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OIL TRANSPORTATION IN THE GULF OF FINLAND IN 2020 AND 2030

Olli-Pekka Brunila

Jenni Storgård

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2007–2013

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FOREWORD

Maritime oil transportation in the Baltic Sea area has been a source of wide concern about the possibility of a large-scale oil accident and its harmful effects. The volumes of maritime transportation of oil have increased, especially due to the growing oil production and export activities in Russia. The aim of this report is to analyze the current structure of maritime oil transportation in the Baltic Sea and to forecast the future development in the Gulf of Finland until 2020 and 2030. Future scenarios will help to analyze future risks and to develop necessary risk mitigation measures in order to decrease the risk of an oil accident at sea.

In this study, three alternative scenarios for 2020 and 2030 were produced. The alternative scenarios describe oil transportation volumes in different circumstances considering, for example, energy policies and the economic situation. Future oil volumes are based on expert estimations. On the basis of this study, no dramatic increase in oil transportation in the Gulf of Finland is to be expected. Most of the scenarios only forecast a moderate growth in maritime oil transportation compared to the current level. The effects of European energy policy which favours renewable energy sources can be seen in the 2030 scenarios, in which the oil transportation volumes are smaller than in the 2020 scenarios.

This report was produced as part of the “Minimizing risks of maritime oil transport by holistic safety strategies” (MIMIC) project. The MIMIC project is financed by the European Regional Development Fund, the Central Baltic INTERREG IV A Programme 2007-2013; the City of Kotka; Kotka-Hamina Regional Development Company (Cursor Oy); the Centre for Economic Development, Transport and the Environment of Southwest Finland (VARELY); and the project partners, which include Kotka Maritime Research Centre, the Centre for Maritime Studies at the University of Turku, Kymenlaakso University of Applied Sciences, Aalto University, the University of Helsinki, Tallinn University of Technology, the University of Tartu, the Swedish Meteorological and Hydrological Institute and the Finnish Environment Institute.

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Kotka, 30 August 2012

Jenni Storgård
Centre for Maritime Studies
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ABSTRACT

This study is part of the Minimizing risks of maritime oil transport by holistic safety strategies (MIMIC) project. The purpose of this study is to provide a current state analysis of oil transportation volumes in the Baltic Sea and to create scenarios for oil transportation in the Gulf of Finland for the years 2020 and 2030. Future scenarios and information about oil transportation will be utilized in the modelling of oil transportation risks, which will be carried out as part of the MIMIC project.

Approximately 290 million tons of oil and oil products were transported in the Baltic Sea in 2009, of which 55% (160 million tons) via the Gulf of Finland. Oil transportation volumes in the Gulf of Finland have increased from 40 million to almost 160 million tonnes over the last ten years. In Russia and Estonia, oil transportation mainly consists of export transports of the Russian oil industry. In Finnish ports in the Gulf of Finland, the majority of oil traffic is concentrated to the port of Sköldvik, while the remainder mainly consists of different oil products for domestic use. Transit transports to/from Russia make up small volumes of oil transportation. The largest oil ports in the Gulf of Finland are Primorsk, Tallinn, St. Petersburg and Sköldvik.

The basis for the scenarios for the years 2020 and 2030 is formed by national energy strategies, the EU`s climate and energy strategies as well other energy and transportation forecasts for the years 2020 and 2030. Three alternative scenarios were produced for both 2020 and 2030. The oil volumes are based on the expert estimates of nine specialists. The specialists gave three volumes for each scenario: the expected oil transport volumes, and the minimum and maximum volumes. Variations in the volumes between the scenarios are not large, but each scenario tends to have rather a large difference between the figures for minimum and maximum volumes. This variation between the minimum and maximum volumes ranges around 30 to 40 million tonnes depending on the scenario.

On the basis of this study, no a dramatic increase in oil transportation volumes in the Gulf of Finland is to be expected. Most of the scenarios only forecasted a moderate growth in maritime oil transportation compared to the current levels. The effects of the European energy policy favouring renewable energy sources can be seen in the 2030 scenarios, in which the transported oil volumes are smaller than in the 2020 scenarios. In the *Slow development 2020* scenario, oil transport volumes for 2020 are expected to be 170.6 Mt (million tonnes), in the *Average development 2020* 187.1 Mt and in the *Strong development 2020* 201.5 Mt. The corresponding oil volumes for the 2030 scenarios were 165 Mt for the *Stagnating development 2030* scenario, 177.5 Mt for the *Towards a greener society 2030* scenario and 169.5 Mt in the *Decarbonising society 2030* scenario.

TIIVISTELMÄ

Tämä tutkimus on tehty osana Minimizing risks of maritime oil transport by holistic safety strategies (MIMIC) -hanketta. Tutkimuksen tavoitteena on analysoida Itämeren merikuljetusten nykytilannetta sekä luoda skenaariot öljykuljetusmääristä vuosille 2020 ja 2030 Suomenlahdella. Öljykuljetusmääriä ja tulevaisuusskenaarioita tullaan hyödyntämään öljykuljetusten riskeihin liittyvässä mallinnuksesessa, joka on osa MIMIC-hanketta.

Itämerellä kuljetettiin vuonna 2009 noin 290 miljoona tonnia öljyä ja öljytuotteita, josta noin 55 % eli 160 miljoona tonnia kuljetettiin Suomenlahden kautta. Öljykuljetukset Suomenlahdella ovat kasvaneet 40 milj. tonnista melkein 160 milj. tonniin viimeisten kymmenen vuoden aikana. Venäjän ja Viron satamissa öljykuljetukset koostuvat pääasiassa Venäjän öljytuotannon vientikuljetuksista. Pääosa Suomen Suomenlahden öljykuljetuksista on Porvoon öljynjalostamon liikennettä Sköldvikissä. Muu öljyliikenne Suomen satamissa koostuu erilaisten öljytuotteiden kuljetuksista kotimaista kysyntää varten. Vähäisiä määriä öljytuotteita kuljetetaan myös Venäjän transitoliikenteessä Suomen satamien kautta. Suomenlahden suurimmat öljysatamat ovat Primorsk, Tallinna, Pietari ja Sköldvik.

Skenaarioiden lähtökohtana on käytetty kansallisia energiastrategioita, EU:n ilmasto- ja energiastrategioita sekä muita energia- ja kuljetusennusteita. Vuosille 2020 ja 2030 on tehty kolme vaihtoehtoista öljykuljetusskenaariota. Öljykuljetusten määrät skenaarioissa arvioitiin yhdeksän asiantuntijalausunnon perusteella. Asiantuntijat määrittelivät jokaiselle skenaariolle kolme eri öljykuljetusten määrää: todennäköisimmän arvon sekä minimi- ja maksimimäärän. Öljykuljetusmäärissä eri skenaarioiden välillä ei ole kovin suuria eroja kokonaisuutena katsoen, mutta yksittäisissä skenaarioissa minimi- ja maksimimäärän välinen ero oli usein melko suuri eli 30–40 miljoonan tonnin välillä.

Tämän tutkimuksen perusteella öljykuljetusten määrän dramaattista kasvua nykymääriin nähden ei ole näköpiirissä. Suurin osa asiantuntijoiden eri skenaarioille antamista kuljetusmääristä ennustavat maltillista kasvua nykytilanteeseen nähden. Vuoden 2030 skenaarioissa on nähtävissä uusiutuvia energiamuotoja suosivan energiapolitiikan vaikutukset Euroopassa eli öljykuljetusten määrän vähentyminen vuoteen 2020 verrattuna. Suomenlahden öljykuljetusten todennäköisimmän määrän ennustettiin olevan *Slow development 2020* -skenaariossa 170,6 milj. tonnia, *Average development 2020* -skenaariossa 187,1 milj. tonnia ja *Strong development 2020* -skenaariossa 201,5 milj. tonnia. Vastaavat arviot vuoden 2030 skenaarioille olivat 165 milj. tonnia *stagnating development scenario 2030* -skenaariossa, 177,5 milj. tonnia *towards greener society 2030* -skenaariossa ja 169.5 milj. tonnia *decarbonised society 2030* -skenaariossa.

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1 INTRODUCTION

1.1 General

There has been a remarkable increase in maritime transportation, and the transportation of oil in particular, in the Baltic Sea in the 2000´s. Over the last ten years, the volume of oil and oil products transported has tripled in this area. The economic recession had a negative effect on transportation and on the demand for goods in the Baltic Sea region in the final years of the 2000's. However, the volume of oil transported did not decrease during the recession. The main reason for the increase in maritime oil transportation volumes in the Baltic Sea is Russia`s new oil terminals in the eastern part of the Gulf of Finland. The Port of Primorsk started operating in 2002, and other ports have increased their capacity as well. Oil terminals in the port of Ust-Luga started operating in March 2012. This will increase the transportation of oil in the Gulf of Finland in the future.

In 2010, almost 290 million tonnes of oil and oil products were transported in the Baltic Sea, of which more than 55% via the Gulf of Finland (Holma et al. 2011). The shallow and rocky waters, narrow channels and severe ice conditions add to the risks of navigation in the Baltic Sea and, more particularly, in the Gulf of Finland. Every day, more than 2,000 ships are sailing in the Baltic Sea, and 25% of these are tankers. Almost 15% of the world's maritime transportation takes place in the Baltic Sea. (HELCOM 2009; the Baltic Sea Action Group 2008) The relatively small sea areas, crossing traffic between Helsinki and Tallinn and oil tankers going to the west from the eastern part of the Gulf of Finland are a combination which can cause a huge environmental disaster. Maritime oil transportation is also vulnerable to security threats, an issue that has attracted less attention in the Baltic Sea.

1.2 MIMIC project

This report is part of Work Package 2 in the "Minimizing risks of maritime oil transport by holistic safety strategies" (MIMIC) project. The project takes a comprehensive, holistic approach to risks related to maritime oil transportation in the Baltic Sea. The main focus in the project is on integrating the knowledge acquired in earlier projects and new information on the less studied aspects of oil hazards. Another aim is to study and compare the effect of different management actions taken to avoid accidents, giving insights into the cost-effectiveness of such actions. In the project, a probabilistic model will be developed, which integrates models related to traffic, accident probabilities, ecosystem impacts and the oil spill response capacities of society to decrease the likelihood and consequences of oil hazards.

Work Package 2 focuses on the development of traffic flows. Information on future scenarios of maritime oil transportation and detailed information on ships sailings in the Gulf of Finland will be produced. This information will be utilized in the integrative model. The present report relates to WP 2 Task 1: Oil cargoes: present situation and scenarios.

The MIMIC project partners are Kotka Maritime Research Centre, the University of Turku Centre for Maritime Studies, Kymenlaakso University of Applied Sciences, Aalto University, the University of Helsinki, Tallinn University of Technology, the University of Tartu, the Swedish Meteorological and Hydrological Institute and the Finnish Environment Institute. The MIMIC project's cost estimate is approximately 2 million Euros, and its duration is from May 2011 till the end of 2013. The project is funded by the European Union and it has been approved as an EU flagship project. The financing comes from the European Regional Development Fund, the Central Baltic INTERREG IV A Programme 2007-2013; the Centre for Economic Development, Transport and the Environment of Southwest Finland (VARELY); the City of Kotka; Kotka-Hamina Regional Development Company (Cursor Oy); Kymenlaakso University of Applied Sciences; the Finnish Environment Institute; the University of Tartu; Tallinn University of Technology and the Swedish Meteorological and Hydrological Institute.

1.3 Purpose and methodology of the study

The purpose of the study is to present maritime oil transportation scenarios for the years 2020 and 2030 in the Gulf of Finland. An analysis of the current state and future development of oil transportation in the Gulf of Finland is also provided. A base for future oil transportation scenarios is formed based on statistics, a current state analysis and a comprehensive study of the energy strategies on national and EU level. Oil volumes in 2020 and 2030 were estimated by specialists.

The study focuses on crude oil and oil products. Crude oil and oil products are looked at separately whenever possible (in many statistics there is only one group, "oil"). The transport/handling volumes of oil and oil products in this report are based on statistics from different sources (e.g. ports, operators, terminals, previous studies, governmental and EU databases). Ship statistics and ship calls were picked from AIS data from 2009. The future scenarios are based on international and national energy strategies and on other future scenarios (e.g. the Baltic Transport Outlook 2030, the Technology Outlook 2020 and the Baltic transport system – Finnish perspective). An expert workshop was arranged in May 2012, in which the specialists gave their estimations of the oil volumes transported for each scenario. In addition, some specialists were asked to give their evaluations by e-mail.

One objective of the MIMIC project is to put together the results of previous projects. Maritime oil transportation scenarios for the Gulf of Finland for the year 2015 were produced earlier in the SAFGOF project (Kuronen et al. 2008). In the Baltic Transport

Outlook 2030 project, the development of maritime traffic was forecasted until 2030 in order to achieve a better basis for national long term infrastructure planning in the Baltic Sea region with the aim of making the region more accessible and competitive (Petersen et al 2011).

1.4 Structure of the report

The report is structured as follows. Chapter 2 contains the current state analysis of oil transportation in the Baltic Sea. In this analysis, the oil and oil product volumes are presented individually for each Baltic Sea country. Chapter 3 focuses on the trends of oil transportation volumes in the Gulf of Finland. All ports that handle oil and oil products in the Gulf of Finland are discussed individually. The volumes are given for the last ten years.

In Chapters 4 and 5, national and international energy and climate strategies and forecasts for the years 2020 and 2030 are described. These strategies and forecasts create the basis for the MIMIC oil transportation scenarios in the Gulf of Finland for the years 2020 and 2030 presented in Chapter 6. Three alternative scenarios for 2020 and 2030 are formulated, taking into consideration the economic situation and investments on new technologies and oil production capacity. In Chapter 7, the results of the expert estimations of oil volumes transported in the Gulf of Finland in 2020 and 2030 are presented. Chapter 8 includes a current state analysis of tanker size distribution and future tanker size distribution. Tanker size distribution is correlated to MIMIC scenarios, and the tanker size trend has been estimated for each scenario.

This report was written by Olli-Pekka Brunila with the help and guidance of Jenni Storgård, both from the University of Turku Centre for Maritime Studies, the Maritime Logistics Research unit. The authors also wish to acknowledge Annukka Lehikoinen from the University of Helsinki, who took part in arrangements for the workshop by assisting in the creation of an evaluation form for the specialists.

2 TRANSPORTATION OF OIL AND OIL PRODUCTS IN THE BALTIC SEA IN 2010

2.1 General information about the Baltic Sea area

Maritime traffic in the Baltic Sea is very dense, especially if the traffic volumes are compared to the size of the sea area. More than 2,000 vessels continuously transport different kinds of cargoes on the Baltic Sea. Approximately 25% of the vessels are loaded with oil, oil products or chemicals. (the Baltic Sea Action Group 2008) The Baltic Sea is 392,000 square kilometres wide with an average depth of only 54 meters. As a comparison, the average depth in the Mediterranean Sea is 1,550 meters and in the Atlantic and Pacific Oceans 4,000 meters. The Baltic Sea is only connected to the North Sea and the Atlantic Ocean by the narrow straits of Denmark. (Myrberg et al. 2011) For a map of the Baltic Sea and the main oil ports, see Figure 2.1. The Gulf of Finland (shown on the map in green) is discussed in more detail in the Chapter 3.

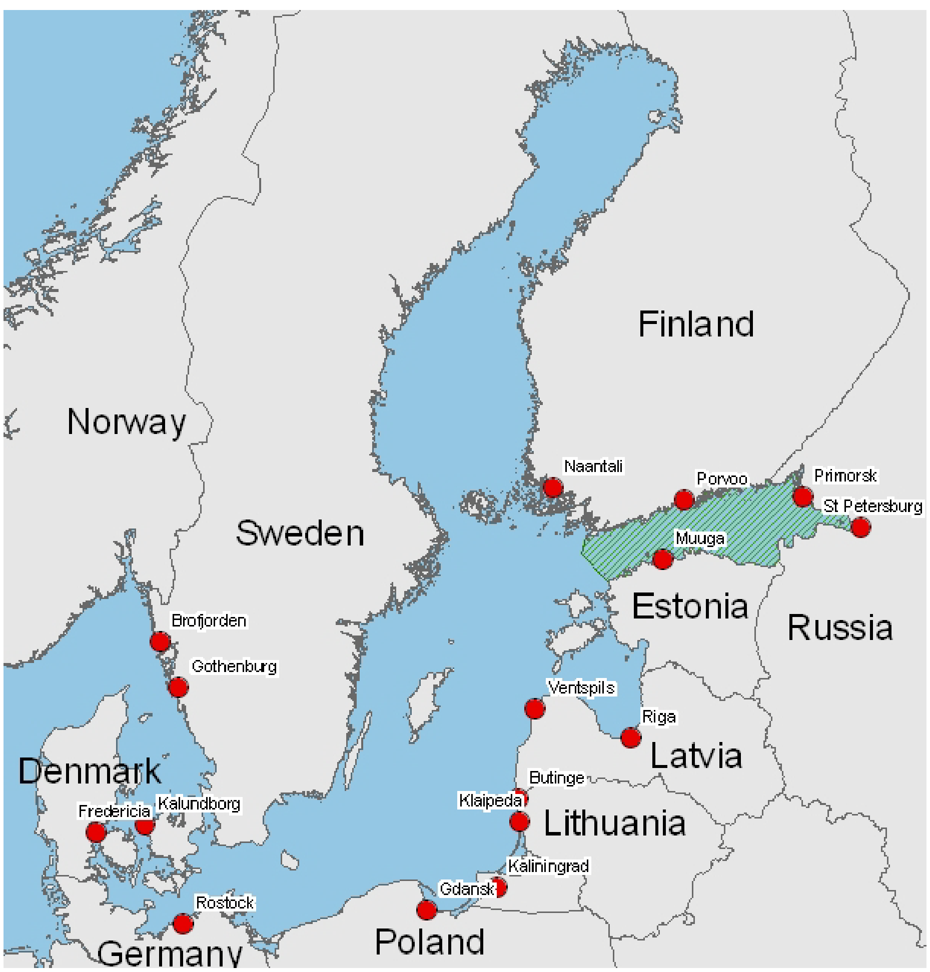


Figure 2.1 The Baltic Sea area and the largest oil ports. (the Finnish Environment Institute 2011)

Oil and oil products are transported in large quantities in the Baltic Sea (see Table 2.1). Russian ports handled some 39% of the total oil transport volumes in the Baltic Sea in 2010, Russia being one of the world`s largest oil producers.

