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2015 status report

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Akvaplan niva
THE BARENTS EURO-ARCTIC REGION
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NORSK INSTITUTT FOR BIOØKONOMI

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The authors, Alexei Bambulyak, Bjørn Frantzen and Rune Rautio, have been working for more than 20 years on environmental, research and business cooperation in the Barents Euro-Arctic Region with special emphasis on Russia. Frantzen led the Norwegian Polar Institute in Svalbard, Rautio was an adviser for economy development and infrastructure in the Norwegian Barents Secretariat, and Bambulyak was a project manager at the Karelian Information Barents Centre. From 1997 to 2005, Bambulyak and Frantzen worked together at Svanhovd Environmental Centre (now, NIBIO Svanhovd) leading the Barents Council Environmental Management Programme for the Murmansk Region (EMP-Murmansk), and facilitating environmental capacity building projects in Northwest Russia. In 2003, they published the first in series status report “Oil transport from the Russian part of the Barents Region”. Now, Bjørn Frantzen is a project manager at NIBIO Svanhovd; Rune Rautio is a department manager Finnmark at Akvaplan-niva, and Alexei Bambulyak is a region manager Russia & Eastern Europe at Akvaplan-niva and a PhD candidate at NTNU. Authors and their companies have for many years closely collaborated with the Norwegian Barents Secretariat and been focused on the environmental aspect related to development of oil-and-gas industry in the Arctic regions. Bambulyak, Frantzen and Rautio have published a number of reports, articles and papers on Arctic marine shipping, oil-and-gas transportation, environmental impact assessment, oil pollution prevention issues. Authors have personally visited many of the sites described in this report, had meetings with environmental authorities, oil-and-gas and transport companies working in the region. The report also presents their experience undertaken in this sphere.

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The Norwegian Barents Secretariat serves the Norwegian-Russian relations in the north and provides grants to projects. The Barents Secretariat in Kirkenes, Norway was established in the aftermath of the signing of the Kirkenes Declaration in 1993. Today, the primary task of the Barents Secretariat is to assist the Barents Regional Council, Norwegian Authorities and other major regional structures. The Secretariat has an extensive network of contacts and cooperates closely with EU institutions and international organisations. The Secretariat has information centres in Russia – in Arkhangelsk, Murmansk, and Naryan-Mar.

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Akvaplan-niva AS is a research and consultancy company in the NIVA group, Norwegian Institute for Water Research. Akvaplan-niva provides a wide range of services in environment and aquaculture to companies, authorities, non-governmental organisations and other customers worldwide. Akvaplan-niva has been working in Russia since the late 1980s, and developed an extensive network with Russian research and environmental institutes, authorities and business companies. In 2006, Akvaplan-niva established a subsidiary in Murmansk, Akvaplan-niva Barents.

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NIBIO, the Norwegian Institute of Bioeconomy Research, is a leading national centre for development of knowledge in bioeconomics. NIBIO was established in 2015 as a merger between the Norwegian Institute for Agricultural and Environmental Research (Bioforsk), the Norwegian Agricultural Economics Research and the Norwegian Forest and landscape Institute. NIBIO Svanhovd works with issues related to natural resources, environment and agriculture in the Barents Region, as well as Norwegian-Russian environmental co-operation.

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Contents:

1 Summary

Oil transportation from the Russian part of the Barents Region along the Norwegian coast had insignificant volumes before 2002. In 2002, there was a dramatic increase in oil shipment, when 5 million tonnes were delivered westwards through the Barents Sea. In 2004, some 12 million tonnes of petroleum cargoes were shipped for export from the Russian part of the Barents Region along the Norwegian coast. From 2005 to 2008, the annual volumes were on the levels between 9 and 12 million tonnes. In 2010, petroleum flow exceeded the level of 15 million tonnes. The following four years, volumes were on the levels between 10 and 13 million tonnes per year. Snøhvit gas field and Melkøya LNG in the Norwegian part of the Barents Sea were put on stream in 2007. From 2010 to 2014, between 4 and 5 million tonnes of liquid gas cargoes were offloaded Melkøya annually.

