of middle distillates and increase the quality of the gasoline (Oil and Energy Trends, 2014).

The purpose of new refining capacity in China differs from other project locations which aim to produce products for export. China has not been highlighted by the respondents as a major competitor to refiners in the EEA. However, until China´s own demand corresponds to the country´s refining capacity, China has capacity to export products. Even though China is located at a greater distance compared to other competitors with respect to the EEA, petroleum products produced in China may find their way to the EEA if it is lucrative. Traditionally, diesel has been exported from China to Vietnam and Singapore, but it is expected that diesel could potentially be exported to the EEA (Oil and Energy Trends, 2014)

5.3.2 *Environmental legislations*

Three respondents out of nine mentioned that stringent environmental legislations would be challenging for the refining industry in the EEA. If the legislations become more stringent, the

interest for upgrading refineries with old technology is expected to decrease (Intermediate operator No.1). Beside environmental legislations relating to emissions, noise creation and odour involved with refining operations, are other factors which can be challenging for the industry (Intermediate operator No.1). This is something that another respondent mentioned in question four (What kinds of ships are expected to be demanded for carrying out the transportation within the intermediate product tanker segment?). The respondent explained that ships have to be assessed and handled as part of the total refining facility when it comes to noise and odour creation (Manager, shipping division).

In general, Europe and the EEA are in front when it comes to environmental legislations. Tax on CO_2 emissions is one example. For the time being, the price is eight Euros for every tonne of CO_2 emitted. However, there is a political intention to increase the tax to 25 Euros. (Manager, trading). Such incentive will put more pressure on refiners' margins within the EEA and lead to higher competition from refiners based in e.g. India, the Middle East and China. The refining industry in the EEA would be more competitive if rules were globally uniformed. This as it contributes to cost neutrality. (Manager, physical management).

According to the European Commission Directorate-General for Energy (2014), refiners within the EU are interested to continue their operations on the EU market. This despite a falling regional demand for petroleum products since the petroleum product market in the EEA is substantial. However, it is important that the industry has long-term regulations, which allow for refining operations which do not decrease the industry´s competitiveness. (European Commission Directorate-General For Energy, 2014).

5.3.3 *Refining technology and margins*

According to one respondent, the petroleum product mix demanded in the EEA changes (Shipping analyst) as well as the total demand for petroleum products in the EEA is in decline (Manager, trading). All answers except three of the answers given with regards to the refining industry´s challenges in the EEA; were in some way related to technology or poor margins. Secondary data indicates that an expected change in oil consumption globally, change in oil supply and the use of alternative energy sources force the global oil refining industry to change and adopt. The oil refining industry in Europe is expected to have difficulties with adjusting to these changes. This will lead to overcapacity in the refining industry within the EU (International Energy Agency).

Two respondents out of nine believed that the refining industry in the EEA is expected to operate with low margins. According to one respondent …During recent years, refiners within the EEA have been struggling with poor margins (with 2015 as exception)… (Trading manager). This corresponds to secondary data and is relevant. In the years between 2006 and 2012, European refiners had constantly less net margins compared to refiners located in other regions (European Commission Directorate-General For Energy, 2014). If the global refining market is divided into thirds when it comes to net cash margins, European refiners were in the top third in the years between 2000 and 2008. This has changed and between year 2008 and

2012 European refiners were placed in the bottom third (Oil and Energy Trends, 2014). According to the European Commission Directorate-General For Energy (2014), the reason why European refiners performed weaker than their international competitors, was constantly higher operation costs.

The competition to EEA refiners increase and it is expected that the competition will be harsh on the diesel market in the EEA and lead to poor margins on diesel. This despite the deficit of diesel in the region since the global refining industry operates with overcapacity of middle distillate production. This will put pressure on EEA refiners' margins on middle distillates (Manager product trading). It is also expected that margins will be poor on gasoline since there is surplus of gasoline production in the EEA (Manager, optimization and planning)

Even though poor margins are an issue for the refining industry in the EEA, it is interesting that according to the European Commission Directorate-General For Energy (2014), the best performing refineries in the EU region do well. 50 per cent of the best performing refineries in the EU; had better net refining margins compared to the average of international competitors between year 2000 and 2012. To increase the profitability, EEA refiners have to seek new markets for their products. An example is the African market (MR operator). This is also mentioned by another respondent who expects the demand for petroleum products to grow extensively if the economy in the African region grows (Manager, physical management).

Different contributing factors to why the refining industry in the EEA is expected to operate with poor margins were given by the respondents. The main underlying factors were described as: the regional market in the EEA is mature and the competition from the Middle East, India, and the United States is expected to increase (Shipping analyst). Beside the competition from non-EEA refiners, low margins are the result of low complexity of the refining industry and a limited capacity to upgrade the "bottom of the barrel" (Independent Maritime Professional). This is also mentioned by another respondent who said that …one challenge is the industry´s poor ability to upgrade heavy fuel oil and transform it into products of higher value. (Manager, physical management). According to one respondent, the refining technology in the EEA is older compared to its competitors´ technology (Manager product trading). This is something that Mohite (2014) mentions as well. Moreover, deteriorated margins for the refining industry in general are due to the discrepancy between how the refineries are constructed and what products the market demands. (Mohite, 2014).