Table 2.1 A summary of oil and oil product transportation volumes (tonnes) in the Baltic Sea in 2010. (Holma et al. 2011)

Country	Oil & oil products (t)	Percentage of total oil volumes handled (%)
Denmark	**16,023,000**	**5.5**
Estonia	**28,565,000**	**9.9**
Finland	**20,231,000**	**7.0**
Germany[1]	**4,156,000 (51,972,000 total)**	**1.4**
Latvia	**20,458,000**	**7.1**
Lithuania	**17,780,000**	**6.1**
Poland	**16,242,000**	**5.6**
Russia	**112,842,000**	**38.9**
Sweden	**53,585,000**	**18.5**
Total	**289,906,000**	

2.2 Denmark

In 2010, 48 sea ports in the Baltic Sea region handled cargo in Denmark. The total amount of cargo handled was 80.2 million tonnes in 2009–2010. Liquid bulk was handled by 28 sea ports. The amount of liquid bulk cargoes decreased compared to 2009 (by 16%). The share of oil and oil products in this decrease was 18%. In 2010, 16,023,000 tonnes of oil and oil products were transported in Denmark. The biggest oil ports were Fredericia with 8,133,000 tonnes, Statoil-Havnen with 4,431,000 tonnes and Copenhagen with 1,314,000 tonnes. These three ports handled almost 87% of all oil and oil products in Denmark. (Holma et al. 2011) Table 2.2 below shows the Danish sea ports and the volumes of oil and oil products they handled.

[1] The first figure includes the Baltic Sea ports, while the second figure in parentheses also includes the North Sea ports.

Table 2.2 The amount of oil and oil products in Danish ports in the year 2010. (Holma et al. 2011).

Denmark (sea port)	Oil & oil products (t)	Denmark (sea port)	Oil & oil products (t)	Denmark (sea port)	Oil & oil products (t)
Rønne	50,000	Kalundborg	35,000	Thyborøn	4,000
Copenhagen	1,314,000	Odense	4,000	Aalborg	902,000
Avedøreværketdore	3,000	Nyborg	229,000	Aalborg Portland	3,000
Køge	38,000	Aabenraa	148,000	Frederikshavn	57,000
Rødby	31,000	Fredericia	8,133,000	Skagen	29,000
Korsør	18,000	Esbjerg	56,000	Hirtshals	1,000
Stat oil-Havnen	4,431,000	Aarhus	537,000	**Total**	**16,023,000**

2.3 Estonia

Estonian ports handled 46.1 million tonnes of cargo in total in 2010. The total volume increased by 19.8% compared to the previous year. 96% of liquid bulk was oil and oil products. The remainder of liquid bulk was liquid chemicals. Estonia`s largest oil port is Muuga (Port of Tallinn). In 2010, Muuga handled 82% of the oil transportation. (Holma et al. 2011) Table 2.3 contains the volumes of oil and oil products by ports in Estonia.

Table 2.3. Volumes of oil and oil products in Estonian ports in 2010. (Holma et al. 2011)

Estonia	Oil and oil products handled (t)
Sillamäe	2,196,000
Muuga (Port of Tallinn)	23,505,000
Miiduranna	340,000
Paljassaare (Port of Tallinn)	95,000
Vene-Balti	374,000
Paldiski South (Port of Tallinn)	2,055,000
Total	**28,565,000**

2.4 Finland

Finnish ports handled 109.9 million tonnes of cargo in 2010, of which 24% (26.8 million tonnes) was liquid bulk. Oil and oil products were handled in 17 ports, but the two largest oil ports were Sköldvik (15,898,000 t) and Naantali (3,166,000 t). These two ports handled 94% of all oil in Finland. In total, Finnish ports handled oil and oil products totalling

20,231,000 tonnes. (Holma et al. 2011) Table 2.4 contains the volumes of oil and oil products by port in Finland.

Table 2.4. Volumes of oil and oil products in Finnish ports in 2010. (Holma et al. 2011)

Finland	**Oil and oil products (t)**	**Finland**	**Oil and oil products (t)**
Hamina	242,000	Rauma	36,000
Kotka	18,000	Pori	130,000
Kilpilahti	15,898,000	Vaasa	16,000
Helsinki	340,000	Pietarsaari	26,000
Inkoo	45,000	Kokkola	69,000
Hanko	9,000	Oulu	95,000
Turku	32,000	Kemi	27,000
Naantali	3,166,000	Tornio	79,000
Marienhamn	3,000	**Total**	**20,231,000**

2.5 Germany

German ports in the Baltic Sea handled 54.8 million tonnes of cargo in 2010, which was 9.6% more than in the previous year. Five of the thirteen ports handled liquid bulk and oil cargoes in the Baltic Sea, which was 23% more than the previous year. 99% of liquid bulk was oil and oil products (the remainder being chemicals). The largest German oil port in the Baltic Sea was Rostock, which handled almost 94% of all oil and oil transportation in Germany`s Baltic Sea ports (Holma et al. 2011) Table 2.5 contains the volumes of oil and oil products by port.

Table 2.5. Volumes of oil and oil products in German ports in 2010. (Holma et al. 2011)

Germany	**Oil and oil products (t)**
Greifwald, Landkreis	69,000
Sassnitz	1,000
Rostock	3,884,000
Lübeck	4,000
Kiel	195,000
Total	**4,153,000**

2.6 Latvia

In 2010, oil and oil products were handled in three Latvian ports. The total amount of liquid bulk in Latvian ports was 21.2 million tonnes, of which 20.5 million were oil and oil products. The largest oil port was Ventspils with 13.4 million tonnes, followed by Riga with 6.5 million tonnes. Liepaja port handled 0.5 million tonnes of oil. Compared to 2009, the handling of oil and oil products decreased by 13% (by 3 million tonnes). (Holma et al. 2011) Table 2.6 contains the volumes of oil and oil products by port in Latvia.

Table 2.6. Volumes of oil and oil products in Latvian ports in 2010. (Holma et al. 2011)

Latvia	Oil and oil products (t)
Riga	6,535,000
Ventpils	13,446,000
Liepaja	504,000
Total	**20,485,000**

2.7 Lithuania

Lithuania only has two ports. These two ports handled 40.3 million tonnes of cargo in 2010, which was 11% more than in the previous year. The amount of liquid bulk was 18.8 million tonnes, of which the share of oil and oil products was 17.8 million tonnes. The port of Butinge concentrates on oil and oil products, while the port of Klapeida is also a general cargo port. (Holma et al. 2011) Table 2.7 contains the volumes of oil and oil products handled by port in Lithuania.

Table 2.7. Transported oil and oil products in Lithuania in the year 2010. (Holma et al. 2011)

Lithuania	Oil and oil products (t)
Butinge	9,018,000
Klaipeda	8,762,000
Total	**17,780,000**

2.8 Poland

Polish ports handled a total of 59.5 million tonnes of cargo in 2010, which was an increase of 32% compared to 2009. The volumes of all cargo types increased: liquid bulk by 43%, dry bulk by 27% and other dry cargo by 30%. Six Polish ports handled liquid chemicals, oil and oil products. Almost 93% of the liquid bulk handled was oil and oil products (16.24 million tonnes). Liquid bulk volumes increased in Gdansk (+ 1,462,000 tonnes) and in Swinoujscie (+ 619,000 tonnes), while the volumes in other liquid bulk ports decreased. (Holma et al. 2011) Table 2.8 contains the volumes of oil and oil products by port in Poland.

Table 2.8. Volumes of oil and oil products in Polish ports in 2010. (Holma et al. 2011)

Poland	**Oil and oil products (t)**
Gdansk	14,107,000
Gdynia	945,000
Kolobzeg	9,000
Swinoujscie	893,000
Police	11,000
Szczecin	277,000
Total	**16,242,000**

2.9 Russia

Russia has six sea ports in the Baltic Sea area. In 2010, the total amount of cargo handled was 177.2 million tonnes, which was 3.8% more than in the previous year. Five of the six Russian ports handled liquid bulk cargoes. Their total amount was 113.2 million tonnes, of which the share of oil and oil products was 112.3 million tonnes. The largest port was Primorsk, which handled 69% of the oil and oil products (77.6 million tonnes). The second largest port was St. Petersburg with 16.1 million tonnes, and the third largest was Vysotsk with 12 million tonnes. (Holma et al. 2011) Table 2.9 contains the volumes of oil and oil products by port in Russia.

Table 2.9. Volumes of oil and oil products in Russian ports in 2010. (Holma et al. 2011)

Russia	**Oil and oil products (t)**
Vyborg	2,000
Vysotsk	12,010,000
Primorsk	77,640,000
St Petersburg	16,117,000
Kaliningrad	7,073,000
Total	**112,842,000**

2.10 Sweden

Swedish ports handled 177.6 million tonnes of cargo in 2010, which was an increase of 11% compared to the previous year. Swedish ports handled 56 million tonnes of liquid bulk cargo in 2010, of which the share of oil and oil products was 53.6 million tonnes. In Sweden, 29 ports handled oil and oil products. Sweden´s largest oil ports were Gothenburg and Brofjorden Preemraff. These two ports, which are situated in the area of Kattegat and Skagerrak in the Baltic Sea near Denmark, handled more than 67% of Swedish oil and oil product cargoes. (Holma et al. 2011) Table 2.10 contains the volumes of oil and oil products by port in Sweden.

Table 2.10. Volumes of oil and oil products in Swedish ports in 2010. (Holma et al. 2011)

Sweden	**Oil and oil products (t)**	**Sweden**	**Oil and oil products (t)**	**Sweden**	**Oil and oil products (t)**
Luleå	217,000	Bergs Oljehamn	1,090,000	Malmö	4,204,000
Piteå	130,000	Nynäshamn Oljehamn	1,717,000	Helsingborg	181,000
Skellefteå	6,000	Södertälje	137,000	Halmstad	12,000
Umeå	242,000	Oxelösund	1,810,000	Varberg	51,000
Örnskjöldsvik	16,000	Norrköping	1,072,000	Gothenburg	19,855,000
Härnösand	35,000	Oskarshamn	86,000	Stenungsund	2,247,000
Sundvall	519,000	Kalmar	119,000	Uddevalla	49,000
Gävle	713,000	Karlskrona	6,000	Brofjorden Preemraff	16,297,000
Mälarhamnar	206,000	Karlshamn	1,837,000	Karlstad	93,000
Stockholm	535,000	Trelleborg	103,000	**Total**	**53,585,000**

3 DEVELOPMENT OF OIL TRANSPORTATION IN THE GULF OF FINLAND IN 2000–2010

In this section, we will discuss the transportation of oil and oil products in the Gulf of Finland. The Gulf of Finland is the easternmost part of the Baltic Sea. It is approximately 400 km long, and its width varies between 65 km and 135 km. The Gulf of Finland is surrounded by Finland, Estonia and Russia. The narrowest point is found between Helsinki and Tallinn. The shores of the Gulf of Finland and the archipelago are mainly rocky, and there are hundreds of islands of various sizes. The total length of the coastline including the islands in the Gulf of Finland is up to 6,500 km. (Knuutila 2011) The Gulf of Finland is very shallow, the average depth only being 37 meters. The Gulf and the archipelago are very sensitive and vulnerable to pollution, due to for example the low volumes and slow turnover of water, low temperatures and ice cover during winter, and stratification of water into layers with different temperatures. (Knuutila et al. 2009) See Figure 3.1 for the oil ports in the Gulf of Finland.

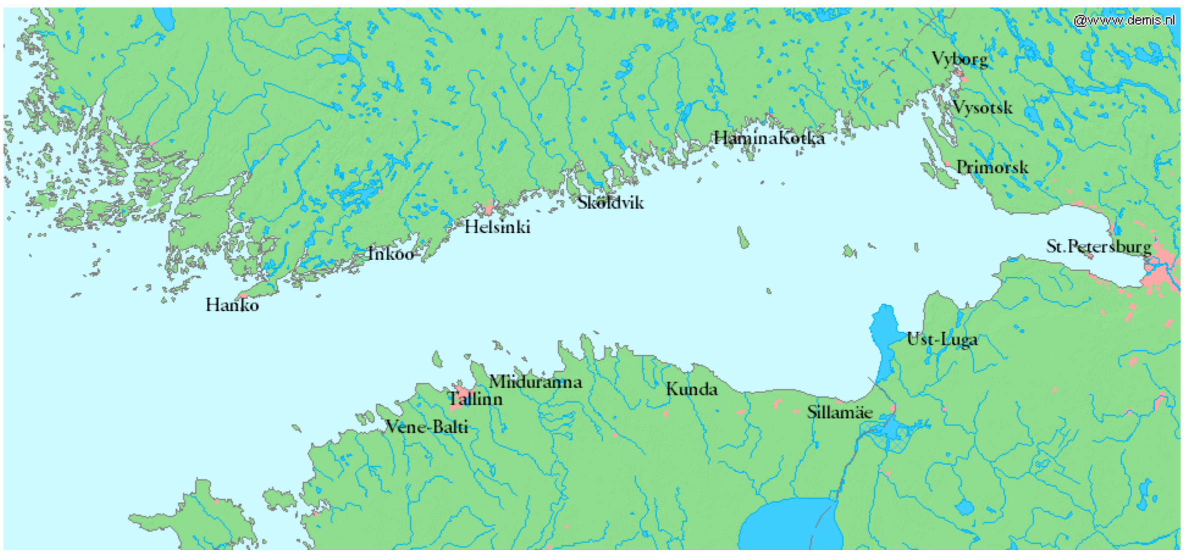


Figure 3.1. Oil ports in the Gulf of Finland. (Wikimedia commons 2005)

3.1 Finnish oil ports

Finland has 12 sea ports in the Gulf of Finland, of which six handle oil and oil products. See below for these six ports and statistics on oil and oil products transported in the period 2000–2010.

3.1.1 HaminaKotka

In May 2011, the ports of Hamina and Kotka merged to form a single port company. The port of HaminaKotka is the easternmost port in Finland, with the port area in Hamina located only 35 kilometres from the Russian border. HaminaKotka is the largest general port in Finland. It handles all types of cargoes, including container, RoRo, liquid bulk, dry bulk, LoLo and project cargo. (Port of HaminaKotka 2011) A special feature in HaminaKotka port is transit traffic to/from Russia. (Baltic Ports Organization 2011).

For the volumes of oil handled by HaminaKotka in 2000-2010, see Figure 3.2. Volumes in tonnes are shown separately for Hamina and Kotka, as these two were separate ports in the past. In Hamina, the amount of oil has been more stable than in Kotka. After the first year following the merger, the oil product volumes handled were some 420,000 tonnes (the Finnish Transport Agency 2012).