The terminals loading oil for export in the Russian Western Arctic have been continuously developed, and the overall shipping capacity has been enlarged. The changes in oil volumes carried for export through the Barents Sea were not so much dependent on the terminals' capacities as on the external factors. The changes in the export taxes and rates for cargo transportation by railways, development of new trunk pipelines to the Baltic Sea and Far East, construction of new railway-sea terminals in on the Baltic Sea were a few examples that induced oil transport operators to develop new or enlarge capacities of existing railway-sea terminals in the Barents or White Seas. Sanctions introduced against Russian oil-and-gas businesses, and sharp decline of oil prices delayed implementation of new oil-and-gas development projects in the Arctic.

The big oil export challenges that occurred in the recent years due to conflicts between Russia and neighbouring transit countries made the Russian Government and trunk oil pipeline monopolists Transneft to diversify Russian oil export routes increasing capacities of the Baltic Pipeline Systems (BPS-1 and -2), Sever, and Eastern Siberia–Pacific Ocean (ESPO-1 and -2) pipelines.

In the beginning of 2009, there was a gas transit conflict between Russia and Ukraine. In 2012, two lines of the Nord Stream pipeline through the Baltic Sea were completed. In 2014, the conflict between neighbouring countries went to another level. That has led to significant changes in big Russian gas export projects. Uncertainties with realisation of South Stream and Turk Stream projects in the south, in a way, endorsed such projects as Power of Siberia-1 and -2 in the south-east and Nord Stream-2 in the north-west, and gave additional arguments for developing LNG projects in the north, such as Yamal, Arctic and Pechora LNG.

2014 saw the first shipment of Arctic crude oil from Prirazlomnoye field in the south-eastern Barents Sea – the Pechora Sea. Prirazlomnaya became the first offshore platform that was put on stream in the Russian Arctic, and the first oil producing rig in the entire Barents Sea. Gazprom Neft Shelf plans to reach the maximum production of 6 million tonnes per year at Prirazlomnoye after 2020. And in five years' time perspective, Varandey terminal of LUKOIL may offload about 10 million tonnes of oil per year. Varandey terminal with the annual capacity at 12 million tonnes, was out in operation in 2008; the following year, it sent more than 7 million tonnes of crude oil for export. In 2012, Varandey annual volumes dropped to about 3 million tonnes, but with new pipeline system that was built and connected Kharyaga oil field with Varandey, they started to grow and almost reached 6 million tonnes in 2014.

In 2015, Gazprom Neft managed the first winter oil offloading operation in the Ob Bay of the Kara Sea. Crude oil from Novoportovskoye oil field in Yamal was loaded to ice-class tankers through a temporary terminal. In 2016, Gazprom Neft plans to start offloading oil via the new Arctic oil terminal in the Ob Bay with 8 million tonnes design capacity.

In the present report on oil transportation along Russian and Norwegian northern coasts, we have given special attention to the description of the existing and prospective offshore and onshore oil and gas terminals in the northern regions of Russia and Norway, and their connection to oil-and-gas reserves on one hand and to the export routes on the other. We demonstrate that even without a Russian trunk oil pipeline from Western Siberia to

the Barents Sea coast, the overall capacity of the terminals shipping oil and gas for export through the Barents Sea can reach 100 million tonnes in fiveten years' perspective.

In Russia, about 50 million tonnes of petroleum cargoes can be delivered by railway to port terminals in the Barents and White Seas. Up to 15 million tonnes of crude oil will come from the northern Timano-Pechora oil fields shipped from Varandey terminal and Prirazlomnaya platform. Dolginskoye should be the next large offshore field in the Pechora Sea to be put on stream.

New Arctic oil terminal in the Kara Sea can offload up to 8 million tonnes of Novy Port crude oil. Three trains of Yamal LNG will produce 5.5 million tonnes of LNG and condensate each to be shipped to sea-going carriers at Sabetta port.

In Norway, Statoil's LNG plant at Melkøya will keep offloading 5 million tonnes of liquefied gas annually. Goliat oil field in the Barents Sea will be put on stream in 2016, and the northernmost floating platform in the Barents Sea should produce and ship 5 million tonnes of oil within the first year of production.