According to Jenster & Solberg Soilen (2009), the oil refining industry in Europe is an example of market with high exit barriers. This means that an exit from the market for a company may lead to substantial financial losses. With high exit barriers, companies may have to operate with losses during long times. This could be one factor to why the margins have been poor for the refining industry in the EEA.

According to Mohite (2014) substantial changes in the global oil market and surpluses of gasoline within Europe, means that oil refineries which are configured to produce gasoline are expected to struggle with their economical margins. European refiners have previously and traditionally exported gasoline to the United States. However, the United States demand of importing gasoline has decreased. The demand of gasoline is expected to decrease in the European Union as well. If refineries in the European Union should be able to carry on with their operations, the surplus of their refining processes has to be absorbed by the global market (FuelsEurope).

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5.4 How will the import of petroleum products to the European Economic Area develop?

Out of primary data, five respondents out of nine believed in an increased import of petroleum products to the EEA and three respondents believed the import to be stable or to possible increase. No answer relating to decreased import was given. However, one respondent answered that the import will be influenced by the pull/push situation.

The respondents have mainly mentioned the deficit of middle distillates in the EEA and international competition as major factors to why the region is expected to increase its imports of petroleum products. According to one respondent, the import is considerably influenced by the situation in the United States. The ban for exporting crude oil in the United States has increased the export of petroleum products to the global market. (Manager, physical management).

The increased import of petroleum products to the EEA is driven by international competition and the EEA´s deficit of middle distillates (Shipping analyst). This primary data match secondary data from FuelsEurope (2015), where the present deficit of diesel leads to an import of one million barrels per day of diesel to the EU. The quantity is expected to increase and reach 1.6 million barrels per day in year 2019, even though the consumption of diesel is expected to decrease in the EU since several refineries in the EU are expected to close (FuelsEurope).

For the time being, there are refineries in India, Saudi Arabia, and the United States which all are able to produce products for export purposes. If prices on products are higher in the EEA compared to other regions, the import of petroleum products to the EEA will increase. This since refiners´ margins will only be allowed to reach a certain degree until products will come to the EEA from producers outside the region. (Manager, physical management).

Even though the import to the EEA is driven by middle distillates, one respondent explained that the import of light distillates could increase as well. This since the United States, with its resources of tight oil and shale gas, has capacity to produce and export “cheap energy”. In total with transportation included, this makes petroleum products produced in the United States price competitive on the EEA market as well. (Shipping analyst).

Beside answers relating to increased import of petroleum products to the EEA, answers were also given which indicated stable import. This since refiners based in the EEA have capacity to supply the EEA market with products and are expected to be competitive compared to non-EEA refiners. (Manager, physical management). This respondent explained that the demand of imported petroleum products in relation to products produced within the EEA is expected not to grow (Manager, physical management). This since it is more a matter of "give and take" of petroleum products between different regions; and a balance will occur between imported and domestically produced products in the EEA. Despite a relative low price for transporting petroleum products, there is a cost involved. This factor restrains import of products. (Manager, physical management).

Even though one respondent did not expect the import of gasoline to increase to the EEA, due to the surpluses of gasoline in the region (Manager, physical management), the author believes that import of gasoline could increase. Furthermore, if the import of petroleum products is influenced by the push/pull situation, the extensive production of petroleum products in the United States could lead to imbalances of petroleum product flows within the transatlantic region (Independent Maritime Professional). Therefore, if gasoline produced in e.g. the United States is price competitive on the EEA market, the author believes that import of gasoline in the long run could increase to the EEA.

5.5 How will the intermediate product tanker segment be used in the distribution system for petroleum products in the European Economic Area?

According to one respondent, the trade for intermediate product tankers with capacity to carry 10.000-20.000 tonnes is regional and oil markets are global. Moreover, the market for intermediate product tankers in the EEA is not driven by the demand of petroleum products only; it is also influenced by activities in surrounding oil markets. Examples may be the Russian export routes and activities in North- and West-Africa which have impact on the demand for transportation on the Mediterranean markets. (Independent Maritime Professional). This description corresponds to secondary data that describes the oil refining industry and is relevant.

In this question, no answer was given that represented the majority of the respondents. However, there were two answers which were represented by three respondents. These two answers were that: the intermediate product tanker segment will be used for regional transportation within the EEA even in future and that the intermediate segment faces competition from larger segments. One respondent explained that there will always be demand for short hauls in the EEA between remaining refineries and consumers (Shipping analyst). Even though the import of petroleum products to the EEA increases, the demand for intermediate product tankers is expected to continue. (MR shipping).

According to two respondents, the intermediate product tanker segment is a part of the infrastructure for petroleum products in the EEA. In Sweden and in the United Kingdom as example, storage cisterns for petroleum products are located along coast lines. The capacity of these is usually 8.000, 10.000 or 15.000 m^3. To handle such quantities, intermediate product tankers are preferred instead of larger ships. The intermediate product tanker segment is well established when it comes to suit reception facilities and quays. One of the respondents argued that with a recognized segment for carrying out the transportation, many cargoes are produced in quantities which correspond to the size of ships. (Intermediate operator No.2).