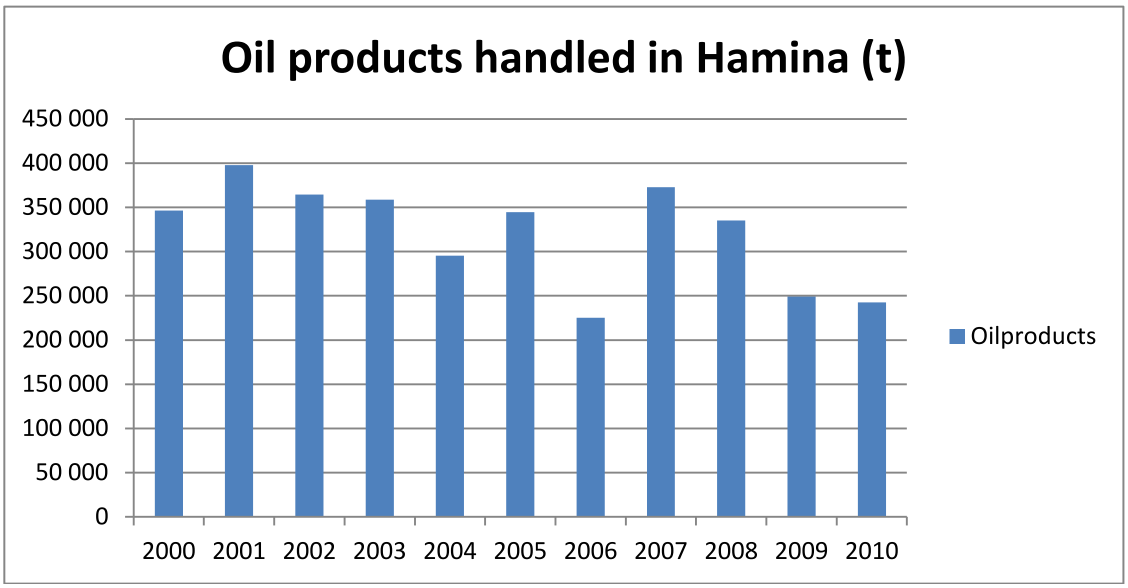


Figure 3.2 Oil volumes handled in the port of Hamina in 2000–2010. (Martina database 2011)

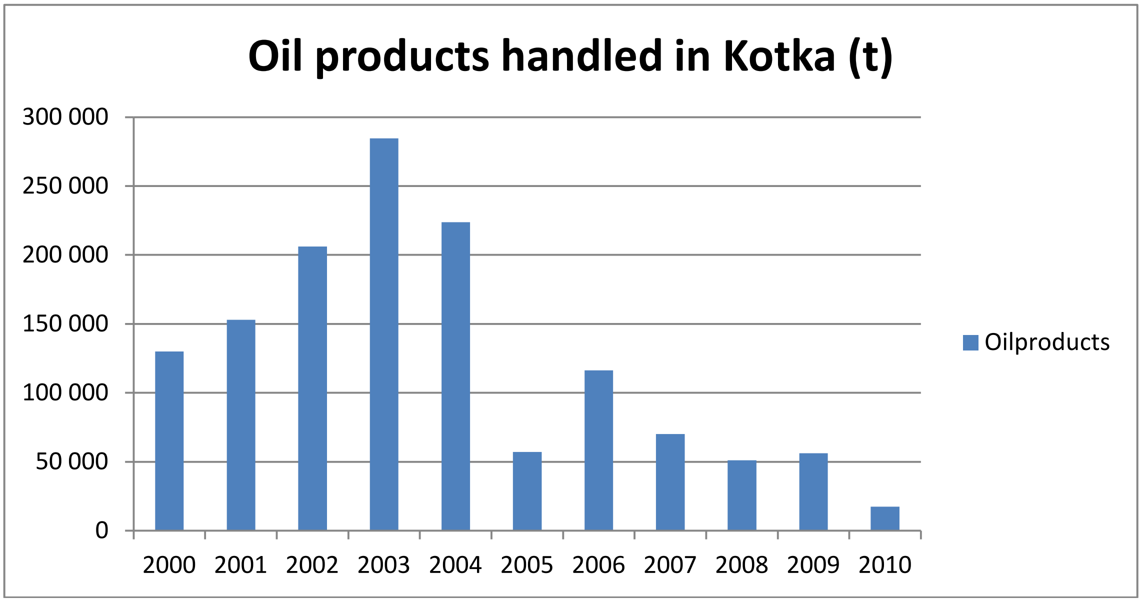


Figure 3.3 Oil volumes handled in the port of Kotka in 2000–2010. (Martina database 2011)

3.1.2 Sköldvik

Approximately 1,200–1,400 ships a year call at the port of Sköldvik, which is Finland`s largest port when measured in tonnes. The main operator in the port is Neste Oil Ltd Porvoo refinery. There are also more than ten other companies that process plastic and petrochemical products operating in the proximity of the port. Neste Oil Ltd Porvoo refinery concentrates on the production of premium-quality, low emission fuels and biodiesel. The refinery has four production lines and more than 40 process units. It produces more than 150 products and components. Neste Oil has two manufacturing plants for biodiesel, the production capacity of which is 380,000 tonnes annually. (Neste Oil Ltd 2011)

Figure 3.4 illustrates the volume of oil and oil products handled in the Port of Sköldvik. The volume of oil handled has been quite stable, with an increase in volume handled in 2008, after which the figures remained stable in 2008 and 2010.

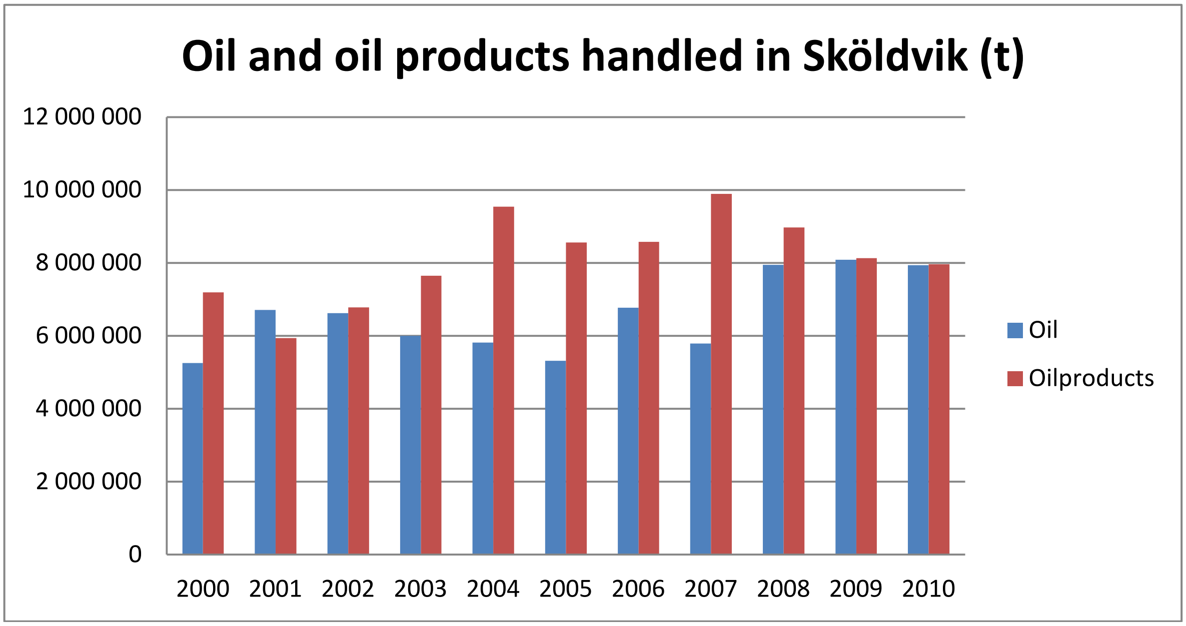


Figure 3.4 Oil and oil products handled in the port of Sköldvik in 2000–2010. (Martina database 2011).

3.1.3 Helsinki

The port of Helsinki is one of Finland's main ports. It specializes in unitized cargo services for Finnish companies engaged in foreign trade. The port of Helsinki has frequent regular liner traffic, and it is the largest port for passenger traffic. (Port of Helsinki 2011) Vuosaari port area was opened in 2008, and the majority of cargo traffic is handled in Vuosaari. (Baltic Ports Organization 2011)

Figure 3.5 shows the volumes of oil handled in the port of Helsinki. The volume of oil cargoes in the port of Helsinki has increased after the economic slowdown in 2008, while in HaminaKotka, oil transport volumes have decreased since 2008.

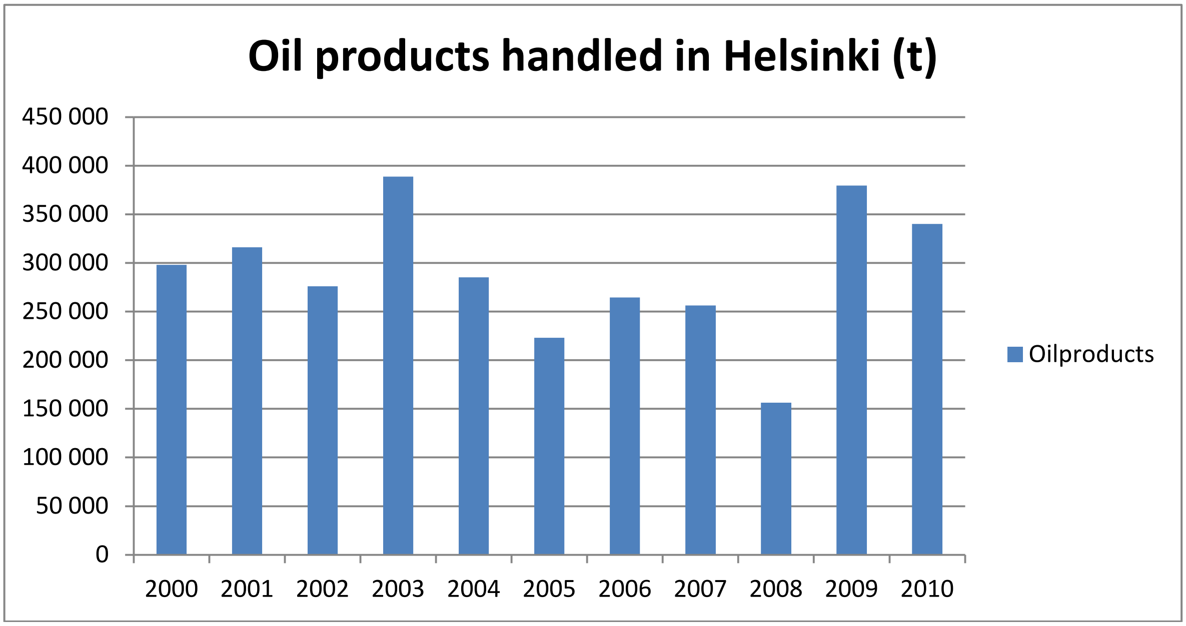


Figure 3.5 Oil volumes handled in the port of Helsinki in 2000– 2010. (Martina database 2011).

3.1.4 Inkoo

The Port of Inkoo is a privately owned commercial port. In addition, a berth of the Fortum power plant is also found next to the Port of Inkoo. The port concentrates on the handling and storage of dry bulk (coal, limestone and petroleum coke) (Länsi-Suomen ympäristölupavirasto 2008).

Since 2003, the volume of oil products handled in the port of Inkoo has decreased (see Figure 3.6). The port of Inkoo is used by Shell Oil Company as a warehouse for oil products.

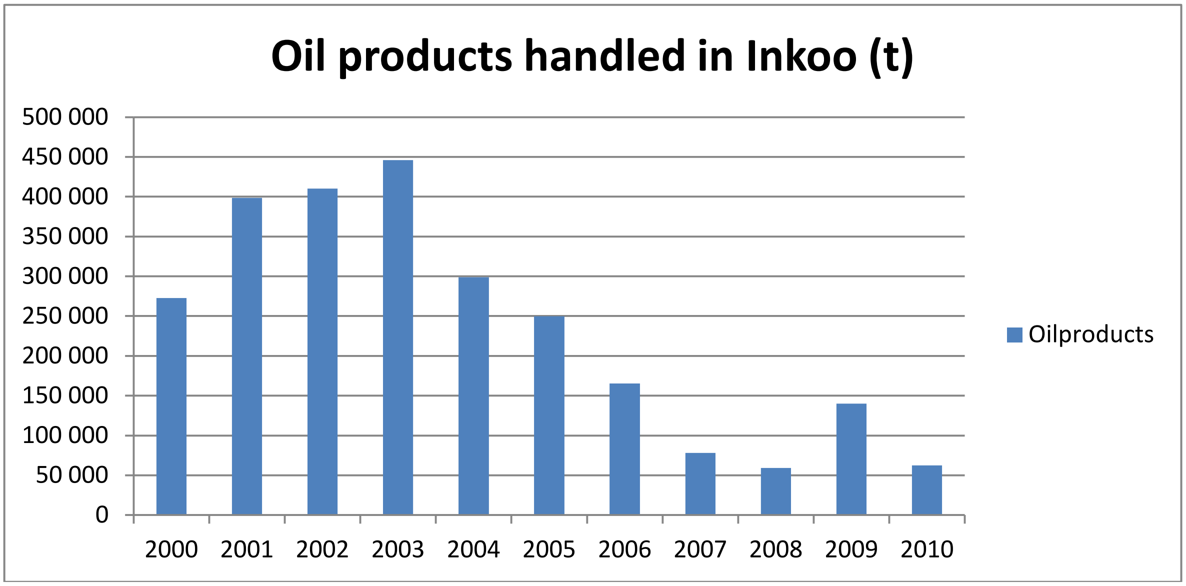


Figure 3.6 Oil volumes handled in the port of Inkoo in 2000–2010. (Martina database 2011).

3.1.5 Hanko

The Port of Hanko is situated on Hanko peninsula in the southernmost tip of Finland. The Port of Hanko is a port owned by the local government that operates in two locations. RoRo traffic, paper exports, car imports as well as container and trailer traffic are concentrated to the Western Harbour. The Outer Harbour and the Freeport Area are mainly used for car imports and unloading. Small amounts of chemicals and oil products are also handled in the port of Hanko. (Port of Hanko 2011)

The volume of oil handled in the port of Hanko has been very small (see Figure 3.7). In 2010, the volumes peaked at approximately 9,000 tonnes.

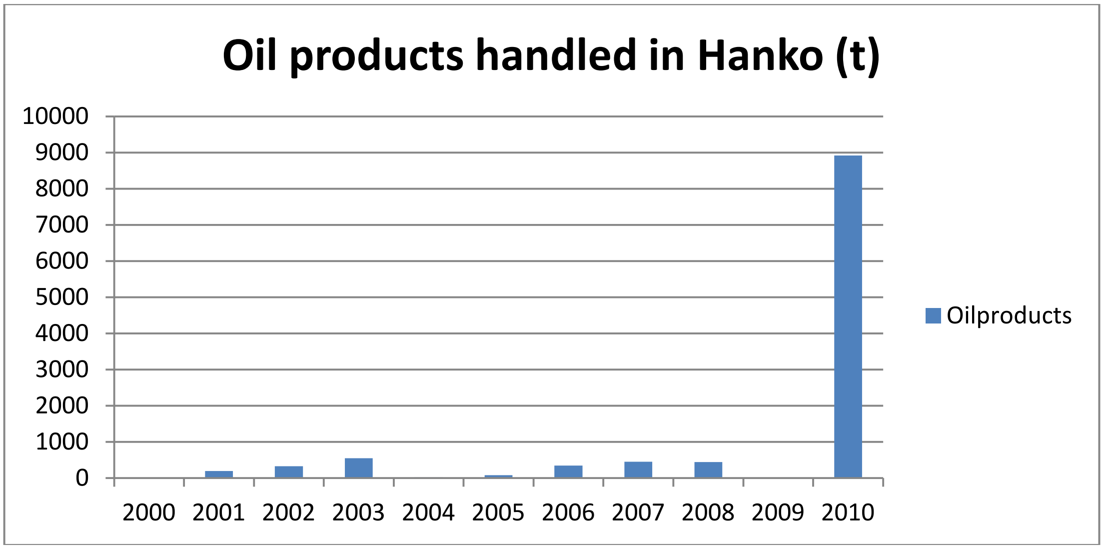


Figure 3.7.Oil products handled in the port of Hanko in 2000–2010. (Martina database 2011).

3.2 Estonian oil ports

Oil is handled in six Estonian ports. The majority of oil transportation concerns transit traffic from Russia via Estonian ports to Europe. Estonia has no crude oil reserves or oil production plants or refineries of its own. Figure 3.8 illustrates the development of oil transportation in the past ten years in Estonia. Oil transported via Estonian ports mainly consists of oil products, as only 1-2 % of the oil handled here is crude oil.

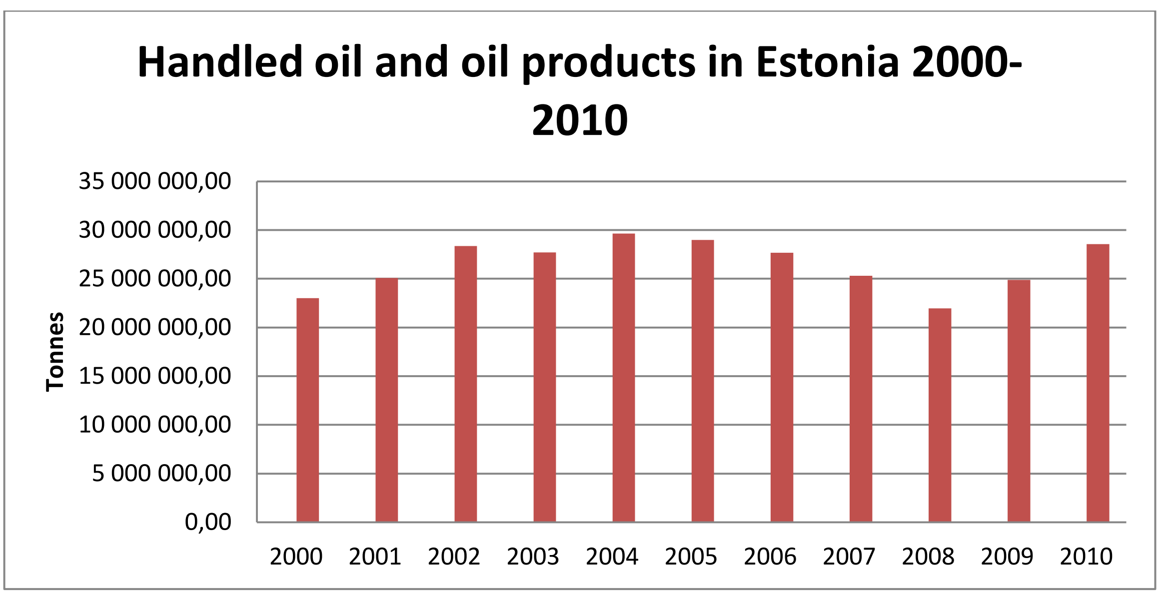


Figure 3.8 The development of oil transportation in Estonia in 2000–2010. (Holma et al. 2011 & Port of Tallinn 2012 & Estonian statistics 2012)

3.2.1 Sillamäe

The commercial name of the port of Sillamäe is SILPORT and it is the easternmost port in the EU, with a distance of only 25 km to the Russian border. The port is multifunctional, handling all cargo groups from oil products and dry bulk to containers. The natural depth of the fairway is 16 meters, accommodating all vessels which can enter through the Danish Strait to the Baltic Sea. In the port area there are three terminals which can handle oil products and bunker oil, liquid petrochemicals and other liquid chemicals. Table 3.1 shows the volumes of oil cargoes in the port of Sillamäe in 2008-2010.