In 2010, we saw the start of international transits through the Northern Sea Route (NSR), then 4 vessels sailed with 111 000 tonnes of cargo eastbound along the NSR. In 2013, 71 transit passaged were registered with 1.36 million tonnes of cargo transported eastbound and westbound, including 67 000 tonnes of LNG carried from Statoil's plant at Melkøya in the Barents Sea to Japan. In 2014, international cargo transits dropped to less than 300 000 tonnes, while the overall freight traffic within the NSR area almost reached 4 million tonnes. In a long term perspective, this Arctic lane will give the way for huge Yamal and Kara Sea oil-and-gas resources to the European and Asian markets.

Oil pollution prevention should be the central issue for ensuring safe and stable petroleum cargo transportation in the Barents Sea. We saw that during the recent years, special attention was paid to maritime safety and oil pollution prevention issues in the Arctic, and new rules and regulations were adopted at the national and international levels, including International Maritime Organisation and the Arctic Council. Norway and Russian improve their national rescue and oil-spill response systems developing new technologies and building modern salvage vessels. Two countries continue and develop cooperation for environmental protection against oil pollution. A new mandatory Barents Ship Reporting System was set in operation in 2013, and strengthened Norwegian-Russian cooperation for maritime safety in the Barents Sea. Joint bilateral exercises for search-and-rescue and oil-spill response in the Barents Sea are held every year and involve resources of military and civilian rescue units of both countries.

This cooperation should be continued and strengthened on all levels to ensure reliable oil pollution prevention in response to prospective oil-and-gas production and transportation in the Barents Sea and the entire Arctic.

Figure 1.1 Arctic coast of Russia and Norway. Red dots (1-22) point locations of existing or planned terminals for shipping petroleum for export via the Barents Sea. These terminals are described in the report.

2 Introduction

Petroleum shipping along northern coastlines of Norway and Russia is one of the hottest topics discussed in terms of both economical possibilities and environmental challenges. It is also an important issue of Arctic, Barents and bilateral cooperation agendas.

This report is the sixth in a series, namely "Oil Transport from the Russian Part of the Barents Region" after the ones released in 2003, 2005, 2007, 2009 and 2011. In 2003, Svanhovd Environmental Centre published the first report, where Bambulyak and Frantzen described the existing and planned oil terminals in the Russian part of the Barents Euro-Arctic Region[1]. In 2005, the report was extended and updated with information about petroleum transportation in the period from 2002 to 2004. The report gave an overview of oil production and transport systems, as well as environmental aspects of oil shipment. Both reports from 2003 and 2005 were prepared and published with the financial support from the Norwegian Barents Secretariat, and the second one was co-financed by WWF Arctic Programme. The 2007, 2009 and 2011 reports, included data about Russia's hydrocarbon resources, status and prospects of oil and gas production and transportation systems; and gave updated description of oil export schemes and their development plans for the northern regions of Russia and Norway.

The present report, as well as 2007, 2009 and 2011 ones, is a joint project of the Norwegian Barents Secretariat and Akvaplan-niva, with participation of NIBIO Svanhovd (former Bioforsk Svanhovd). The purpose of this updated version is to provide the reader with new and additional information, both at general and more detailed levels. The logistic of oil deliveries for export through the Barents Sea is being developed continuously, although, not steadily. This report gives the current status of terminals and schemes of transportation of crude oil, oil products and gas liquids through the Barents Sea. We present the dynamics of cargo volumes shipped to the end of 2014, and look at oil transport development prospects in the northern regions of both Russia and Norway. Moreover, we look at the Barents export channel for oil and gas in the perspective of developing the hydrocarbon production and transportation system in Russia in general. We pay attention to environmental safety of the oil shipment and Norwegian-Russian co-operation in oil pollution prevention.

In the section "Oil and Gas Production", we give information about Russian and Norwegian hydrocarbon resources, oil and gas production and development potential with a main focus on the Timano-Pechora oil-and-gas province, Yamal Peninsula and the western Arctic shelf of Russia.