If the terminal infrastructure changes, it may challenge the use of intermediate tankers. With a declining oil demand in the EEA, it is expected that the number of terminals will be reduced (Manager, product trading). Another factor to why a terminal may close if it gets too expensive to use intermediate product tankers compared to larger ships. Moreover, a larger vessel than an intermediate product tanker could be used for calling a nearby terminal instead and the last distribution leg is performed by trucks. (Manager, product trading).

Out of the results, it has been possible to note the importance of the just-in-time concept and that cargo owners want to keep their storage of petroleum products at a minimum. These factors seem to have become more important during the last years. The author believes that it will become even more important to keep storage of petroleum products at minimum even in

future since rates of interest may increase. This could be beneficiary for the intermediate product tanker segment.

According to one respondent, the advantage intermediate product tankers have compared to larger vessels (in terms of benefits for the customers) is efficiency, flexibility and access to more berths. The number of vessels in the EEA is one important parameter for "flexibility". The flexibility may decrease if the number of vessels is reduced. Moreover, a low new-building rate of vessels would be threatening to the segment itself. (Independent Maritime Professional). The author believes that it could be beneficiary in a limited time for ship-owners which operate intermediate product tankers in the EEA if the new-building rate is low. This may lead to higher freight rates for existing tonnage. However, if the number of vessels gets too low, the author believes that cargo owners will seek other alternatives of transportation. The author believes that this particularly applies to the use of larger segments.

The use of larger vessels for carrying out traditional voyages of the intermediate segment has been mentioned by the respondents and this seems reasonable. One respondent explained that, during recent years, substantial volumes from the Baltic region to Europe´s North Western continent have shifted from the intermediate segment to MR tankers and larger ships. The trend is expected to continue. (Intermediate operator No.1). This means that larger product tanker segments capture market shares from the intermediate product tanker segment.

Even though the competition from larger segments to the intermediate segment grows, the respondents expect the role of intermediate product tankers to not be overtaken by larger segments (MR operator). However, distributors and cargo owners aim to reduce the transportation costs through economy of scale. This can be done by loading two intermediate cargoes on a MR ship. This has occurred in larger segment. (MR operator). In the respect of intermediate and MR tankers, the flexibility of MR tankers may increase if cargo owners are able to load several cargoes simultaneously for optimizing the cargo space (MR operator). If successfully done, this could reduce the freight (cost per tonne).

The author believes that the flexibility of larger product tanker segments compared to the intermediate segment will increase if the number of terminals and refineries is reduced. This since the author believes that it will be small facilities which will be closed first. These facilities are important for keeping the advantage of the intermediate segment´s flexibility compared to larger segments.

5.6 How will the use of intermediate product tankers develop with emphasis on hauls?

Five out of seven respondents answered that the length of hauls for intermediate product tankers in the EEA may possibly increase. The respondents have based their expectations on an increased import of petroleum products to the EEA and that the number of terminals will

be reduced. The reason why terminals are closed has mainly been highlighted as the result of decreasing demand of oil.

One respondent explained and gave an explanation to how petroleum products could be handled if the import of petroleum product increases to the EEA: imported volumes could be expected to arrive to the EEA with large product tankers. Such large vessels are unable to distribute to all customers. Moreover, ports may have size restrictions or terminals are only able to handle limited quantities. These volumes will therefore be handled at central storage facilities (hub). The distribution to the receiver is then handled by e.g. intermediate product tankers. As an example, instead of having six to eight refineries for supplying a certain region with petroleum products, the supply may be handled by four to five refineries and a central storage facility. If the distribution patterns for petroleum products develop like this, it is potential that the length of the hauls for intermediate product tankers is increased. (Shipping analyst).

Even though there are several respondents which have answered that the lengths of hauls may increase, the cost of transportation counteracts a possible increased length of hauls since costs should be kept at minimum (Manager, product trading). The author believes that this factor is relevant and of high importance. Moreover, if the number of refineries and terminals will be reduced, the author believes that the reduction will take place by closure of small or unsophisticated facilities. This could initially lead to longer hauls for intermediate product tankers. However, cargo owners´ demand of intermediate product tankers´ flexibility with emphasis on size will be reduced if the smallest terminals close. If the demand of intermediate product tankers´ flexibility is reduced, the competition from larger segments will increase. With reduced demand of flexibility and greater opportunity to gain economy of scale by using larger vessels, the author believes that larger segments could capture additional market shares from the intermediate product tanker segment. However, this is also a question where the importance of the just-in-time concept and keeping storage at minimum is crucial.

5.7 What kinds of ships are expected to be demanded for carrying out the transportation within the intermediate product tanker segment

In this question, there were no answers given that represented the majority of the respondents. However, three respondents out of seven answered that the present intermediate product tanker segment fits well in the distribution and three respondents answered that they expected competition from larger segments.

A common size within the intermediate product tanker segment trading in the EEA, are ships with cargo carrying capacity of 16.000 tonnes. In the respect of what kind of intermediate product tanker that is expected to be demanded, one respondent answered that it is a question of ship-owners´ individual business models and targeted customers since it is a dynamic situation where the demand of ship depends on the demand of product deliveries and the economy of scale (freight cost per ton) (Independent Maritime Professional). Another

respondent said that, instead of expecting a specific type of intermediate product tankers in future, this is more a question of the demand of the intermediate product tanker segment in general compared to other segments. The respondent explained that if the segment fits well into the distribution system and continues to do so, the size does not have to change if the segment keeps its market shares. (MR shipping). This opinion is relevant and as long as the intermediate segment fits in the distribution system it does not have to change.