Table 3.1 Volumes of oil handled in the port of Sillamäe 2008–2010. (Holma et al. 2011)

Port of Sillamäe	Oil & oil products handled (tonnes)
2010	2,196,000
2009	1,362,000
2008	1,019,000

3.2.2 Muuga (Port of Tallinn)

The Muuga port area is part of the port of Tallinn. It is the largest port in Estonia, and it is situated some 17 kilometres to the east from Tallinn. Muuga handles about 80% of the total cargo volume of the port of Tallinn and 90% of transit traffic in Estonia. Three quarters of the goods handled are oil and oil products. The port has six liquid bulk terminals in total, and the capacity of its oil tanks is 1,100,000 m^3. The maximum depth of the fairway is 18 meters. (Port of Tallinn 2011a) For the volume of oil cargoes handled in the port of Tallinn in 2008-2010, see Table 3.2.

Table 3.2 Volumes of oil handled in the port of Muuga in 2008–2010. (Holma et al. 2011)

Port of Muuga	Oil & oil products handled (tonnes)
2010	23,505,000
2009	20,237,000
2008	20,526,000

3.2.3 Miiduranna

The port of Miiduranna is located near Tallinn on the coast of Tallinn bay. The port area comprises two basins: the northern and the southern basin. The port has 10 quays, the depths of which vary from 2.5 to 13 meters. The maximum dimensions for oil and chemical tankers are: length 195 meters, breadth 32 meters and depth 12.3 meters. (Miirunda Sadam 2011) For the volume of oil cargoes in the port of Miiduranna in 2008-2010, see Table 3.3.

Table 3.3 Volumes of oil handled in the port of Miiduranna 2008–2010. (Holma et al. 2011)

Port of Miiduranna	Oil & oil products handled (tonnes)
2010	340,000
2009	291,000
2008	206,000

3.2.4 Paljassaare (Port of Tallinn)

Paljassaare port is also part of the port of Tallinn. The port area is situated on Paljassaare Peninsula approximately 6 km from the city centre of Tallinn. Vessels enter and leave the port through a canal whose length is 800 meters, width 90–150 meters and depth 9 meters. For liquid bulk, there are two terminals: an oil and a cooking oil terminal. The oil terminal's capacity is 42,000 m^3. For the oil volumes transported through the port of Paljassaare in 2008-2010, see Table 3.4.

Table 3.4 Volume of oil handled in the port of Paljassaare in 2008–2010. (Holma et al. 2011)

Port of Paljassaare	Oil & oil products handled (tonnes)
2010	95,000
2009	179,000
2008	No data available

3.2.5 Vene-Balti

The port of Vene-Balti is situated on the Kopli peninsula near Tallinn, and it is part of the BLTR Grupp. The port is open for international traffic, and it has 21 quays. The total length of the quays is over 2 km, and the depth for tankers is from 8.3 to 11 meters. (BLTR Grupp 2005) In 2007, the port offered 115,000 m^3 of oil tank capacity. Oil and oil products are handled by Eurodek, a company that owns 24 tanks. For the volume of oil handled in the port of Vene-Balti in 2008-2010, see Table 3.5.

Table 3.5 Volumes of oil handled in the port of Vene-Balti in 2008–2010. (Holma et al. 2011)

Port of Vene-Balti	Oil & oil products handled (tonnes)
2010	374,000
2009	331,000
2008	876,000

3.2.6 Paldiski South (port of Tallinn)

Paldiski South Harbour is located 45 km west of Tallinn, and it is also part of the port of Tallinn. Paldiski South focuses on handling Estonian export and import cargoes and transit cargo, which mainly consists of Ro-Ro, metal, timber, peat and oil. For the volume of oil handled in Paldiski South, see Table 3.6.

Table 3.6 Volumes of oil handled in the port of Paldiski South in 2008–2010. (Holma et al. 2011)

Port of Paldiski South	Oil & oil products handled (tonnes)
2010	2,055,000
2009	2,467,000
2008	No data available

3.3 Russian oil ports

Oil is handled in five Russian ports. 80 % of handled oil is in port of Primorsk. Second largest is the big port St. Petersburg. March 2012 oil port of Ust-Luga started to operate and first oil tanker was loaded. Ust-Luga has a huge potential and in the future it can be seen how the oil transportation in Ust-Luga will developed.

3.3.1 Vyborg

The port of Vyborg is located near the Finnish border and 113 km from St. Petersburg. (Port of Vyborg 2011) The port concentrates on transshipments of Russian exports and transportation to Finland via Saimaa Canal (Baff Vyborg Ltd 2011). In the port of Vyborg, many types of cargoes are handled; paper, timber, coal, ore, chemicals, cellulose, saw logs, steel, food and liquid bulk cargoes. Every year, the port handles some 3 million tonnes of cargo, whereas the share of oil and oil products is not large. The port has 13 berths, and its maximum depth is now 6.6 meters; however, it will be deepened to 8.5 meters in the future. (Port of Vyborg 2011) See Table 3.7 for the volume of oil and oil products in the port of Vyborg in 2008-2010.

Table 3.7 Volume of oil handled in the port of Vyborg in 2008–2010. (Holma et al. 2011)

Port of Vyborg	Oil & oil products handled (tonnes)
2010	2,000
2009	No data available
2008	No data available

3.3.2 Vysotsk

The port of Vysotsk concentrates on dry bulk cargoes such as coal, coke and oil and oil products. In 2002, Lukoil Oil Company invested in new oil terminals. (Hänninen & Rytkönen 2004) In 2004, Lukoil´s oil and oil product terminal was opened. In phase 1, the terminal capacity is 4.7 million tonnes. (Seanews 2004) Phase 2 of the oil terminal construction was completed in September 2006 (Lukoil 2006), increasing the annual capacity to 11.6 million tonnes. In 2007, Lukoil started to expand its transportation infrastructure around the port area (Lukoil 2007). See Table 3.8 for the volumes of oil transported via the port of Vysotsk in 2007-2010.

Table 3.8 Volumes of oil handled in the port of Vysotsk in 2007–2010. (Holma et al. 2011 & pasp RU 2012)

Port of Vysotsk	Oil & oil products handled (tonnes)
2010	12,010,000
2009	13,728,000
2008	12,561,000
2007	14,713,600

3.3.3 Primorsk

The port of Primorsk is located 120 kilometres to the northwest of St. Petersburg and 60 kilometres to the south of Vyborg. The port started operating in late 2001 as the Baltic Pipeline System (BPS) was completed. The pipeline gives Russia a direct connection to the European oil market and enables Russia to use its own port for oil transportation in the Baltic Sea. (Hänninen & Rytkönen 2004; Leningrad Region 2011) The future capacity of the port of Primorsk may increase to 120 million tonnes a year (DP 2008). In late 2011, the Russian government invested in a second track and the electrification of the railway line to the Seaside Commercial Port. The investment plan covers the years 2012-2014. The aim of the plan is to increase the handling capacity of petroleum products to 122 million tonnes. (RZD-partner 2011)

The port of Primorsk has a loading capacity of 10 thousand tons per hour for one tanker, or five thousand tons per hour for two tankers at the same time. The port has four berths, three of which are 367.6 meters long. The depths of these three berths vary from 18 to 18.2 meters. The fourth berth is 385 meters in length with a depth of 17.5 metres. Berths 1 and 2 are used for crude oil exports, and 3 and 4 are used for the export of crude oil and petroleum products. The berths can serve tankers up to 150 thousand DWT, 307 metres long and 55 meters wide with a maximum draft of 15.5 meters. (World Port Source 2012) See Table 3.9 for the volumes of oil handled in Primorsk in 2002-2010.

Table 3.9 Volumes of oil products handled in the port of Primorsk in 2002–2010. (Holma et al. 2011 & Pasp RU 2012)

Port of Primorsk	Oil & oil products handled (tonnes)
2010	77,640,000
2009	79,157,000
2008	74,226,900
2007	74,226,900
2006	66,078,100
2005	57,337,200
2004	44,656,400
2003	17,685,300
2002	12,402,900

3.3.4 St. Petersburg

The port of St. Petersburg is the second largest port in the Baltic Sea. It is connected to the sea by a canal of 43 kilometres. The canal is 80–150 metres wide, and its depth varies from 11.6 to 14.8 metres (the Baltic Port Organization 2011). The port consists of several port areas and 200 berths. The port can receive vessels with the following maximum dimensions: length 320 meters, width 42 meters and depth 11 meters. In 2008, a project to deepen the fairways to 13 meters was launched. (Pasp RU 2012).

In 2010, the total cargo turnover in the port was 57.8 million tonnes (Taloussanomat 2003; the Baltic Ports Organization 2011). The port of St. Petersburg handles many types of goods, for example containers, cars and machinery, metal and piping, heavyweights and long measures, timber, coal, grain, and many other goods. (Pasp RU 2012) Several port development programmes have been drawn up since 2007. In 2008, phase 1 of a car terminal with the annual capacity of 80,000 cars was put into operation. In 2009, work started on phase 1 of a RoRo terminal with the annual capacity of 1 million tonnes (JSC 2009). See Table 3.10 for the volume of oil and oil products handled in 2000-2010.

Table 3.10 Volumes of oil handled in the port of St.Petersburg in 2000–2010. (Holma et al. 2011 and Pasp.ru 2011)

Port of St.Petersburg	Oil & oil products handled (tonnes)
2010	16,117,000
2009	15,887,900
2008	15,069,800
2007	14,713,600
2006	12,944,600
2005	15,637,400
2004	13,451,100
2003	11,040,400
2002	10,611,300
2001	9,018,200
2000	7,393,400

3.3.5 Ust-Luga

The construction of the port of Ust-Luga started in 1997, and the expansion of the port is still continuing. The planned annual capacity of the port is up to 180 million tonnes. (Ust-Luga Company 2012) There are seven terminals currently operating in the port of Ust-Luga: a coal terminal, a universal cargo terminal, a sulphur terminal, an auto-railway ferry complex, a multipurpose terminal 'Yug-2', a factor timber terminal and a container terminal (UK & Trade Investment 2010).

So far, the port has handled small amounts of liquid bulk only (Holma et al. 2011). At the moment, there are six terminals in total under construction in the port of Ust-Luga. Two of them will handle oil and oil products: a bunker terminal and an oil terminal/oil products terminal. The Baltic Pipeline System 2 (BPS-2) will be connected to the oil terminal/Ust-Luga bunker terminal. According to plans, it will be operational by 2012 (UK Trade & Investment 2010). The planned annual capacity of the BPS-2 is to be 50 million tonnes, of which 38 million tonnes will be delivered to Ust-Luga and 12 million tonnes to Kirishi oil refinery (Orlov & Shikorova 2010). The construction of an oil product terminal was started by Rosneftbunker JSC, affiliated with Zarubezhneft JSC, and then sold on March 2009 to the Swiss oil trader Gunvor. Initially, the operations were scheduled to start in late 2009, with a phase 1 capacity of 10 million tonnes of oil and bunker fuel per year, increasing to a full capacity of 25 million tonnes per year (UK Trade & Investment 2010).

4 PERSPECTIVES ON THE FUTURE DEVELOPMENT OF MARITIME TRANSPORTATION OF OIL UNTIL 2020

In this section, we will discuss background information for the oil transportation scenarios in the Gulf of Finland in 2020. The most important role in oil transportation in the Gulf of Finland is played by Russia. This section will begin by going through Russia`s energy strategy and oil production plans as well as the EU’s climate and energy strategies and the national energy strategies of Estonia and Finland. The scenarios concerning future transportation volumes in the Baltic Sea and in the Gulf of Finland to be presented are based on these factors.

4.1 Russia’s Energy Strategy 2020

Russia has one of the world’s largest energy resources. It controls one third of the global natural gas reserves, one tenth of the oil resources and one fifth of the coal reserves. These resources are the basis of the economic growth, external trade and policy of Russia. Many countries in Europe are dependent on Russia´s energy resources. The main factors of Russia’s long-term national energy policy are energy safety, energy efficiency, budget effectiveness and ecological energy security. The realization of a social and economic long-term energy state policy has been divided into two phases. The first phase includes the basis for Russia´s progressive development with different scenarios of social and economic development. The key scenarios for the first phase are a normative and legislative base without barriers, energy efficiency, and exports of oil and gas in the internal and external fuel and energy markets. The second phase comprises the formation of a new fuel and energy complex. The policy aims for growth, transparency and competition in the energy markets. Existing energy modes will also be developed. One future scenario involves creating a basis for a substantial increase in the proportion of renewable energies in the future. (the Ministry of Energy of Russian Federation 2003)

4.2 Oil production development up to 2020 in Russia

Oil production will continue in the traditional oil production regions in Russia. These areas are in the Western Siberia, Caucasus and Volga regions. New oil and gas fields will be found in North-eastern Russia (the Timan-Pechora region). In the future, Russia´s main oil base will be in Western Siberia. In oil production, the main priority will be increasing productivity. Russia aims to achieve a better oil supply through the creation and wide assimilation of technologies and equipment. Improving technologies for difficult climate conditions and assimilation of existing and new methods will also increase the oil output. The main target will be the modernization and reconstruction of oil refineries. With modern refineries it will be possible to improve the quality of oil products and the production of catalysts. (the Ministry of Energy of Russian Federation 2003)

The main trend in Russia´s oil and gas transportation will be the creation of new oil pipeline systems. Russia has visions of building pipelines in the Caspian–Black Sea–Mediterranean, Eastern Siberian, Far Eastern, Central European and North-Baltic areas. (the Ministry of Energy of Russian Federation 2003) For the purposes of this study, the most interesting one will be the North Baltic Pipeline, which refers to the Baltic Pipeline System and the Baltic Pipeline System 2 (BPS-2). The Baltic Pipeline System is connected to the port of Primorsk (see Chapter 3.3.3). In 2009, Russia started the construction of BPS-2. This project will be completed in 2012. With BPS-2, the oil capacity will increase to 30 million tonnes per year in the first stage, with plans to later upgrade this figure to 50 million tonnes per year. (Stroytransgaz 2010 and Downstreamtoday 2011) The BPS-2 pipeline ends in Ust-Luga, where large investments have been made in a new oil port. In the first stage 12 million tonnes of oil will be transported to Ust-Luga and 12 million tonnes of oil to Kirishi refinery. When BPS-2 and Ust-Luga are in operation, the annual volumes of oil handled in Russian oil ports will be more than 130 million tonnes in the Gulf of Finland in the first stage. (Downstreamtoday 2011)

The following Figure 4.1 illustrates gas and oil pipelines and also pipelines under construction. The green lines represent oil pipelines and the red lines gas pipelines.

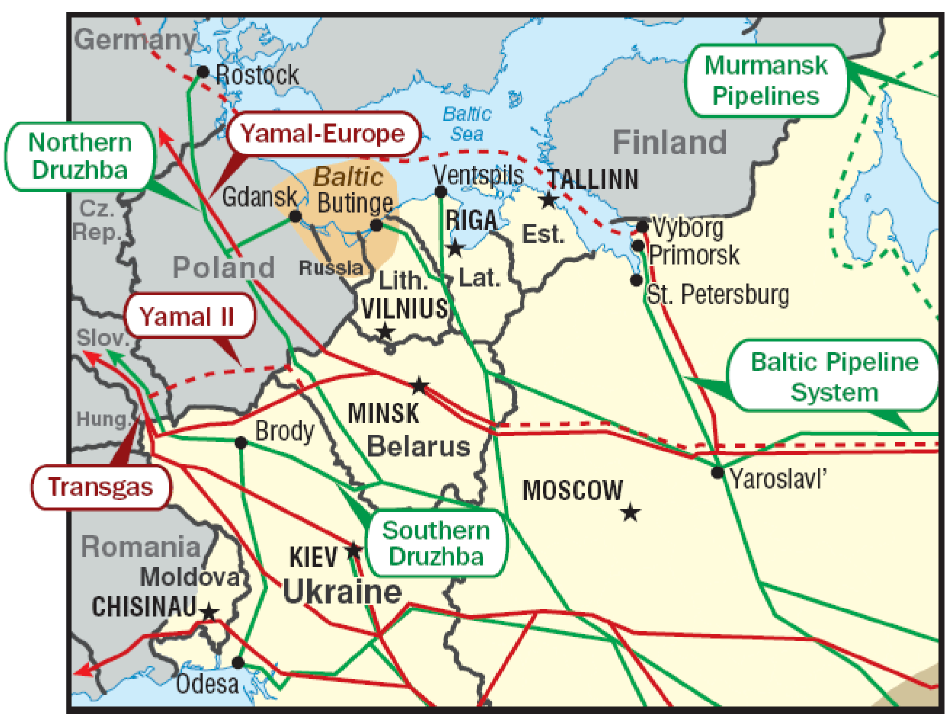


Figure 4.1. Oil and gas pipeline network in Russia and the BPS II oil pipeline under construction. (Petersen et al. 2011).