General description of the transport systems in Russia, including information about railways, sea transport, inner waterways and pipelines is given in the next section "Oil and Gas Transport". The article "The Northern Sea Route: Status and Prospects" is an adopted extract from the report prepared by the Central Marine Research and Design Institute (CNIIMF) for Akvaplan-niva.

In the chapter "Oil Transportation Routes in the Barents Region", we describe oil and gas offloading terminals along the Arctic coast of Russia and Norway with logistic schemes and export routes.

The section "Environmental Safety" provides information about status and development of the maritime and oil-spill response systems in Norway and Russia; Norwegian-Russia cooperation in environmental protection against oil pollution. We look at of the oiled wildlife response system in Norway and give some recommendations on how this system can be developed.

In the section, "Conclusions", we give our own reflections and comments about oil transportation safety, and point out factors that we believe are essential for building an efficient system for environmental protection against oil pollution.

The section "References" include the list of information sources that we used for makig this 2015 status report.

[1] The Barents Euro-Arctic Region was founded in 1993. Today, it includes 13 regions: Finnmark, Troms and Nordland in Norway; Norrbotten and Västerbotten in Sweden; Lapland, Oulu and Kainuu in Finland; Murmansk and Arkhangelsk Regions, the Republics of Karelia and Komi, and the Nenets Autonomous District in Russia.

3 Oil and Gas Production

3.1 OIL AND GAS RESOURCES OF RUSSIA

The main sources of information in this section are reports of the Ministry of Nature Resources and Environment of the Russian Federation (Minprirody), Ministry of Energy of the Russian Federation, the Federal Subsoil Resource Management Agency of Russia (Rosnedra), Statistical Review of the British Petroleum, as well as news published in media.

Official Russian data on the country's oil reserves were classified as a state secret from the Soviet time until 2013. In July 2013, the governmental resolution was signed excluding these data from the list of state secrets. As official data became open, Minprirody reported that as of 1 January 2013 recoverable oil and gas condensate reserves of A, B and C_1 categories amounted 20.1 billion tonnes and category C_2 to 12.3 billion tonnes. At the end of 2013, these reserves amounted 20.3 and 12.3 billion tonnes respectively. Oil and gas condensate resources or prospective reserves or of C_3 category were estimated to 14.5 billion tonnes and prospective and forecasted resources of D_1 and D_2 categories to 59.7 billion tonnes (see Table 3.1).

Russia is one of the reaches in the world with its natural gas resources. According to the state report of Minprirody, at 1 January 2014, the explored natural gas reserves of A, B and C_1 categories amounted 50.9 trillion cubic metres, and preliminary estimated ones of C_2 to 21.1 trillion cubic metres; prospective and forecasted resources of resources of C_3, D_1, and D_2 were estimated to 197.8 trillion cubic metres (see Table 3.1). The Russian gas monopolist, Gazprom owns about 70% of Russian natural gas reserves. As of the end of 2012, Gazprom's natural gas reserves were estimated to 33.1 trillion cubic metres according to Russian classification (ABC_1) or 29.9 trillion cubic metres according to the international PRMS standards.

Data published by the British Petroleum in the Statistical Review of World Energy 2014 showed that proved oil reserves (technologically and economically recoverable) in Russia at the end of 2013 were estimated to 12.7 billion tonnes (93 million barrels), which was 5.5% of the world's total oil reserves of 238.2 billion tonnes (1688 billion barrels). By these estimates, Russia was eighth in oil reserves after Venezuela, Saudi Arabia, Canada, Iran, Iraq, Kuwait, and United Arab Emirates. Proved reserves of natural gas in Russia at the end of 2013 were estimated to 31.3 trillion cubic metres or 16.8% of the world's total proved reserves of 185.7 trillion cubic metres. Russia was the second in the world in natural gas reserves after Iran. By proved total oil and gas reserves, Russia was on the fourth place with 40.9 billion tonnes in oil equivalent owning 10% of global hydrocarbon reserves (see Table 2).