Out of the results, the just-in-time concept has been frequently discussed. With regards to petroleum products, the concept is important to keep storage of petroleum products at minimum (Intermediate operator No.1) Keeping storage at minimum is something that another respondent mentioned as well when the respondent said that he use of small intermediate product tankers (with approximate cargo carrying capacity of 10.000-12.000-tonnes) may increase. Furthermore, instead of having one ship a month for depot deliveries, a customer may prefer to have two smaller ships per month to keep storage costs at minimum. However, the length between supplier and customer decides. (Manager product trading). This concept appears to be reasonable and corresponds to other industries where focus is in reducing storage costs as well. However, the cost of storage and cost of transportation of the petroleum product have to be assessed in total.

During the late 1990s, intermediate product tankers grew in size, from a common size of ships with cargo carrying capacity of 10.000-12.000-tonnes to 15.000-tonnes (Manager, product trading). The respondent explained that the size became larger probably due to the increased export of petroleum products from Russia. However, the general demand for large intermediate product tankers may decrease. This since the frequency of batches appropriate for the intermediate product tanker segment exported from Russia is reduced. There are still volumes of semi-finished heavy products transported from Russia on intermediate product tankers with capacity to carry 15.000 tonnes; however, the number of such voyages is continuously reduced. (Manager product trading). One contributing factor to why the frequency is reduced of such volumes transported on intermediate product tankers could be that larger vessels capture market shares (as discussed before). The reason why intermediate product tankers grew in

One respondent explained that, flexi-size ships with capacity to carry 26.000-27.000 m^3 were until recently popular ships for carrying out transportation within the North-western Europe. However, the use of this segment is in decline and handy-size ships with capacity of 40.000m^3; nowadays do these voyages. Handy-size ships overtake market shares from the intermediate segment as well. The competition has especially increased in the Baltic Sea when it comes to cargoes of naphtha and gasoil. (Intermediate operator No.2). If the development continues, it could be relevant to expect that the use of large intermediate product tankers could decrease as the respondent (Manager, product trading) said.

5.8 With regards to size and capacity

When it comes to the size of intermediate product tankers, there is no answer given that represented the majority of the respondents. One answer was shared by three respondents out of seven and was that the size of the segment may become larger. The rest of the answers given were represented by one respondent only.

Three out of seven respondents answered that they believed in a size increase of the intermediate product tanker segment. Different factors to why are described below:

- One respondent said that the size may become larger if the history of development continues (Intermediate operator No.1)
- It is a marginal cost for building a larger ship. Furthermore, the cost for building a ship with cargo carrying capacity of 15.000-16.000 tonnes or 19.000 tonnes is marginal. This also applies to the bunker consumption. It is more expensive to use a larger ship but the revenue potential is substantial. (Intermediate operator No.2).
- Due to technical improvements and better utilization of cargo spaces the capacity could increase (Shipping analyst).

Even though three respondents answered that they believed in an increased size of intermediate product tankers, there are factors which counteracts an increase. For the time being, it is according to one respondent hard to predict how the size of intermediate product tankers will develop since there are few ships on order (Independent Maritime Professional). Factors which counteract an increased size of the intermediate segment; were by the respondents explained as: restrictions in ports and at terminals limit the size (Intermediate operator No.1), customers do not want to store their petroleum products (Manager product trading) and increased trade of smaller lots (Manager, shipping division).

The increased trade of smaller lots is because batches of specialized fuels are traded more frequently in the EEA. This applies to both the supply and production side of the refining process when producing biofuels. Specialized fuels are expensive and are traded in small batches. (Manager, shipping division). Biofuels are examples of such fuels specifically produced for a certain market. Moreover, products are produced according to a customer´s individual specification and lead to smaller batches. As petroleum products are expensive, both refiners and customers want to keep their storage at minimum. Due to this development, intermediate product tankers are expected to be able to carry and handle different petroleum products simultaneously. (Manager, shipping division).

The above mentioned counteracting forces to an increased seize of intermediate tankers appears relevant. Moreover, with all answers in concern, companies do not want to store their products and if the intermediate product tanker segment should be able to retain its flexibility compared to larger segments, the segment should not grow in size. With an increased production of specialized fuels, batches become smaller and more expensive and the demand of flexibility is high. However, according to one respondent, the main question is whether the

use of intermediate product tankers will continue or not. If this segment fits well into the distribution system and continues to do so, the size does not have to change (MR shipping).

In this question, one respondent gave the following description on ideal sizes of intermediate product tankers trading in the EEA: if the voyage's duration is up to two days, ships with cargo capacity of 8.000 to 12.000 tonnes are preferred. If the duration is longer, ships with capacity of 15.000 tonnes are suitable. (Manager product trading). These sizes appear reasonable since the flexibility has advantage compared to economy of scaly when it comes to voyage durations up to two days and the importance of economy of scale grows when the duration is more than two days. The respondent also explained that if the ship should be appropriate for trading purposes, the ship should be able to carry 20.000 tonnes since that volume is commonly traded. The author comprehends that particularly trading with heavy petroleum products are done on ships which have capacity to carry at least 20.000 tonnes. This since heavy residual products is of relative low value.