4.3 The EU´s strategies and policy drivers until 2020

The European Union has created an ambitious energy strategy extending to 2020. The aims of the strategy are to reduce emissions of greenhouse gases by 20% (compared to the 1990 levels), to increase the share of renewable energies to 20 % of the EU’s final energy consumption and to increase energy efficiency by 20 %. The aims also include increasing the share of biofuels in the transport sector to 10%. (Finland`s Ministry of the Environment 2011) The EU climate and energy package includes four directives: revision and strengthening of The Emission Trading System (ETS), An “Effort Sharing Decision”, Binding national targets for renewable energy and carbon capture and storage. (European Commission 2010)

The European Union has also created the concept of Short Sea Shipping, which refers to a maritime transport space without barriers. The maritime mode of transport is highly efficient in terms of environmental performance and energy efficiency. For example, the barrier-free maritime transport area will decrease the usage of congested roads for freight transportation and reduce freight forwarding costs. The Short Sea Shipping policy should help to boost services in all maritime regions and to reduce administrative formalities. (European Commission 2011 b) “The “Motorways of the Sea” concept aims at introducing new intermodal maritime-based logistics chains in Europe. These chains will be more sustainable, and should be commercially more efficient than road-only transport. Motorways of the sea will thus improve access to markets throughout Europe, and bring relief to the over-stretched European road system. For this purpose, fuller use will have to be made not only of maritime transport resources, but also of potential in rail and inland waterways, as part of an integrated transport chain. (European Commission 2011c)

The EU`s maritime transport policy until 2018 includes the main strategic goals for the European maritime transport system until 2018 and identifies key areas for action which will strengthen the competitiveness of the sector while enhancing its environmental performance in the EU. The underlying economic context and the characteristics of shipping market cycles have been taken into account. In maritime transport policy, the key goal is to achieve and maintain stable and predictable global competitive conditions for shipping and other maritime industries. It can be achieved with an attractive framework for quality shipping and quality operators in Europe. Also a clear and competitive EU framework for tonnage taxation, income taxation and state aid should be maintained and, where appropriate, improved. The framework should allow positive measures to support greener shipping efforts, technological innovation as well as maritime careers and professional skills. (Commission of the European Communities 2009)

4.4 Estonia`s national energy strategy

Over 90% of energy in Estonia is produced by oil shale thermal power plants, which date back to the Soviet era. (Hamburg 2007; Kisel 2008) Estonia is interested in accessing the Nordic-Baltic energy market, which would provide energy security and reduce emissions in energy production. As a first step, an interconnection between Finland and Estonia was set up in 2006. (Hamburg 2007)

The EU´s climate and energy package is very challenging for Estonia as oil shale produces a lot of CO_2 emissions, but this source of energy secures Estonia's own energy production. In addition, Estonia's energy grid is connected to the grid in CIS countries that do not participate in the emission trading in the EU. The EU`s response has been to prevent this carbon leak and offer Estonian energy producers free emission quotes. Estonia has updated and modernized over 400 MW of its oil shale power plants, and the country has been granted a few years to modernize the rest of the plants. In the future, more attention needs to be paid to better combustion technology, the use of gas turbines, alternative energy resources, the development of energy networks and cooperation between Baltic and Nordic states. (Kisel 2008 and Hamburg 2007)

4.5 Finland´s national energy strategy

The EU´s climate and energy package places strict obligations on Finland. Emissions outside the Emission Trading must decrease by 16% by 2020. In comparison, Estonia can increase its emissions outside the Emission Trading system by 11% by 2020. Finland's Energy Strategy has been divided in two scenarios: a development path based on the current development and measures, and a target path fulfilling the EU and national emission targets. (Turunen et al. 2008)

In the first scenario, energy use is forecasted to increase from 302 TWh (in 2005) to 347 TWh. In 2005, the transportation sector consumed 60 per cent of all oil. Under obligations imposed by the EU, by the end of 2020, 10% of fuel used in transportation must contain bio components. Bio diesel and petrol containing 10% of ethanol have been developed in Finland. The consumption and transportation of bio fuels will increase across the EU area. In the future, bio fuels will be so-called second generation bio fuels, or fuels whose raw materials are not oils suitable for the food industry. (Turunen et al. 2008)

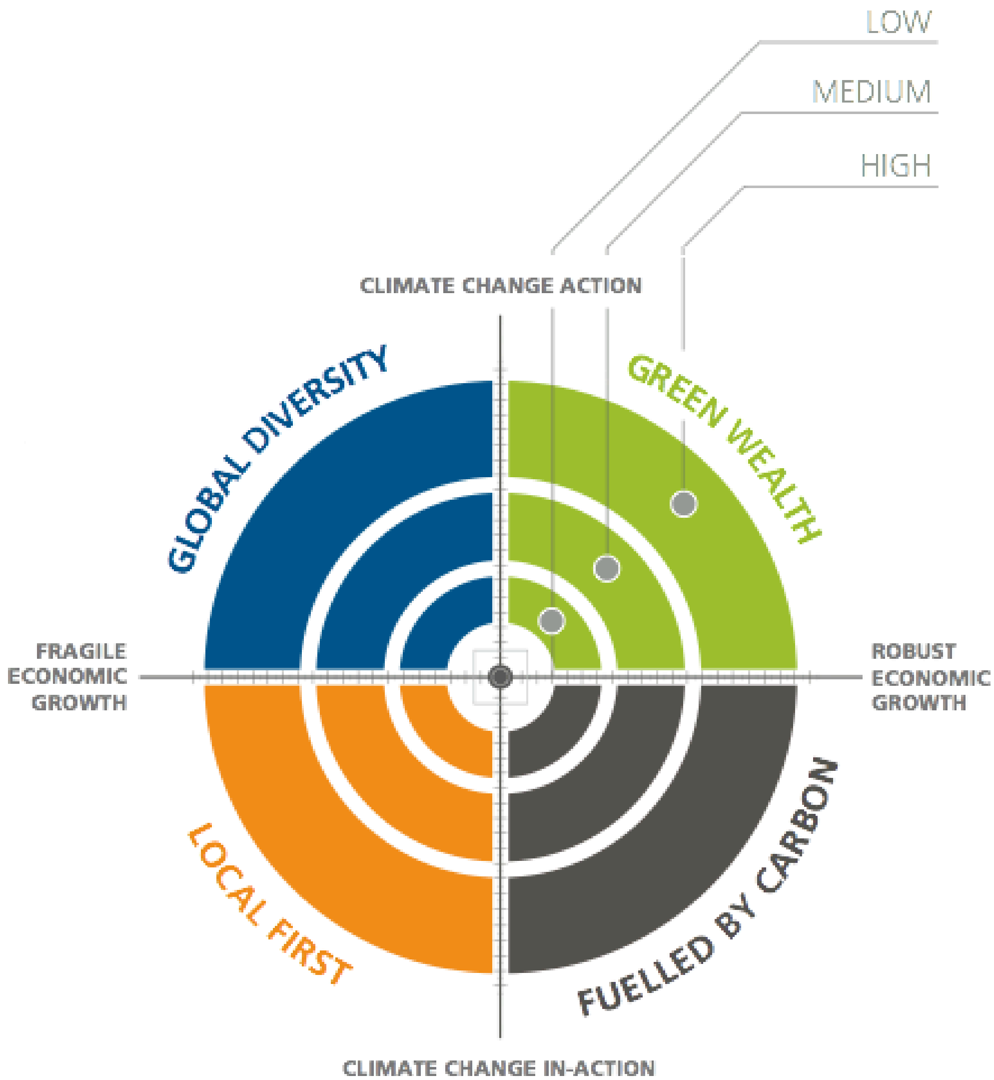
The main focus of the second scenario is on energy efficiency. The aim is to halt Finland´s increasing energy consumption. The final energy consumption should be less than 310 TWh. As part of the long-term vision, by 2050 the final energy consumption will be one third of the 2020 level. In addition, Finland is committed to producing 38% of the final energy consumption from renewable energy sources in 2020. (Turunen et al. 2008)

4.6 Transportation system development scenarios in the Baltic Sea region

The Finnish Transport Safety Agency released a report on future scenarios of the Baltic transport system and the effects of these scenarios on Finland in 2020. The study focuses on identifying megatrends of global change. These five operating environment scenarios chart the megatrends, which will affect development in the Baltic Sea region until 2020. (Mäkelä et al. 2011)

Mäkelä et al. (2011) began by identifying the most important megatrends, such as environmental awareness and the growth of global trade due to globalization. They then went on to formulate future tables containing the main parameters of operating environments, such as the price of energy and oil, potential emission limits, the economical situation in Finland and the EU, changes in Russian development and foreign trade. These parameters formed the basis for the scenarios in the Baltic transport 2020 report. By changing the parameter values, alternative future scenarios were created.

Det Norske Veritas analyzed trends and scenarios for maritime transportation in the report "Technology Outlook 2020" (Det Norske Veritas 2011). Their focus was on global megatrends and technology uptake in the maritime sector and oil, gas and coal production. The aim of the report is to share views and stimulate discussion on future technologies in maritime transport towards 2020. Det Norske Veritas (2011) analyzed megatrends on the global level, but the same trends are also applicable to the Baltic Sea context. For the DNV's scenario chart model, see Figure 4.2. The chart shows two main drivers: climate change and economic growth, which divide the future into four scenarios.



Picture 4.2. Det Norske Veritas Scenario chart model. (Det Norske Veritas, 2011)

In the *Global Diversity* scenario, the world is expected to have recovered from the financial crisis, some countries better than others. Growth will still remain low, in the West at about 2 % a year and in Far East at about 5% a year. The USA and China will also be committed to decreasing emissions, and investments will be made in new greenhouse gas (GHG) mitigation technologies. It is estimated that the global price for carbon dioxide tonne will be around 30–50 US dollars in 2020. The *Global Diversity* scenario will have the following impacts on maritime transportation. Consumers will have accepted the higher price of energy as a necessity for fighting against climate change, and the consumers' choices of transportation will be controlled by the carbon footprint. In maritime transportation, regional shipping will increase due to an increase in regional trade. The IMO will have introduced new energy requirements for ship design and operation in order to reduce the carbon footprint. (Det Norske Veritas, 2011)

In the *Local First* scenario, fragile economic conditions will cause disparity in the distribution of wealth. In the Western world, economic growth will be less than 2% and in China less than 5% of the GDP. In the EU, the economies of Portugal, Ireland, Greece and/or Spain will have collapsed, and Euro collaboration will have broken down. There will be neither the capital nor the interest to invest in new decarbonisation technologies. Oil, gas, and coal dominate as energy sources, but there will be a tendency to push more for local energy solutions. In the maritime sector, the effects of this scenario will be that fewer new ships will be built and there will be a lack of incentive to regulate CO_2 emissions in shipping. (Det Norske Veritas, 2011)

In the *Green Wealth* scenario, the world economy will have grown strongly, and CO_2 emissions will have been reduced widely. Economic growth will largely be based on low carbon energy and technologies. The total use of fossil fuels will have declined to 70% of the 2010 level. Renewable energy recourses will be widely used, and the saving potential of energy efficiency will be fully exploited. The Global price per carbon ton will vary between 50–100 US dollars. New emission requirements will drive the shipping industry towards innovative and energy saving ships. (Det Norske Veritas, 2011)

The last scenario is the *Fuelled by Carbon* scenario. In this scenario, fossil fuels will remain the main energy resource. The demand for oil products will remain high, and sensitive areas will be opened for oil pumping. As in the *Local first* scenario, the carbon ton will be free, and there will be no wide interest in energy efficiency. Renewable energy recourses will be interesting if they are financially competitive. In the Western world, the economy will have grown by 4% annually, and in China and India, by more than 8%. The amount of maritime transportation will have increased because of a large demand for oil and oil products. (Det Norske Veritas 2011)

4.7 Summary of the energy industry`s future perspectives in the Gulf of Finland

In Russia, the main goal is to increase the volumes of oil and oil product production. Most of the oil refineries and oil drilling plants date back to the Soviet era and are obsolete. With new investments in energy efficient technologies combined with a solid legislative base, Russia`s oil production will increase. The new fuel and energy complex will be taken in use, which means that there will be growth, transparency and competitiveness in the Russian energy market. Existing local energy modes in the Russian provinces will also be developed.

In the EU, the implementation of the energy and climate strategy will be challenging because of the financial and Euro crisis, especially in the southern part of Europe. In difficult times, investments in the implementation of the climate and energy package might not be adequate. However, we have almost eight years to achieve the goals of the Strategy – and some of the goals have already been achieved. In year 2012, aviation will join the Emission Trading Scheme and in the future, the Scheme will expand to the petrochemicals, ammonia and aluminium industries. When transportation becomes part of the Emission Trading Scheme, this will probably increase the cost of transportation, while it will also decrease emissions from transportation. (European Commission 2010d)

The challenged faced by Estonia is that 90% of Estonia`s energy consumption is produced with oil shales. In addition, the country's connection to Russia's energy network causes carbon leakage. Estonia has already invested in cutting down on emissions from the oil shale power plants.

In Finland, the main goal is to decrease the consumption of energy and to cut down on emissions. Emissions that are outside Emission Trading must be reduced by 16% by 2020. In Estonia and in Finland, national energy strategies go hand in hand with the EU`s climate and energy package.

5 PERSPECTIVES ON THE FUTURE DEVELOPMENT OF MARITIME TRANSPORTATION OF OIL UNTIL 2030

5.1 Baltic Transport Outlook 2030

The main aim of the Baltic Transport Outlook 2030 (BTO) project was to examine the transport infrastructure and flows of goods and passengers in the Baltic Sea region. Another goal was to achieve better prerequisites for national long-term infrastructure development in the Baltic Sea states and make the Baltic region more accessible and competitive. Scenarios for the future development extending to 2030 were prepared. The study was completed in late 2011. (Baltic Transport Outlook 2030 2011a)

In the “Baltic Transport Outlook 2030” report, socio-economic development in the Baltic Sea countries is seen as unbalanced. The western countries, or Denmark, Germany, Finland, Norway and Sweden, have positive future perspectives, as these countries have strong economies and well-developed social and educational systems. In the Eastern European countries, these sectors will develop, but reaching the level of the countries in the western Baltic Sea will take time. (Meyer-Rühle et al. 2011)

5.1.1 Energy consumption trends in maritime transportation in the Baltic Sea area

The price of fuel has been one of the key drivers in transportation. Relatively cheap fuel in recent years has resulted in a lack of interest in developing alternative fuels and modern engines for the transportation sector. Bio fuels and other renewable energy sources have a major role in new energy and climate strategies aiming to reduce emissions and pollution. About 90% of freight ships use heavy fuels, while the remainder use diesel and marine gas oil (MGO) in their engines. The so-called “Sulphur Directive”, which will come into force in 2015, will set strict limits to the sulphur content of the ship fuel: in the Baltic and North Sea (the so-called SECA area), the sulphur content of the fuel must not exceed 0.1%. Currently the limit for sulphur is 1%. (European Commission, 2011). New requirements can encourage new techniques in the power supply of ships, for example LNG (Liquefied Natural Gas), solar energy or wind energy. (Meyer Rühle et al. 2011)

5.1.2 Freight development

The BTO 2030 study estimates that maritime freight traffic will grow by 20% between 2010 and 2030. The largest growth is expected in container, RoRo and dry bulk traffic. It is estimated that the volumes of liquid bulk transported consisting mainly of crude oil will decrease by 7%. The total volume of maritime transportation will be more than 220 million tonnes in 2030. The largest growth potential will be in the area of St. Petersburg with an increase of almost 30% of total transportation, which in tonnes equals over 66 million. This growth will focus on container transportation. (Kyster-Hansen et al. 2011)

In the Baltic Transport Outlook 2030 report, the estimated annual decrease in liquid bulk is -0.4%. As a reference, the growth of cargo throughput in the Baltic Sea ports in 1997–2008 was 244 million tonnes and 3.25% annually. The development of liquid bulk transportation is mainly dependent on Russia. The BTO 2030 report estimated that Russian oil trade will increase slightly, while in the other Baltic Sea countries, the liquid bulk volumes will go down. The share of liquid bulk will decrease from around 40% to 30% compared to the 2010 statistics. However, liquid bulk will still remain the largest freight segment in 2030.

Table 5.1 below gives an estimation of freight development between 2010 and 2030 in percentages and in tonnes following the BTO 2030 scenarios.

Table 5.1 Freight development in 2010–2030. (Kyster-Hansen et al. 2011.