Minprirody has stated that Russian traditional classification of oil and gas reserves and resources calculation was outdated and approved a new system that should be applied from 1 January 2016. The new classification system with A, B, C and D categories takes into consideration as geological characteristics of a deposit as economic parameters for its development, like it is done in Petroleum Resources Management System (PRMS).

Table 3.1 Oil, gas condensate and natural gas reserves and resources of the Russian Federation as of 1 January 2014 (Sources: Minprirody 2014; BP 2014)

	Reserves and resources by current Russian classification (Minprirody)				Reserves by PRMS (BP)
	$A+B+C_1$	C_2	C_3	D_1+D_2	Proved
Oil, bln t	18.2	11.0	12.6	47.7	12.7
Gas condensate, bln t	2.1	1.3	1.9	12.0	
Natural gas, trln m³	50.9	21.1	33.2	164.6	31.3

Table 3.2 Proved oil and gas reserves of selected countries (Source: BP 2014)

Country	Proved reserves		
	Oil, bln t	Gas, trln m³	Oil&gas, bln t o.e.
Iran	21.6	33.8	52.0
Venezuela	46.6	5.6	51.6
Saudi Arabia	36.5	8.2	43.9
Russia	12.7	31.3	40.9
Canada	28.1	2.0	29.9
Qatar	2.6	24.7	24.8
Iraq	20.2	3.6	23.4
UAE	13.0	6.1	18.5
Turkmenistan	0.1	17.5	15.9
Kuwait	14.0	1.8	15.6
USA	5.4	9.3	13.8
China	2.5	3.3	5.5
Norway	1.0	2.0	2.8
World total	**238.2**	**185.7**	**405.3**

Russia has a stable position of one of the largest oil and gas producer and exported in the world. During the recent five years, Russian annual production was over 500 million tonnes of oil and 640 billion cubic metres of natural gas, with domestic consumption rate about 28% for oil and 68% for natural gas.

Estimates, published in BP Statistical Review in 2014, show that hydrocarbon reserve-to-production ratios in Russia in 2013 were about 24 years for oil and 52 years for natural gas (in 2012 report, that ratio for natural gas was 74 years).

According to Minprirody data, Russia discovered more reserves of hydrocarbons than produced oil and gas annually during the recent 10 years (see Figures 3.1 and 3.2). In the period from 2009 to 2014, 290 new fields were discovered. The additions to oil and gas condensate reserves (ABC_1) that year were estimated to 750 million tonnes, including 650 billion tonnes added as a result of exploration and 100 million tonnes – revaluation. The additions to natural gas reserves in 2014 totalled 1250 billion cubic metres, of which exploration gave 1000 and revaluation 250 billion cubic metres.

Western Siberian oil-and-gas bearing province is the largest Russian oil and gas region with two third of the country's discovered oil reserves. 22% of Russia's oil reserves (ABC_1C_2) are located in nine unique oil fields (with reserves over 300 million tonnes each) in the region. And more than two third of Russia's natural gas reserves are located in the northernmost area of the Western Siberia – Yamal-Nenets Autonomous District. 28 unique gas fields (with reserves over 500 billion cubic metres each) hold 48.2 trillion cubic metres of natural gas reserves (ABC_1C_2) or 67% of total Russian discovered natural gas reserves.

As for 2014, The State Register of the Russian Federation accounted 2950 deposits with oil reserves, including 2401 oil deposits and 549 complex ones (oil-and-gas, gas-and-oil, and oil-and-condensate; and 956 deposits with natural gas reserves.

Minprirody reported that at the end of 2013 recoverable oil reserves for Russia in general depleted for more than 50%; in Timan-Pechora oil-and-gas bearing province – for 33%. The level of

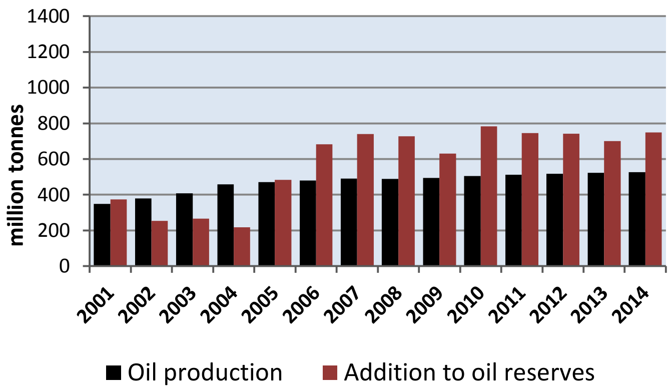


Figure 3.1 Oil production and addition to reserves in Russia in 2001-2014 (Sources: Minprirody, Rosnedra).