5.9 With regards to fuel source?

Different alternatives for fulfilling coming bunker specifications have been mentioned by the respondents. The alternatives discussed were propellants fuel by LNG, the use of scrubbers and ECA oil. According to one respondent, the future fuel for intermediate product tanker trading in the EEA significantly depends on coming regulation of marine bunkers. In the North-western Europe, ships have to conform to sulphur emission control areas (SECA). With the substantial price fall of crude oil in 2014, different kinds of gasoil became relative cheap compared to before. Due to this, the transition from using heavy fuel oils to middle distillates with 0.1% sulphur went smooth. (Manager product trading). Several oil companies started to develop heavy fuel oils with low sulphur levels for distribution in ECAs within Europe. However, these fuels have not become particularly popular. If the popularity should increase, the price of gasoil has to increase compared to alternative fuels (Manager product trading).

Even though there is technology available beside conventional engines, most of the vessels in general are today built with conventional engines. However, according to five respondents out of seven, LNG has potential to become a future fuel used in the intermediate product tanker segment. One respondent explained that, with present alternatives at hand, LNG is expected to become the future fuel for intermediate product tankers ships built for trade in the North-western Europe. This since other alternatives, e.g. scrubbers, creates residues which are to be disposed or taken care of. With LNG, the technology is cleaner itself and does not need cleaning of exhausts. (Intermediate operator No.2). To not limit the ship-owner to one source of fuel only, the next generation of intermediate product tankers are expected to be equipped with dual-fuel engines. Dual-fuel engines can combust heavy fuel, gasoil and LNG. (Intermediate operator No.1).

In an economical point of view, it is hard to predict whether it will be more financial lucrative to use LNG compared to other fuels. However, in the long perspective, there is according to

one respondent room for investing in LNG propellants in ships performing shorter hauls within the EEA (Shipping analyst). One respondent explained that the additional cost for installing a propellant that could combust LNG in a new ship is approximately 3-4 million dollars out of a total cost of 35 million dollars. If the cost is spread out over 20 years, the cost is reasonable. However, reduced emissions to the environment is the largest benefit and with a potential low price of LNG compared to marine gasoil, intermediate product tankers with LNG propellants have potential to become more cost effective as well. (Intermediate operator No.2).

The increased use of LNG in propellants will mainly occur through new building projects and not through retrofitting. It is also expected that next round of EU subsidizations in shipping for improving environmental footprints will go to LNG related projects (Manager, shipping division). The use of LNG is expected to be most popular in tanker ships. This since it is possible to arrange the system, (e.g. tank) in a way that does not capture cargo space (Manager, shipping division). Trade in coastal-, inland- and Baltic Sea areas are the locations where the amount of LNG powered vessels is expected to increase. This since infrastructure for supplying LNG is expected to be built in the Baltic Sea region. (Manager, product trading). This data is considered as relevant and out of the interviews, the author understands that infrastructure for LNG supplies are planned in the Baltic Sea. Out of secondary data, there are large reservoirs of LNG globally. However, the lack of sufficient infrastructure hampers the development to increase the use of LNG. Insufficient infrastructure for LNG in the EEA; is something one respondent (Intermediate operator No.1) mentioned as incentive that lowered the interest to invest in LNG propellants.

5.10 With regards to loading/discharging capacities

Out of the result, six out of seven respondents said that the loading and unloading capacity of intermediate product tankers is sufficient. A ship should load and unload its cargo as quickly as possible. For the time being, restrictions usually relate to reception facilities. According to one respondent, in general, existing intermediate product tankers are able to handle the cargo at terminals in an appropriate way (Intermediate operator No.1)

According to one respondent, it is expensive to upgrade terminals and quays and therefore focus has to be in using ships which are time efficient when alongside terminals. This can be achieved by the use of intermediate product tankers which have high loading and discharging capacity and are able to handle different products simultaneously (Manager, shipping division). Ships have occasionally been restraining when refineries intend to deliver higher rates than vessels´ capacity to receive (Manager, product trading). The author considers the data given with regards to loading and discharging capacities to be relevant.

5.11 Methodological considerations

Whatever job or study one have performed, it is always easy to be after-wise. In this study this mostly applies to the geographical area chosen. If the study would have been conducted study

again, the geographical area would have been limited to the EU instead of the EEA. The underlying factor to this is that it is more convenient to find and compare theoretical information that relates to the EU than the EEA. However, in such case, it would not have been possible to involve Norway in this study which is a large player on the oil market in the EEA. Even though Switzerland is not included in the EEA, the country was included in this study since Switzerland has refining operations and the country is included in several previous studies related to oil refining in the EU.

The choice of conducting a case study with semi-structured interviews and focusing questions on the topic for this study seems appropriate. However, it is easy to underestimate the effort needed to perform semi-structured interviews and to analyse the information from the interviews. The more interviews performed, the harder it was to not discuss or become partial to the answers given by the respondents. The alternative would have been structured questions. However, this would have limited the possibility to use the respondents as independent sources of information and to collect as many different aspects on the topic as possibly. Two interviews in this study were conducted via the use of telephone. However, these interviews did not provide as "deep" information compared to the interviews held with physical meetings. It would have been better if all interviews were conducted via physical meetings.