Freight segment	Total growth 2010–2030 (M tonnes)	Total growth 2010–2030 (%)	Average growth rate per year (%)
Containers	+82	+138	+4.4
Dry bulk	+75	+42	+1.8
Liquid bulk	-22	-7	-0.4
RoRo, trailers	+56	+47	+2.0
RoRo, others	+12	+93	+3.4
Other Cargoes	+25	+32	+1.4
All cargoes	+228	+30	+1.3

The BTO 2030 report contains estimations of sea freight volumes for 2030 for every Baltic Sea country. In the present report, our focus is on the Gulf of Finland. Russia is the main driver for the trends in freight volumes in the Gulf of Finland. It is forecasted that the sea freight volumes in the Gulf of Finland will grow by 228 million tonnes, of which Russia´s share will be 72 million tonnes. Table 5.2 below gives the total volumes in Finland, Estonia and Russia and a comparison of these figures with total volumes in the Baltic Sea region (including international cargo only).

Table 5.2 Total cargo volume development in Finland, Estonia, Russia and in BSR 2010–2030. (Kyster-Hansen et al. 2011)

	Volume 2010 (tonnes)	Volume 2030 (tonnes)	Volume change 2010–2030 (M tonnes)	Volume change 2010–2030 (%)
Finland	98,351,104	125,269,304	26.9	27.4
Estonia	37,112,053	38,730,507	1.6	4.4
Russia	171,631,578	243,800,782	72.2	42.0
Total BSR	**757,138,147**	**984,807,839**	**227.7**	**30.1**

5.1.3 Oil price trends

Compared to 2010, the BTO 2030 study expects the oil price to increase by 45%. In the BTO 2030 scenarios the price of Low Sulphur Light is set at 85 dollars per barrel. For comparison, the crude oil price varied between 75.92 and 114.18 dollars per barrel between April 2011 and April 2012 (Oil-Price.net 2012). The BTO´s estimation of crude oil price in 2030 is $124 per barrel. (McDaniel and Kyster-Hansen 2011)

In the past few years, oil prices have gone up and down as a result of the economic crisis. Future oil price scenarios differ from each other. For example, the US Energy Information Administration (EIA) has given two estimations of oil price development. In Figure 5.1, the dark blue line represents an estimation from the year 2008, and the light blue line one from 2009. These two estimations have to be examined against the background of significant price fluctuations in recent years. A dramatic 45-percent price increase took place from January to July in 2008, coupled with much greater short-term price volatility. This illustrates the great sensitivity of oil prices over short term. The light blue line correlates with short term external factors that are likely to have a permanent effect on the oil price. If the EIA estimations are compared to the BTO 2030 estimation, the EIA 2009 estimation is quite close to the BTO`s forecast of oil price ($124) for 2030. (Ruske et al. 2009)

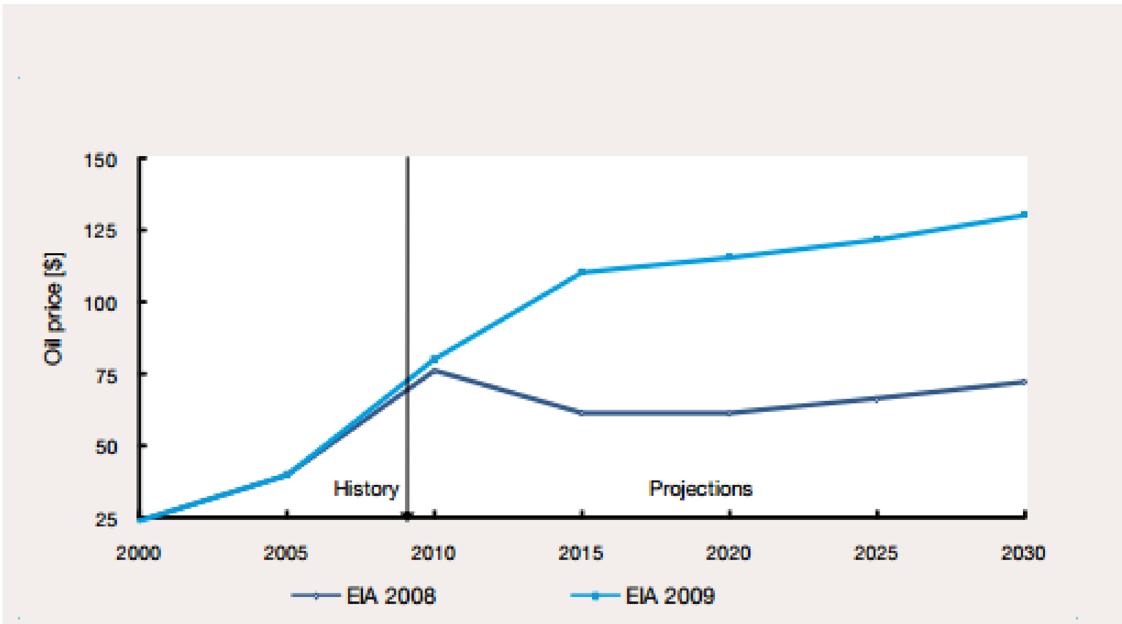


Figure 5.1 Oil price projection. (Ruske et al. 2009)

According to Ruske et al. (2009), the demand for oil and oil products will also remain strong in the year 2030, despite the push towards reducing fossil fuel consumption. The demand might even increase due to the growing oil markets in developing countries.

5.2 Russia`s Energy Strategy 2030

In 2009 it was reported that Russia will invest 1.8-2.1 trillion US dollars in oil and gas projects by 2030. These projects will increase oil production for European and Asian demand and also for Russia`s own demand. The investments will be made in three stages, and as a result, gas production will increase by 4% and oil production by 9% compared to the production volumes of oil and gas in 2008. (Kupchinsky 2009)

For a summary of Russia´s Energy Strategy up to 2020, see Chapter 4.2. The main objectives and goals of the strategy were the development of the production infrastructure and a competitive market environment. Many of the 2020 Strategy guidelines have been implemented in practice, but work still remains to be done for example as regards the legal and regulatory framework and the energy markets. (the Ministry of Energy of the Russian Federation 2010)

According to the 2030 Energy Strategy, Russia´s major trends and projections will be based on an innovative development of the economy with the following priorities. Economic growth will be based on Russia´s competitive edge in traditional sectors (such as energy production) and in new knowledge intensive sectors along with an improvement in the effectiveness of human capital. (the Ministry of Energy of the Russian Federation 2010)

If the oil production infrastructure will develop as planned, the following trends will have to be taken into account according to the Energy Strategy of 2030. Large oil reserves in Western Siberia have decreased and oil drilling fields need to be expanded in the Arctic Sea, the Far East and Eastern Siberia. Russia will increase the share of hard-to-recover reserves (super viscous oil, natural bitumen etc.) in the structure of mineral resources of the oil complex. Combined oil and gas deposits with multi-component composition will also be put into production with the related necessity to utilize associated petroleum gas, methane, helium and condensate. The main problems in the Russian oil complex are inefficient subsoil use (low rate of oil recovery), low investment capacities of oil companies, infrastructure restrictions of oil exports, high degree of monopolization of oil product markets and finally the low quality of oil products. (Golubkova 2012 & the Ministry of Energy of the Russian Federation 2010).

Currently, outdated infrastructure and a high degree of depreciation in the drilling and refining industries are factors decreasing the quality of oil products. To solve these problems, provision of expanded re-production of oil resources at the expense of geological research works and preparation for operating in traditional and new regions will be required. A switch to modern techniques and modern equipment will be needed. More investments should be made in oil exploration and preparation of new oil deposits for drilling operations. Improvements of oil drilling technologies, the transport infrastructure, oil refineries and energy efficiency will increase oil production and improve the quality of oil while also saving energy and natural resources. (the Ministry of Energy of the Russian Federation 2010)
Russia's Energy Strategy also contains objectives related to renewable and local energy resources, although these are not very strictly defined. Russia`s aim is to rationalize and to reduce the growing consumption of fossil fuels. If the global and the Russian economies develop in a positive direction, there might be investments in renewable energy sources and production. One of the promising renewable energy resources is peat. If peat production can be modernised, efficient thermal plants will become possible in the future. The Energy Strategy includes state support for the use of local energy resources (peat, waste wood from forestry) in energy production till 2030. The use of municipal waste in energy production could also be developed. (the Ministry of Energy of the Russian Federation 2010)

The Energy Strategy estimates that energy consumption will increase from the level of 2008 by a factor of 1.4–1.6 and the energy production by a factor of 2.5–2.7. Regarding oil transportation in the Gulf of Finland, the most important issue will be the development of the Baltic Pipeline System 2. Crude oil terminals in the ports of Primorsk and Ust-Luga will be completed in phase 1 of the Strategy. In phases 2 and 3 of the strategy, gas and oil production and transportation will be developed, especially on the continental shelf of the Arctic sea areas. In this phase, modernization of the transportation infrastructure will be a part of the strategy. (the Ministry of Energy of the Russian Federation 2010)

5.3 EU Energy strategy 2050

In its “Energy Roadmap 2050”, the EU defined a vision of reducing greenhouse gas emissions by 80–95% from the 1990 levels by 2050. In the Energy Roadmap 2050 strategy, the EU Commission explores the challenges facing decarbonised economy while ensuring energy supply and competitiveness. The Roadmap does not replace national, regional and local efforts to modernize energy supply, but seeks to develop a long-term European technology-neutral framework in which these policies will be more effective. The guideline will continue the same principles as the 2020 climate and energy package. (European Commission 2011e)

In the Energy Roadmap 2050, two *current trend scenarios* and five *decarbonisation scenarios* are presented. The current trend scenarios are a reference scenario and current policy initiatives (CPI). The reference scenario includes current trends and long-term projections on economic development. In this scenario it is estimated that the GDP will grow by 1.7% annually. This scenario includes the current EU climate policy and such targets as GHG reductions and the Emission Trading Scheme. The CPI scenario was updated a few years ago after the natural disaster and Fukushima accident in Japan. The scenario includes actions concerning the Energy Efficiency Plan and the new Energy Taxation Directive. (European Commission 2011e)

Decarbonisation scenarios mainly concentrate on energy efficiency and the use of renewable energy sources. The *High Energy Efficiency* scenario is a political commitment to very high energy savings. It has stricter requirements for new and existing buildings. This scenario forecasts a decrease of 41% in the demand for energy by 2050 compared to the peak period in 2005–2006. In the *Diversified supply technologies* scenario, no single technology is preferred. All energy sources can compete in the markets without any economical drivers except decarbonisation. In the *High renewable energy sources* scenario (RES) there is a strong support for renewable energy sources. In this scenario, 75% of the final energy consumption is renewable energy, and 97% of electricity consumption is renewable energy. The *Delayed Carbon Capture and Storage (CCS)* scenario is otherwise similar to the *Diversified supply technologies* scenario but it assumes that CCS decarbonisation will be driven by the carbon price instead of new technologies. In addition, nuclear energy has a larger share in this scenario. The *Low nuclear* scenario assumes that no new nuclear power plants will be built besides the reactors currently under construction and believes that CCS will be applied to these reactors. (European Commission 2011e)

Figure 5.2 below illustrates the ranges of fuel shares in 2030 and 2050 in decarbonisation scenarios. The baseline year is 2005. As we can see in Figure 5.2, in 2030 the use of other fuels is at about the same level as in 2005 except for renewable energy sources.

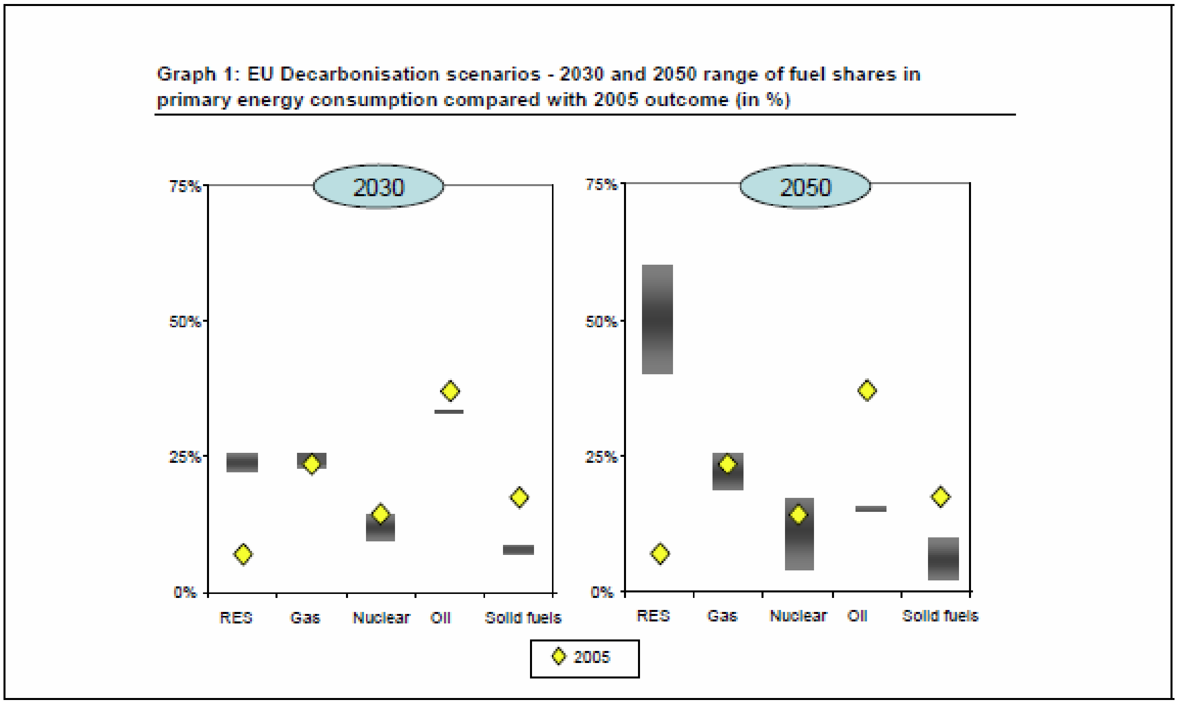


Figure 5.2 Range of fuel shares in EU decarbonisation scenarios in 2030 and 2050. (European Commission 2011e)

Despite the increase in bio and alternative fuels, it is forecasted that oil is likely to remain in the energy mix even in 2050 and will mainly be used in long distance passenger and freight transport. In the future, Europe will have a firm foothold in oil business and in domestic oil refining. The challenge for the oil sector is to adapt to changes in the demand for oil resulting from the switch to renewable and alternative fuels and uncertainties surrounding future supplies and prices. (European Commission 2011e)

5.4 Summary of background information for the 2030 scenarios

The price of fuel is a key driver in transportation. It is estimated that oil prices will increase by up to 45% by 2030. New technologies and renewable fuels are under development (e.g. Liquefied Natural Gas (LNG), biofuels), but bunker oil, which remains relatively cheap in price, controls the maritime transportation sector. It is expected that in the next decade, fossil fuels will still be the main energy source in transportation. Some 90% of cargo vessels currently use heavy oil fuels, while the remainder use diesel oil.

The EU´s Energy Roadmap 2050 maps future energy production and consumption in the footsteps of the Energy Strategy for 2020. The Energy Roadmap 2050 explores the challenges posed to decarbonisation but at the same time ensuring the security of energy supply and competitiveness. The main focus in the future is to increase the use of renewable fuels and fight against climate change. This can for example be done through the current policy initiatives, high energy efficiency, and diversified supply technology. However, it has been estimated that in 2050, oil will still remain a fuel for long distance passenger and freight transport. The challenges in the future will be to adapt to the changes in oil demand, oil price and oil qualities (renewable and alternative fuels). It is important for the EU to keep its foothold in the global oil markets. Oil will be necessary for the EU`s economy and the industrial sectors that depend on refined oil products. Oil will also be important for the security of energy supply.

The Baltic Transport Outlook 2030 study forecasts a growth in cargo volumes in the Baltic Sea. Maritime freight traffic is estimated to increase by 20% between 2010 and 2030, the volume exceeding 220 million tonnes in 2030. The largest growth is expected in container, RoRo and dry bulk traffic. However, it is forecasted that transport volumes of liquid bulk (mainly consisting of oil) will decrease by 7%. Liquid bulk will still remain the largest freight segment in the year 2030.

Russia is planning to invest heavily in oil and gas projects by 2030. These projects will increase oil production for the European and Asian markets and also for domestic demand. As a result of these investments, gas production will increase by 4% and oil production by 9% compared to 2008. Russia will expand its oil production in the Arctic areas in particular. The growing demand will be in Asia, so there are plans to build new pipelines from Siberia to the Pacific, decreasing the pressure to transport more oil via the Baltic Sea.

6 MIMIC SCENARIOS FOR MARTIME OIL TRANSPORTATION IN THE GULF OF FINLAND IN 2020 AND 2030

6.1 About the scenarios

The volumes of oil and oil product transportation in the Gulf of Finland in 2020 and 2030 were formulated by using expert assessments. A workshop was arranged as part of the MIMIC project seminar in Kotka on 15th of May 2012. The workshop was attended by seven persons. In addition, an e-mail inquiry was sent to seven specialists who gave their estimations by e-mail. Nine specialists in total gave their estimations about the volumes of oil transported via the Gulf of Finland in 2020 and 2030.

In the workshop, the specialists were first given basic information on oil transportation in the Gulf of Finland in the past ten years. After that, verbal descriptions of all the scenarios were presented to them. In the following phase, the specialists were asked to give their evaluations of the most probable figures of oil transportation, and also the minimum (volumes that will at least be transported) and maximum (a volume that will not be exceeded) volume of oil transported in each scenario. This phase was carried out by using printed forms in which the specialists noted their evaluations.

The reason for the three different scenarios is that the future development of maritime oil transportation in the Gulf of Finland depends on many factors, and it is not realistic to give one estimation only. By giving three scenarios we can analyze how the volumes of oil transportation would differ in different situations, taking into consideration for example economic, political or energy issues. For each scenario, three different figures of oil transportation volumes were formulated in order to take probability distributions into account. These values are used in the decision model which can be used to analyze risk management. Systems should be developed to minimise accident probabilities as effectively as possible. This model will be developed as part of the MIMIC project. The volume of oil transported in each scenario was calculated as an average value.

6.2 Scenarios for 2020

Previous Chapters discussed the transportation of oil in the Baltic Sea and future energy strategies and transportation forecasts. The starting points for three alternative MIMIC oil transportation scenarios in the Gulf of Finland were formulated on the basis of this background information.

The basic assumption is that Russia will be the strongest driver of the development with a major growth potential. Russia also has a huge impact on the European energy supply. Winter 2011-2012, for example, was very cold in almost every part of Europe, and Russia cut off the gas supply to Europe because the demand was also high in Russia. (Rettman 2012)

In the following, we will present three different scenarios for 2020 and 2030 including their main elements and a short description of each scenario.

6.2.1 The “Slow development” scenario

- Stagnant economic growth in the EU
- Recession prevails
- Heavy industries move to Asia, South America and other continents
- Demand for oil decreases
- Oil production in Russia fails to increase
- No investments in oil production technology

The “Slow development” scenario is based on the assumption that the European countries and Russia will suffer from a long-term economic slowdown due to e.g. the economic crisis in Greece, Portugal, Spain and Italy. The demand for consumer goods will decrease or remain at the current level.

In this scenario it is assumed that heavy industries, such as the metal and forest industry, will continue to move to Asia, South America or other continents in order to cut production costs and because of the growing demand in developing countries.

The demand for oil and oil products will decrease because of high oil prices. Transportation of goods will be more expensive because of the expensive fuel. In this scenario, Russia has no interest in investing in new technology in oil production as the demand for oil is decreasing. However, it is assumed that the Baltic Pipeline System 2 will have bee finished on the planned schedule.

6.2.2 The “Average development” scenario

- Economic growth continues in the EU and Russia
- Heavy industries develop new products and production capacity is maintained in Europe
- Demand for oil increases despite of the increase in the price of oil and oil products
- Russia produces oil at full capacity with Soviet era equipment
- Some investments in oil production/technology are made

This scenario depicts a “business as usual” situation. The population, economy, technology and society continue to develop in a similar manner to the past decades in Europe. It is assumed that if there is economic growth, the demand for oil will also increase. Economic growth will be more rapid in Russia than in the rest of Europe, because new oil and gas pipelines connect Russian ports and gas lines to Europe. Investments in gas and oil pipelines will be made as planned. A growing demand for oil will lead to investments in new and more efficient technologies. In this scenario, heavy industries will continue their operations in Europe and new green products and innovations will be made.

In Finland and Estonia, the demand for oil products will only increase a little, because the share of bio fuels and other alternative energy sources will increase. Oil transportation in Estonia will decrease, because Russia will concentrate its oil transportation to its own ports and only small amounts of Russian oil will be transported via Estonian ports.

6.2.3 The “Strong development” scenario

- Fast development in Europe and Russia
- Despite new innovations in transportation, oil remains the main energy resource despite its high price
- Russia speeds up its investments in production and refinement technology to increase its oil producing capacity
- Russia starts to explore new oil deposits in Arctic areas and seas
- The EU invests more and more in green technology and renewable energy resources
- Large investments in ports, vessels and tankers

The “Strong development” scenario is the most optimistic vision of economic development and transport in Europe and Russia. The overall economic situation and trends are very positive at the global level.

The demand for oil will remain high all over the world, regardless of its high price. Russia will invest in oil production and refinement technologies for the current oil production areas and expand oil drilling in the Arctic areas, but the production will not have started yet. Oil production in the Arctic areas is more expensive, but the high price of oil products will make drilling economically viable.

The EU will invest more and more in green technologies and renewable energy resources. The targets of the climate and energy package for 2020 will be achieved as planned in the strategies. Port areas will be modernized and smaller ports will merge because of the harsh competition. Ports will also specialize in certain products, such as oil and oil products, containers, dry or liquid bulk. This scenario assumes that the physical size of ports will not grow much, meaning that there will be no new pier areas for larger tankers.

6.3 Oil transportation volumes in 2020

In the *Slow development 2020* scenario, the expected volume of oil transported by ships in the Gulf of Finland will be 170 million tonnes. The minimum volume was estimated to be 151 million tonnes and the maximum volume 182 million tonnes. The minimum figure almost equals the volume of oil transported in 2009. The expected figure of 170 million tonnes will be realized, assuming that oil traffic in the Port of Ust-Luga will start as planned, in other words 15-20 million tonnes of oil will be transported via Ust-Luga, starting in late 2012 or 2013. In the specialists’ opinion, the demand for oil in Finland and Estonia will remain stable or decrease a little. The maximum volumes of oil transported in the Gulf of Finland would be 182 million tonnes, assuming that the transported oil volumes will also increase in the port of Primorsk.

In the *Average development 2020* scenario, the expected volume of oil transported is 187 million tonnes, the minimum volume 169 million tonnes and the maximum volume 207 million tonnes. The increase in volumes is based on the completion of the Baltic Pipeline System 2 and the connection of the pipeline to the port of Ust-Luga. Of the Russian oil ports, Ust-Luga and Primorsk will operate at full power and full capacity. In Europe, fossil fuels and oil will remain the main energy sources for transport. In this scenario, oil transportation in Finland and Estonia will remain at roughly the same level as now.

In the *Strong development 2020* scenario, the expected volume of oil transported in the Gulf of Finland is 201 million tonnes, the minimum volume 177 million tonnes and the maximum volume 218 million tonnes. As a result of the high demand for oil, Russia will have made investments in oil production in Arctic areas, and new oil production and refinement technologies will also have been introduced. In the EU area, the demand for oil will remain high.

See Table 6.1 below for the expected volumes of oil transported in each scenario for 2020. The Table also shows the change in percentage points in comparison with the 2009 volumes.

Table 6.1 The expected volumes in oil transportation scenarios for 2020 and change in percentages.

Oil & oil products transported in 2020 in the Gulf of Finland		
	Million tonnes	**Change (%)**
Year 2009	150.6	
Slow development 2020	170.6	13.30%
Average development 2020	187.1	24.20%
Strong developme 2020	201.5	33.80%

6.4 Scenarios for 2030

The scenarios and transported oil volumes for 2030 are much harder to predict, because the time perspective is much longer. Some of the specialists were reluctant to give their forecasts for this year. In the scenarios for 2030, it is expected that Russia will be the main player in oil transportation. Much will also depend on to what extent the European energy and climate strategies will succeed or fail. However, it was believed that the Arctic Sea route will be in use in 2030.

6.4.1 The "Stagnating development" scenario

- Targets of the EU`s climate and energy strategy will not have been achieved
- Lack of investments in green technologies
- Transportation costs are high
- Heavy industries relocate production to Asia, South America or to other continents
- No new oil or gas production areas have been taken into use in Russia because of a lack of investments
- No new investments in tankers or new maritime technology
- The Arctic sea route will have been opened

The forecast for 2030 is more negative than that for 2020 because of the longer time span. More radical changes may take place, for example in the economy, politics and the climate. The *Stagnating development* scenario assumes that the implementation of the EU`s climate and energy package has failed and there is no interest in greener technology. It is believed that despite of the recession, some development must have happened over the next two decades. In this scenario it is believed that the main energy resource for transportation will be oil. The demand for oil will increase the price of oil and transportation costs. Because of the poor economic situation all over the world, there are no investments in new energy saving transportation technology.

Heavy industries have relocated from Europe to Asia, South America or other continents because of lower labour and production costs. Russia has not been able to increase its oil or gas supply. Oil production in the Arctic area is so expensive that only test drillings have been made, but production has not started. No new investments are being made in ports or vessels, except for the compulsory investments if the tanker fleets get too old. The opening of the Arctic Route will change transportation chains to some extent by 2030.

6.4.2 The "Towards a greener society" scenario

- The EU`s climate and energy package will have been implemented as planned

- The EU will become a more and more carbon neutral society following the visions of the energy strategy 2050
- Demand for oil products has decreased
- In the industrial sector, new, successful openings will have been made in Europe
- New innovations in transportation are made, which help to handle increasing volumes more efficiently
- Russia will have expanded its oil production activities to Arctic areas
- The Arctic sea route will have been opened

In the *Towards a greener society* scenario, growth continues in a similar way as in the *Average development* scenario for 2020. The economic situation will be mainly positive. In 2030, the EU`s climate and energy package objectives will have been achieved and new, more ambitious strategies will have been formulated for the following decades. The EU is becoming more and more carbon neutral society. Renewable energy is increasingly replacing fossil fuel energy recourses.

Despite of economic growth, it is believed that the demand for oil will decrease. The reason for the decreasing oil demand is the increasing amount of renewable energy sources and bio fuels. In the transportation sector, there will also be a shift towards railways and multimodal transportation modes. Heavy industries have relocated their production to countries in what are now called developing countries, but the green wave will have brought new innovative industries to Europe.

Russia will have been building up its oil production capacity especially in the Arctic. The growing demand for oil will be in Asia, so the majority of the oil from new oil production areas will go to China and India, where private and public transportation will have increased strongly.

6.4.3 The “Decarbonised society” scenario

- The EU will have implemented new stricter environmental policy
- Many vehicles use electricity
- Demand for oil products is decreasing in EU
- Russia will have built new gas lines to Europe and oil pipelines to the Arctic Sea and Asia
- Oil volumes in Russia will have increased, but most of the new oil production will go to Asia
- The Arctic sea route will have been opened

In this scenario, the EU will have implemented very strict environmental policies, which all EU member states follow. This trend will also be apparent in other western countries. Green technology will be one of the major export products in Europe, and less rich countries in particular are attempting to solve their energy problems with green technology. It is believed that oil and fossil fuels will remain the main energy recourse in poorer countries and also in Russia. Russia will still use oil and fossil fuels because of its national production capacity. New battery technologies will have enabled the use of electricity as a power supply in cars. The remainder of the world will still be mainly using combustion engines in cars.

Russia´s oil production will have expanded to the Arctic areas, and the country will produce increasing amounts of oil. As in the *Towards a greener society* scenario, in this scenario, too, almost all Arctic oil will travel through pipelines to Asia. Russia`s domestic demand for oil will have decreased and Russia will have begun using greener technologies in transportation and energy production. New gas pipelines will have been built to Europe via the Baltic Sea. Europe will prefer using gas because the carbon capture is one of the EU´s key tools in the fight against global warming and climate change.

6.5 Volumes in 2030

In the *Stagnating development 2030* scenario, the expected volume of oil transportation is 165 million tonnes, and the minimum and maximum volumes are 148 and 177 million tonnes respectively. Compared to the oil volumes transported in 2009, oil transportation will have increase by 9.5%. Although there will be slow economic growth, there will be little growth in the demand for oil. In this scenario, the EU`s climate and energy package will have failed, and interest in green technology and renewable energy will have collapsed. In this scenario, Russia will not have expanded its oil production activities to Arctic areas.

In the *Towards a greener society 2030* scenario, oil transportation in the Gulf of Finland will have increased by almost 18% compared to 2009. The expected volume is 177.5 million tonnes. The minimum volume is 156 million tonnes and the maximum volume 192 million tonnes. The demand for oil in Europe will probably decrease or remain stable, while Russia will continue transporting oil and oil products overseas via the Gulf of Finland.

In the *Decarbonised society 2030* scenario, the transportation of oil and oil products will be almost at the same level as in the *Stagnating development* scenario. It is expected that oil transportation volumes will increase by 12.5 % from the 2009 level. The expected volume is 165.5 million tonnes and the minimum and maximum volumes 153 and 190 million tonnes respectively. In this scenario, Russia will have expanded its oil production activities to Arctic areas, and the volumes of oil production will have increased. Oil will be transported through new pipelines to the East, in other words to China, India and other Asian countries. The demand for oil in Europe will have decreased slightly, but fossil fuels will still be the main energy source for transportation.

For the expected oil transportation volumes of each scenario for 2030, see Table 6.2 below. The Table also shows the change in percentage points in comparison with 2009 volumes.

Table 6.2 Expected volumes in oil transportation scenarios for the year 2030 and change in percentage points.

Oil & oil products transported in the Gulf of Finland in 2030		
	Million tonnes	**Change (%)**
Year 2009	150.6	
Stagnating development 2030	165	9.50%
Towards greener society 2030	177.5	17.90%
Decarbonised society 2030	169.5	12.50%

6.6 Summary of the oil transportation scenarios for 2020 and 2030

According to the specialists, there will only be a moderate increase in the oil transportation volumes compared to the statistics for 2009. Variations in the scenarios are not major, but the minimum and maximum volumes of oil and oil products transported in each scenario have quite a wide range. This variation between the minimum and maximum scenarios varies around 30 to 40 million tonnes. Transported oil volumes in the *Slow development* scenario in 2020 and the *Stagnating development* scenario for 2030 are almost the same. We can see that the estimated volumes of Ust-Luga increase the transportation volumes, but depending on the scenario, the volumes for Estonia and Finland might decrease a little. In the *average and strong* development scenarios for 2020, the transported oil volumes will increase. The reason for the increasing oil volumes is that new technologies and the share of renewable fuels will not develop rapidly in the next seven years. If new technologies, for example electric vehicles, are in a wide use, the demand for oil products will decrease. However, especially in transportation of passengers and goods, fossil fuels will remain the main energy source.

7 OIL TANKER SIZE DISTRIBUTION IN THE GULF OF FINLAND: CURRENT SITUATION AND FUTURE DEVELOPMENT

7.1 Oil tanker calls in 2009 in the Gulf of Finland

In 2009, over 1,600 tanker calls were made in the Gulf of Finland. On the basis of AIS data, the tanker lengths varied from 57 meters to 255 meters. Figure 7.1 below shows that the largest number of tanker calls were made by tankers which are either 60 meters, 100 meters, 130 meters or 250 meters long.

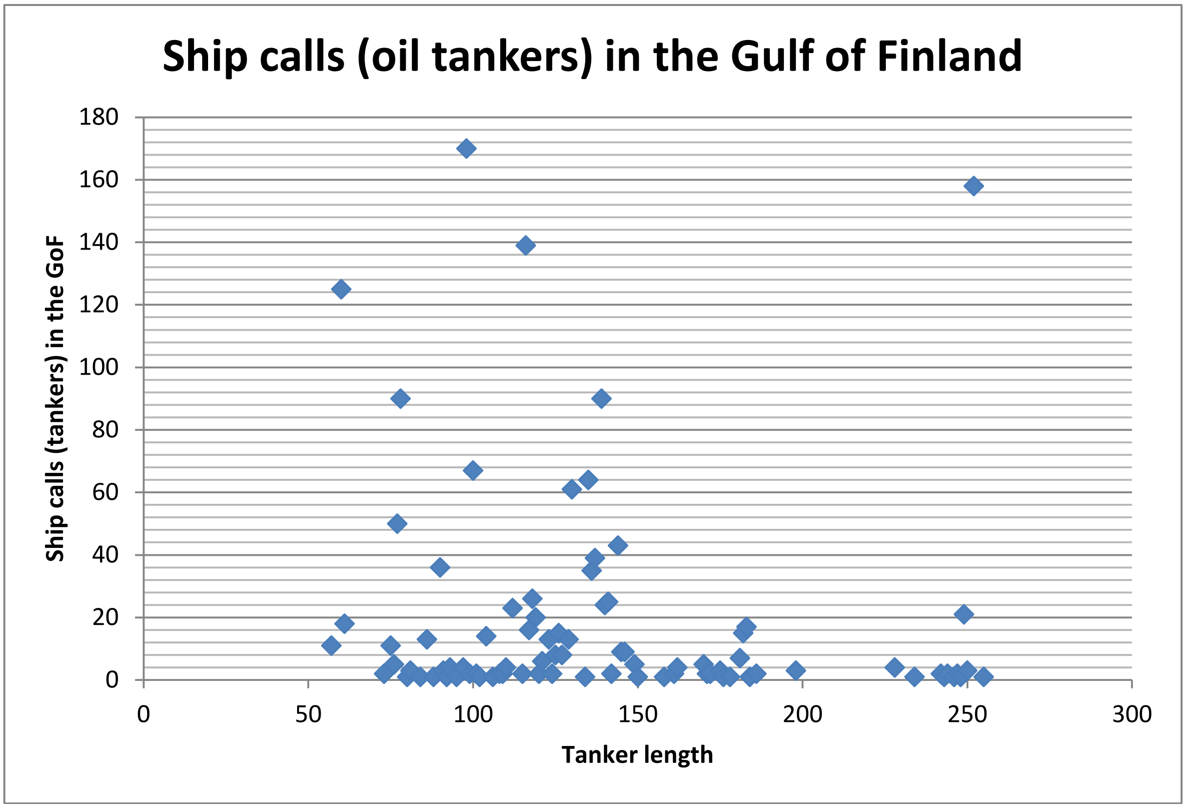


Figure 7.1. Tanker calls and tanker lengths in the Gulf of Finland in 2009(AIS data)