Initially, it was planned to include more respondents in the study. However, out of discussions with the supervisor, it was decided to set a limit to the number of respondents currently involved in this study. With more respondents it would in theory been possible to collect more aspects on the topic. However, the possibility is limited since the aspects on the topic given by the respondents to a great extent correspond to aspects mentioned in secondary data. The validity of questions number one and two is perceived as high. This since the primary data corresponded to secondary data. However, the frequently use of Mohite (2014) as secondary data, reduces the validity. However, information provided by Mohite (2014) corresponds to other secondary data included. The validity of question three and four is lower than question one and two. This since primary data out of question three and four has not been compared to secondary data. However, by the use of triangulation between the respondents increases the validity of data from question three and four. The reliability of the primary data is perceived as high. This since the choices of respondents was based on their knowledge on the topic and that the interviewees felt that they were qualified to answer the questions chosen. Moreover, the respondents selected and answered questions appropriate to the respondents' knowledge. The impression of the respondents during the interview was that the interviewees had long experience of the topic and delivered clear answers without hesitation.

Since I am not professionally involved with the oil refining industry in the EEA or the operation of intermediate product tankers in the EEA, it would have been a good idea to conduct a pilot interview to test and challenge the questions which constituted the base for the interviews. This would have revealed if the questions were relevant or not. An example is the

correct use of the term “oil companies” in question number one. Here, several respondents explained that distributors or suppliers would have been more appropriate since several oil companies in the EEA have divested their refining and distribution operations. A pilot interview would also have revealed that question number three with emphasis on hauls was not fully appropriate. Moreover, two of the sub-questions were similar and should have been one question only.

6 Conclusions

A decreasing demand of oil in the EEA contributes to a reduced utilization rate of refineries located in the EEA. However, there are other factors which affect the utilization rate as well. Refineries in the EEA are not configured to produce the mix of petroleum products demanded in the region. Moreover, refiners are unable to produce the amount of middle distillates demanded and have surpluses of gasoline. These imbalances are driven by a low complexity of the refining units in the EEA. The low complexity mainly applies to the refining industry´s inability to change the produced yield of diesel and gasoline. It also applies to the limited ability to convert heavy residues into products of higher value. Investments in more hydrocracking units could increase the possibility for refiners in the EEA to change their yields of gasoline and diesel. Upgrades in the industry presently take place and additional upgrades are expected to come. However, the development may be slow due to challenging finances.

The refining industry in the EEA operates with an overcapacity and additional closures of refineries are expected to come, particularly with emphasis on refineries with high cost-bases. Refineries with high cost-bases are typically small, have low complexity and could be located in high-cost inland locations. Out of primary data and secondary data the excess refining capacity in the EEA is between 5 and 14 per cent. If the excess capacity is removed, this will contribute to improved margins for existing refiners in the region. However, the margins will only be allowed to be improved to a certain limit until it will be lucrative for non-EEA refiners to sell their products on the EEA market. If refiners in the EEA should operate with good margins, local demand for petroleum products in non-EEA areas has to increase and the refining capacity in the EEA has to reduce. It is expected that import of petroleum products to the EEA will increase. If refiners in the EEA should stay competitive to non-EEA refiners, refiners in the EEA have to be competitive in particularly producing road fuels.

The utmost challenge to refiners based in the EEA is increased competition from non-EEA refiners. The competition from non-EEA refiners is particularly expected to come from refiners in India, The Middle East and the United States. These refiners have access to highly sophisticated refineries with extensive capacity and are able to produce petroleum products which correspond to specifications in the EEA. Even though the competition to refiners based in the EEA from refiners based outside EEA is expected to be harsh, this competition could be only temporary if the local demand of petroleum products in non-EEA areas increases.

The future use of intermediate product tankers will be to carry out regional transportations of petroleum products within the EEA. Even though imports of petroleum products to the EEA may increase and larger segments than the intermediate segment are expected to carry out the transportation to the EEA, the intermediate segment is expected to be needed for regional transportation in the future. Volumes transported by the intermediate segment are expected to be unchanged or falling.

When it comes to the length of hauls for the intermediate product tanker segment, they could hypothetically increase if the number of terminals is reduced and the import of petroleum products increases. To a certain extent, this may be positive for the intermediate product tanker segment. However, the length of hauls should not increase if the transportation costs should be kept at a minimum. This could lead to closures of small local terminals which are able to receive small intermediate product tankers only. Instead, nearby terminals could be used and the last leg of transportation is carried out by trucks instead of small intermediate product tankers. This could potentially increase the competition from larger segments to the intermediate product tanker segment.

The popularity of using small intermediate product tankers with capacity to carry 10.000- to 12.000-tonnes could potentially grow for voyages with duration of up to two days. These ships should also be able to carry and handle several lots simultaneously since the production frequency of specialized fuels increase.

Today, a common size of intermediate product tankers which trade in the EEA, are ships with capacity to carry 16.000 tonnes. Some respondents in this study believed that the size of intermediate product tankers may increase if the history of development continues. One factor that may drive the size increase of intermediate product tankers is that the cost to build and to operate a ship that has a cargo carrying capacity of 15.000-16.000-tonnes compared to a ship with a cargo carrying capacity of 19.000-tonnes; is marginal to the potential of revenue. However, an important aspect is that the intermediate product tanker segment in general faces competition from larger segments. If the intermediate product tanker segment should keep its advantage compared to larger segments, it is essential that the intermediate product tanker segment keeps its flexibility. Therefore, the typical size of an intermediate tanker with 16.000 tonnes of cargo carrying capacity is appropriate. If the size grows, the competition to the intermediate product tanker segment from larger segments will increase.

Different fuels are available to the intermediate product tanker segment. However, LNG as fuel has a great potential to become a future fuel. Meanwhile, the present incentives for investing in LNG propellants are reduced since it is more expensive to use LNG than marine gasoil. However, as intermediate product tankers are built for 20 years of operation, the current or short-term price is not to be the ground for investing in LNG propellants or not. LNG is expected to become most popular in the Baltic Sea region. Since there are large reservoirs of LNG globally, the price of LNG is expected to be reduced if global infrastructure for LNG supplies becomes sufficient.

6.1 Future research

Out of discussions with involved interviewees, different interesting topics for future studies have been mentioned. Two proposed topics are described below.

- Investigate every oil refinery and depot-terminal in detail within the EEA. Moreover, conduct a quantitative study with purpose to investigate which refineries and terminals which possibly may close and which will continue with operations. This could reveal a substantial base for examining which type of product tanker segment that will be the most cost efficient for carrying out transportation between actual and predicted terminals.

- A second suggestion to future research is to use the methodology of this study and to conduct the study on larger product tanker segments, e.g. the MR segment.

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Appendix A

- Interview with Oil Company/ shipping company

The purpose of the interview is to collect data for a master thesis. The aim of the thesis is to investigate how the oil refining industry is expected to develop in the EEA and how intermediate product tankers will be used in oil companies´ distribution systems.

The answers will be recorded or noted on paper during the interview and the material will be used for the thesis purpose only. The respondent is kept anonymous and he/she has to approve the data before it is used in the thesis.

- Demand of oil in the EEA

- How will the demand of different petroleum products develop until in the EEA until year 2025?
- Light distillates?
- Middle Distillates?
- Heavy fuel oil?

- Supply of oil products to the EEA market

- How will the oil companies supply their products; with own refineries or imported products?
- How will the oil refining industry develop in the EEA?
- What challenges does the refining industry in the EEA face?
- How will the import of petroleum products to the EEA develop?
- How will the imported petroleum products be distributed to the different locations?

- Intermediate product tankers in the distribution system

- How will the intermediate product tanker segment be used in the distribution system in the EEA?
- How will the use of intermediate product tankers develop with emphasis on hauls? Will the hauls increase or decrease in distance?

- Type of ships to be used

- What kinds of ships are expected to be demanded for carrying out the transportation within the intermediate product tanker segment?

- With regards to size and capacity?

- With regards to fuel source?

- With regards to loading/discharging capacities?

- Would you like to add anything to the interview?

- *Thank you for your participation!*

Appendix B

Question 1

Answers, question number one, ***"How will the demand of different petroleum products develop until 2025 in the European Economic Area?"***. Sub-questions focus in light distillates, middle distillates and heavy fuel oil.

Respondent	Total demand until of oil 2025	Demand of light distillates	Demand of middle distillates	Demand of heavy fuel oil
Intermediate operator No.1	Increase until 2020 and then level off.	Increase until 2020 and then level off.	Increase until 2020 and then level off.	Stable.
Intermediate operator No.2	Stagnant or decreasing.	Decreasing	Stagnant.	Decreasing
MR operator	Increase until 2020 and then level off.	Increase until 2020 and then level off.	Stagnant.	Decreasing
Shipping analyst	Stagnant.	Stagnant.	Small increase.	Decreasing.
Independent Maritime Professional	Stagnant.	Stagnant or slightly increasing.	Stagnant or slightly increasing.	Decreasing.
Trading manager	Stagnant or decreasing. Increase will not be allowed in the region.	Decreasing.	Has increased during recent years. Further development depends on political incentives.	Decreasing.
Manager, planning and optimization	Stagnant.	Stagnant.	Stagnant and may increase beyond 2020.	Decreasing.
Manager, physical management	Stagnant.	There will still be a demand.	Stagnant and may increase beyond 2020.	Decreasing.
Product trading manager	Decreasing.	Decreasing.	Decreasing.	Decreasing.

Question 2

Nine respondents have answered question two, ***" How will the oil companies supply their products; with own refineries or imported products?***. Sub-questions focus in what challenges refiners within the EEA face and how the import of petroleum products is expected to develop to the EEA.

Respondent	Development of EEA´s refining industry	EEA´s refiners´ challenges	Import of petroleum products to the EEA
Intermediate operator No.1	Additional closures of refineries. Some may be used for storage. Stable production output.	Increased competition from NON-EEA refiners. Environmental restrictions.	Stable and increase if the economy grows. Stable import but will increase if refiners in the EEA are not price competitive.
Intermediate operator No.2	Additional closures of ineffective refineries. Upgrade of some existing refineries. No new refineries.	Increased competition from NON-EEA refiners. More use of renewable energy sources.	Imports are expected to increase.
MR operator	Additional closures of ineffective refineries.	Increased competition from NON-EEA refiners.	Imports are expected to increase.
Shipping analyst	Additional closures of ineffective refineries. Upgrades of some existing refineries.	Increased competition from NON-EEA refiners. Low refining margins. Changing product mix demand within the region.	Increasing. Short-term dominated by middle distillates. In the longer run, light distillates may be imported as well.
Independent Maritime Professional	Additional closures of ineffective refineries. Some consolidation. Vertical disintegration.	Increased competition from NON-EEA refiners. Low refining margins.	Depends on pull/push relation.
Manager, trading	Refining capacity has to reduce. More usual with "independent" refiners. No new refineries.	Increased competition from NON-EEA refiners Decreasing local demand. Environmental restrictions.	Increasing import of particularly diesel.