Although the length of a tanker does not measure volume, it gives some indication of tanker sizes in the Gulf of Finland. For example, oil tanker MT Tempura (owned by Neste Oil) is 252 metres long with 106,208 dwt, and the capacity of its cargo tanks is 121,158 cubic meters. As an example, Table 7.1 below describes Neste Oil’s tanker fleet, showing the length and capacity in dwt. In this Table, crude and dirty fleet refer to larger tankers which transport heavy oil or crude oil. Clean fleet in general refers to smaller tankers carrying refined products such as gasoline, diesel fuel or jet fuel. Crude oil tankers whose length exceeds 250 meters have a dwt capacity of over 100,000. Tankers which are 144 meters long have a dwt capacity of 14,769 to 16,613. The largest tankers in the clean fleet are 228 metres long and their capacity is 75,000 dwt. (Neste Oil Shipping 2012)

Table 7.1 Neste Oil`s fleet (Neste Oil Shipping 2012)

Crude and dirty fleet				Clean fleet		
Name	**Dwt**	**Length (m)**		**Name**	**Dwt**	**Length (m)**
Stena Arctica	117,100	249.79		Palva & Stena Poseidon	74,999	228
Mastera	106,208	252		Futura, Neste, Jurmo & Purha	25,000	169.5
Tempera	106,208	252		Sten Suomi, Sten Aurora & Sten Hidra	16,600	144
Sten Nordic	16,613	144		Ternvik & Ternhav	14,800	141
Sten Botnia	16,611	144		Kiisla & Suula	14,700	139
Ternholm	14,796	141		Astoria	12,700	137
				Scorpius	11,250	129
				Tarndal	8,300	115

Due to the maximum draught of 15 meters in the Baltic Sea and to oil terminal capacity, the maximum tanker size is 150.000 dwt (ITOPF 2003). Tankers of this size can be loaded in the port of Primorsk. Almost all tankers in the port of Primorsk in 2009 were 250 metres long or longer, except for smaller tankers of 100 metres in length operating in domestic traffic. In the port of Primorsk, the maximum length overall (LOA) for crude oil tankers is 307 meters, while it is 200 metres for oil product and diesel oil vessels. The oil terminal in the port of Ust-Luga is designed for tankers up to 100,000 dwt. (UK Trade & Investment, 2010 & Pasp 2010). In the port of Muuga, the largest tanker in 2009 was 249 metres long with a dwt exceeding 100,000. In Finland in the port of Sköldvik, the largest tanker had a dwt of almost 300,000, and the largest cargo amount that was loaded was 180,000 tonnes (Neste Oil 2012).

If Russia builds more 150,000 dwt tankers in the future to operate in the Gulf of Finland, this would mean that fewer tankers would be operating in the area if oil volumes do not increase accordingly. However, if a tanker of 150,000 dwt would collide or run aground, the potential oil spill could be larger than in case of smaller tankers. Currently, different kind of tankers operate in the Gulf of Finland. A good example of this is Neste Oil Shipping´s fleet. Tanker sizes vary according to their use. In domestic oil traffic tankers are small compared to crude oil tankers which are over 100,000 dwt. The same tanker size distribution is seen in Russia and Estonia as well.

7.2 Future ship technology and development

Future trends in ship technology can be divided into two categories; low energy ships and green fuelled ships. Low energy shipping technologies in ship building reach for new materials; drag reduction, propulsion and energy efficiency. New technology and demanding targets as regards emissions, efficiency, strength, and speed or cargo flexibility necessitate holistic designs and use of risk-based methods. The main triggers for development and innovations are the market forces, technological advance, technical development, safety issues, environmental regulations, high bunker costs, market realities and greener values. (Det Norske Veritas, 2011)

Air bubble lubrication and air cavity systems, which aim at reduced friction and decreased fuel consumption, are some of the technologies in low energy shipping. Hybrid materials, hybrid propulsion and ballast water free ships are also being developed in order to reduce the ship's weight. (Det Norske Veritas 2011)

Alternative energy sources like LNG, bio fuels, renewable energy and also more radical energy sources, such as nuclear or wind energy, can become energy sources for future shipping. New environmental regulations require that the emission levels of SOx, NOx, CO_2 and particulars must be reduced. The emission levels push maritime transportation and industry towards cleaner energy resources. (Det Norske Veritas 2011)

Green fuelled ships refer to techniques which can meet increasingly strict environmental regulations and address rising bunker oil prices with natural gas and renewable energy sources. Stricter environmental regulations require a reduction in the emission levels of SOx, NOx and particulates. Alternative energy sources for traditional bunker are for example LNG, biofuels, nuclear and different kinds of kites which decrease the bunker consumption.

8 SUMMARY

This report was written as part of the Minimizing risks of maritime oil transport by holistic safety strategies (MIMIC) project. The purpose of this study is to provide a current state analysis of oil transportation volumes in the Baltic Sea and to provide oil transportation scenarios for the years 2020 and 2030 in the Gulf of Finland. The scenarios were formulated on the basis of the current state analysis, energy and transportation strategies and scenarios, and specialist assessments. The oil transportation data and future scenarios will be utilized in the decision model to be developed in the MIMIC project.

In 2010, almost 290 million tonnes of oil and oil products were transported in the Baltic Sea, of which over 55% via the Gulf of Finland (Holma et al. 2011). Every day, more than 2,000 ships sail in the Baltic Sea, approximately 25% of which are tankers. Almost 15% of the world's maritime transportation takes place in the Baltic Sea. The shallow and rocky waters, narrow channels and severe ice conditions make navigation challenging in the Baltic Sea, and more particularly, in the Gulf of Finland. Relatively small sea areas, crossing passenger and transit traffic between Helsinki and Tallinn and oil tankers heading west from the eastern part of the Gulf of Finland is a combination which, in the worst case, could cause a serious environmental disaster.

Oil transportation in the Gulf of Finland has almost quadrupled in the past ten years. In 2000, little over 43 million tonnes of oil and oil products were transported and handled in the Gulf of Finland. In 2009, this figure was 150.6 million tonnes and, in 2010, almost 160 million tonnes. The economic recession which started in late 2008 has not had much effect on the volume of maritime oil transportation.

The increase in oil volumes is due to the increasing oil production and exports in Russia. Russia´s oil volumes are the largest in the Baltic Sea. They have increased exponentially from 2000. In 2000, the volume handled was only 7.3 million tonnes, while in 2009, the volume was almost 109 million tonnes. Russia opened the oil port of Primorsk in 2002. Since that time, the volumes in Primorsk have increased six-fold from 12.4 tonnes to 79.2 million tonnes. The port of Vysotsk started to handle oil in 2007, and its oil volumes currently are about 14 million tonnes. In the port of St. Petersburg, the annual oil volumes have increased from 7.4 million tonnes to 16 million tonnes. Besides these ports, the port of Ust-Luga started operating in 2012. The Baltic Pipeline System 2 is connected to the port of Ust-Luga. In the initial stage, the planned oil volume will be about 10 million tonnes, and in the second stage it will be up to 25–30 million tonnes annually.

The oil volumes handled in Estonia mainly consist of transit transportation from Russia via Estonian ports. The oil volumes in Estonia have been relatively stable, varying from the peak year of 2004 with 29.6 million tonnes to 21.9 million tonnes in 2008. The economic recession did not decrease transport volumes: in 2009, the oil volumes in Estonia increased by 3 million tonnes. The port of Tallinn handles more than 91% of the total oil volume via Muuga and Paldiski South port areas. In the port of Sillamäe, the volume has varied between 1.01–2.19 million tonnes. Miiduranna, Paljassaare and Vene-Balti handle smaller volumes of oil annually.

In Finland, there are 12 sea ports in the Gulf of Finland, of which six ports handle oil and oil products. The largest oil port in Finland is Sköldvik, which mainly serves Neste Oil Ltd. oil refinery and other petrochemical industry in the vicinity of the port. The oil volume handled increased slightly in the last decade. In 2000, the amount of oil and oil products handled was 12,4 million tonnes and in 2009, it was 16,2 million tonnes. The port of HaminaKotka currently handles some 400,000-450,000 tonnes of oil products. The volume of oil products handled in the port of Helsinki has varied greatly in recent years: from 156,000 tonnes (2008) to 399,000 tonnes (2003). In the port of Inkoo, oil transportation volumes decreased over the last ten years from 446,000 tonnes to very small annual amounts. The port of Hanko also only handles small volumes of oil, amounting to 8.9 thousand tonnes in 2010.

The MIMIC scenarios for the years 2020 and 2030 are based on national energy strategies, the EU`s climate and energy strategies as well other energy and transportation forecasts for the years 2020 and 2030. Energy strategies are crucial for oil transportation, as Russia is one of the world's largest energy producers, and many countries in Europe and other parts of the world are dependent on Russia´s energy resources. Russia's primary interest is to utilize its energy resources for the benefit of the Russian economy. In Europe, political goals have been set for reducing the use of oil and other fossil fuels and for increasing the share of renewable energy sources. The oil volumes transported will also depend to some extent on oil prices.

In the *Slow development* scenario, there will neither be much economic growth nor increases in oil transportation volumes in 2020. The EU`s climate and energy package will have failed to achieve its goals. In Russia, no new investments are made in increasing the oil production capacity. In the *Average development* scenario, the premise is that the development of the population, economy, technology and transportation continues as today in the future. There will be investments both in green technology in Europe and in the oil production technology in Russia. In the *Strong development* scenario, investments in the oil production and transportation infrastructure in Russia will be made following the most ambitious plans. Green technologies and energy sources will not be able to replace oil as an energy source.

The scenarios for 2030 follow the same logic as the ones for 2020, but the time perspective is longer, adding to the uncertainty of the scenarios. In the *Stagnating development* 2030 scenario, the main focus will be on a lack of investments and economic growth. Environmental goals will have not been achieved as balancing the economy will have been more important.

In the *Towards a greener society* 2030 scenario, energy and climate strategies will have succeeded in achieving their goals, and Europe will be moving towards the decarbonisation of society. New innovations in green technology will be made, and the related production activities will be based in Europe. However, fossil fuels will still remain the main energy source. Economic growth will have increased the demand for energy, and even if the share of alternative energy sources will increase, so will the consumption of oil. The EU will have implemented a stricter environmental policy in the *Decarbonised society 2030* scenario. The demand for oil products will have decreased, and the share of bio fuels and renewable energy sources will have increased; for example, many vehicles will run on electricity. New gas lines will have been built to Europe and oil pipes to Asia.

According to the expert assessments of nine specialists, oil transportation volumes will only increase moderately in the Gulf of Finland by 2020 and 2030. The specialists were asked to give three volumes for each scenario: the expected volume of oil transports, the minimum volume (the volume that will at least be transported) and the maximum volume (a volume that will not be exceeded). The variations in volumes between the scenarios are not large, but each scenario tends to have rather a major difference between the minimum and maximum volumes. This variation between the minimum and maximum volumes varies around 30 to 40 million tonnes depending on the scenario.

In the *Slow development 2020* scenario, the minimum volume of oil transported was estimated to be 151 million tonnes, which is almost equal to the volume of oil transported in the Gulf of Finland in the year 2009. The expected value is 170 million tonnes, which would include the oil volumes from the port of Ust-Luga, if oil traffic in this port starts as planned. The maximum volume in the *Slow development 2020* scenario is 182 million tonnes. In the *Average development 2020* scenario, the minimum volume of oil transported is 169 million tonnes and the expected volume 187 million tonnes. The maximum volume is 207 million tonnes. In the *Strong development 2020* scenario, the minimum volume of oil transported in the Gulf of Finland is 177 million tonnes and the expected volume 201 million tonnes. In this scenario, the maximum volume is 218 million tonnes.

In the *Stagnating development 2030* scenario, the expected oil volume is 165 million tonnes, which is a little less than in the *Slow development 2020* scenario. The minimum and maximum volumes are 148 and 177 million tonnes. In this scenario, oil transportation would increase by 9.5 % compared to the year 2009. In the *Towards a greener society 2030* scenario, oil transportation in the Gulf of Finland will increase by almost 18% compared to the year 2009. The estimated volume is 177.5 million tonnes and the minimum and maximum volumes are 156 and 192 million tonnes respectively. In the *Decarbonised society 2030* scenario, the transportation of oil will be almost at the same level as in the *Stagnated development 2030* scenario. In this scenario, it is estimated that oil transportation will increase by 12.5% compared to 2009. The estimated volume is 165.5 million tonnes and the minimum and maximum volumes are 153 and 190 million tonnes respectively. Figure 8.1 shows the three different scenarios for 2020 and 2030 and their expected volumes.

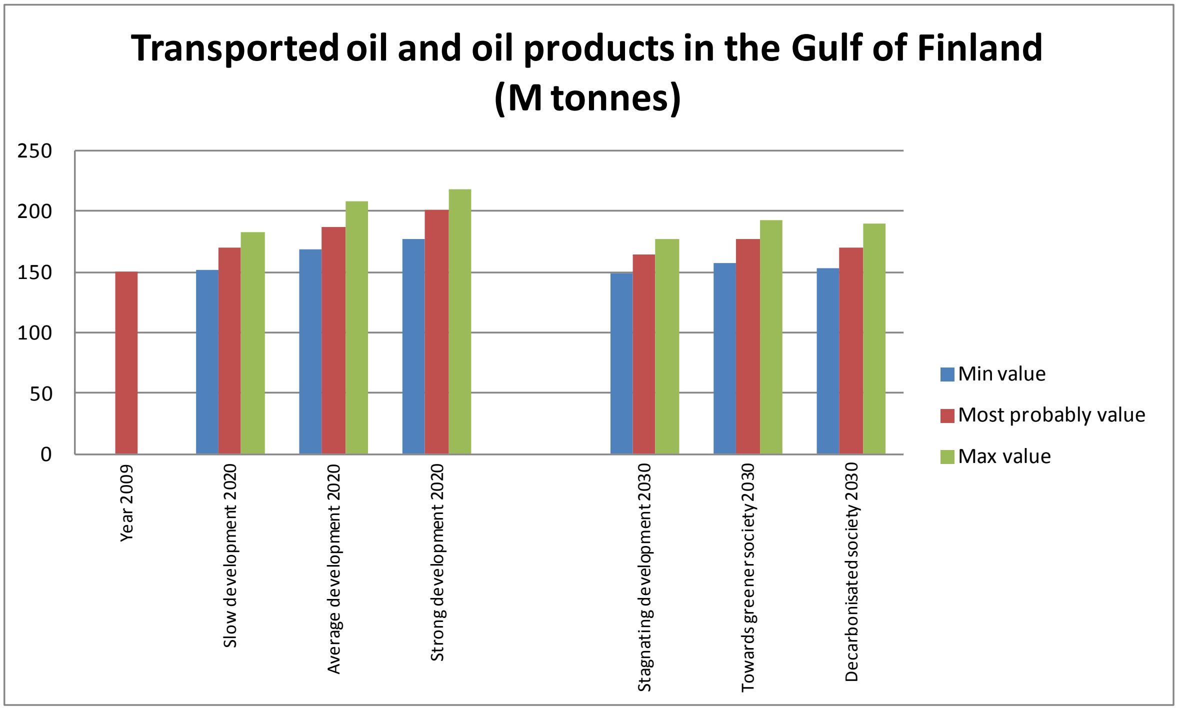


Figure 8.1 Volumes of oil transported in the Gulf of Finland in 2020 and 2030 in three scenarios.

In addition to the tonnes of oil transported, the amount of tanker traffic in the Gulf of Finland was analyzed. According to AIS data, more than 1,600 tanker ship calls was made to the Gulf of Finland ports in 2009. The tanker lengths varied from 57 meters to 255 meters, while the majority of the calls were made by tankers of some 60 metres, 100 metres, 130 metres and 250 metres in length.

In 2009, the largest tankers in the Gulf of Finland were 254 metres long with a capacity of 117,100 dwt. Due to the maximum draught of 15 meters in the Baltic Sea and the capacity of oil terminals, the maximum tanker size in the Gulf of Finland is 150,000 dwt (ITOPF 2003). Tankers of this size can be loaded in the port of Primorsk. If, in the future, Russia will build more 150,000 dwt tankers operating in the Gulf of Finland, this would mean that fewer tankers would be operating in the area if the oil volumes do not increase accordingly. However, if a tanker of 150,000 dwt collided or ran aground, the potential oil spill could be larger than in case of smaller tankers.

On the basis of this study, no dramatic increase in oil transportation volumes in the Gulf of Finland is to be expected. The highest volume in the three scenarios was 218 million tonnes of oil in the *Strong development 2020* scenario, which would represent a growth of approximately 36% compared to the year 2010. However, most of the scenarios forecasted a more moderate growth in maritime oil transportation volumes, which is also supported by the existing investment plans and energy and transportation scenarios.

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