Manager, planning and optimization	Overcapacity is expected to remain. If commodity prices are higher than in other regions, import will continue.	Low refining margins. Surplus of gasoline and heavy fuel oil. Weaken margins on diesel.	The import will continue, particularly of diesel.
Manager, physical management	Additional closures of ineffective refineries. More retailers are expected to overtake distribution of products.	Limited ability to upgrade heavy fuel oil into higher-value products. Industry has 5-10% of overcapacity. Environmental restrictions.	Stable import but will increase if refiners in the EEA are not price competitive.
Manager, product trading	The industry will have overcapacity of gasoline production and deficit diesel production.	Increased competition from NON-EEA refiners. Old technology compared to competitors. Harsh competition on diesel market.	Import of middle distillates is expected to increase.

Question 3

"***How will the intermediate product tanker segment be used in the distribution system for oil products in the European Economic Area?"***. Sub-questions focus in how the intermediate product tanker segment will develop with emphasis on hauls and if the hauls will increase or decrease in distances to the EEA.

Respondent	Segment used in distribution system	Development of hauls	Increase or decrease in lengths of hauls
Intermediate operator No.1	No major changes expected. Other segments may capture market shares.	Much long-haul volumes have shifted to MR and larger segments.	Light products: may decrease. Heavy products: may increase.
Intermediate operator No.2	No major changes expected. The segment is part of the infrastructure.	The hauls may increase if the import increase and the number of terminals are reduced.	Increase.
MR operator	Used for regional transportation between producer and customer. The segment is part of the infrastructure.	The hauls may increase if the import increase and the number of terminals are reduced.	May increase.
Analyst, shipping	Used for regional transportation between producer and customer. The segment will transport unchanged or falling volumes.	The hauls may increase if the import increase and the number of terminals are reduced.	May increase.
Independent Maritime Professional	Partly depends on the rate of new tonnage.	Limited/unchanged lengths.	Unchanged.
Manager, maritime operations	Used for regional transportation between producer and customer.	The hauls may increase if the import increase and the number of terminals is reduced. Hauls are expected to be the same in lengths.	May increase.

Manager, product trading	Used for regional transportation between producer and customer. Other segments may capture market shares. If it gets too expensive to use small ships, terminals may close and the last leg of distribution is performed by e.g. trucks.	Unchanged lengths as transportation costs are to be kept at minimum.	Unchanged.

Question 4

*"**What kinds of ships are expected to be demanded for carrying out the transportation within the intermediate product tanker segment?"***. Sub-questions focus in size and capacity, fuel source and loading/discharging capabilities.

Respondent	Segment in general	Size and capacity	Fuel source	Loading/discharging capabilities.
Intermediate operator No.1	The segment fits well into the distribution system. Factors as: Just-in-time and low storage capacity influence.	Size may become larger if development history continues. Port and terminals constrain.	Conventional diesel engines with dual fuel capabilities (LNG) if oil price stays relative low.	The capacity is sufficient. The capacity may increase if ships are contracted for specific trades and customer demands.
Intermediate operator No.2	The segment fits well into the distribution system. Competition from larger ships.	Size and capacity will likely increase a bit since the price difference when building a new ship is marginal to income potential.	LNG has potential to become a future fuel for the segment. It is friendlier to the environment and may become price competitive.	The capacity is sufficient.
MR operator	The segment fits well into the distribution system. Competition from larger ships.	No major changes. It is more a question of utilization of the whole segment.	New technology is available. However it is hard to predict which technology that will be used.	The capacity is sufficient
Shipping analyst	Size restrictions at reception facilities form the base for the segment.	Up-scaling of capacity may occur due to technical improvements.	There is room for LNG propellants in the long-term.	No comments.
Independent Maritime Professional	Depends on ship-owners´ business models and targeted customers.	Difficult to predict due to low new-building rate.	Depends on ship owners´ business models and targeted customers	Depends on ship owners´ business models and targeted customers
Manager, shipping division.	The same use of the segment but expected to be able to carry several smaller lots.	Popularity of smaller ships may increase as smaller lots of different products are to be distributed.	There is room for long-term LNG investments.	The capacity is sufficient. However, focus is in reducing lay-time.
Manager, product trading	Competition from larger ships on some routes. For optimization, the use of small intermediates may increase.	Optimal sizes for intermediates are: 10.000-12.000 tonnes for voyages up to 2 days. 15.000 tonnes for durations above 2 days. 20.000 tonnes for	Different alternatives. LNG is expected to become most popular in the Baltic Sea region and installed on new ships. Limited LNG	The capacity is sufficient.

		trading purposes.	conversions on existing ships.	