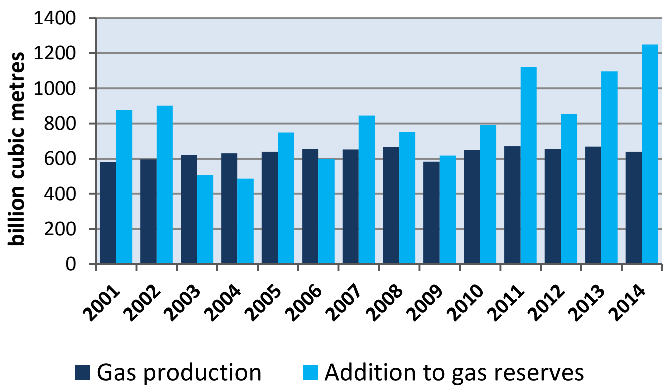


Figure 3.2 Gas production and addition to reserves in Russia in 2001-2014 (Source: Minprirody, Rosnedra).

depletion of large oil fields, located in the traditional oil production regions, was about 60%.

According to the Energy Strategy of Russia for the period to 2030, geological research and exploration through 2030 should give total additions to oil reserves on the levels of 12-14 billion tonnes, and natural gas on the level over 16 trillion cubic metres.

3.1.1 HYDROCARBON RESOURCES OF THE CONTINENTAL SHELF

According to the Ministry of Nature Resources and Environment of Russia (Minprirody), recoverable reserves of hydrocarbons on the Russian Continental shelf are assessed to be 10.8 billion tonnes in oil equivalent, and hydrocarbon resources are estimated to be 98.7 billion tonnes in oil equivalent; about 87% of them are located in the Arctic. The prospective oil and gas territory in the Russian sea areas is estimated as 4 million square kilometres of the total area of the continental shelf of 6.2 million square kilometres. Almost 1.6 million square kilometres or 25% of the country's continental shelf area had been licensed.

According to the US Energy Department 2009 report, 43 of 61 significant Arctic oil and gas fields were located in Russia.

The Arctic shelf of Russia has a total area of 4.5 million square kilometres and about 75% of it has prospects for hydrocarbon resources. The best researched area is the western sector of the Arctic shelf – the Barents and the Kara Sea areas with large deposits of Prirazlomnoye and Dolginskoe of oil; Shtokmanovskoye, Leningradskoye, Ledovoye, and Rusanovskoye of gas and condensate, and newly discovered Pobeda (Victory) of oil and gas.

Assessment of undiscovered oil and gas resources in the Arctic, published by US Geology Survey in 2009, indicated that the total mean undiscovered conventional oil and gas resources north of the Arctic Circle were estimated to be about 90 billion barrels (12 billion tonnes) of oil; 1669 trillion cubic feet (470 trillion cubic metres) of natural gas, and 44 billion barrels (4 billion tonnes) of natural gas liquids. 84% of those resources occur offshore, where Barents and Kara seas are among most prospective ones. The South Kara Sea areas contain almost 39% of Arctic undiscovered gas.

In the Energy Strategy of Russia for the period to 2030, it is stated that the exploration rate of hydrocarbon resources for the Russian continental shelf in total is below 10%. The exploration rates of resources on the continental shelf in the Caspian Sea are 15.7% for gas and 15.9% for oil; in the Okhotsk Sea – 14.4% for gas and 17.9% for oil; and in the Barents Sea – 15.5% for gas.

According to the All-Russian Research Institute for Geology and Mineral Resources of the Ocean (VNIIOkeangeologia), at the end of 2014, there

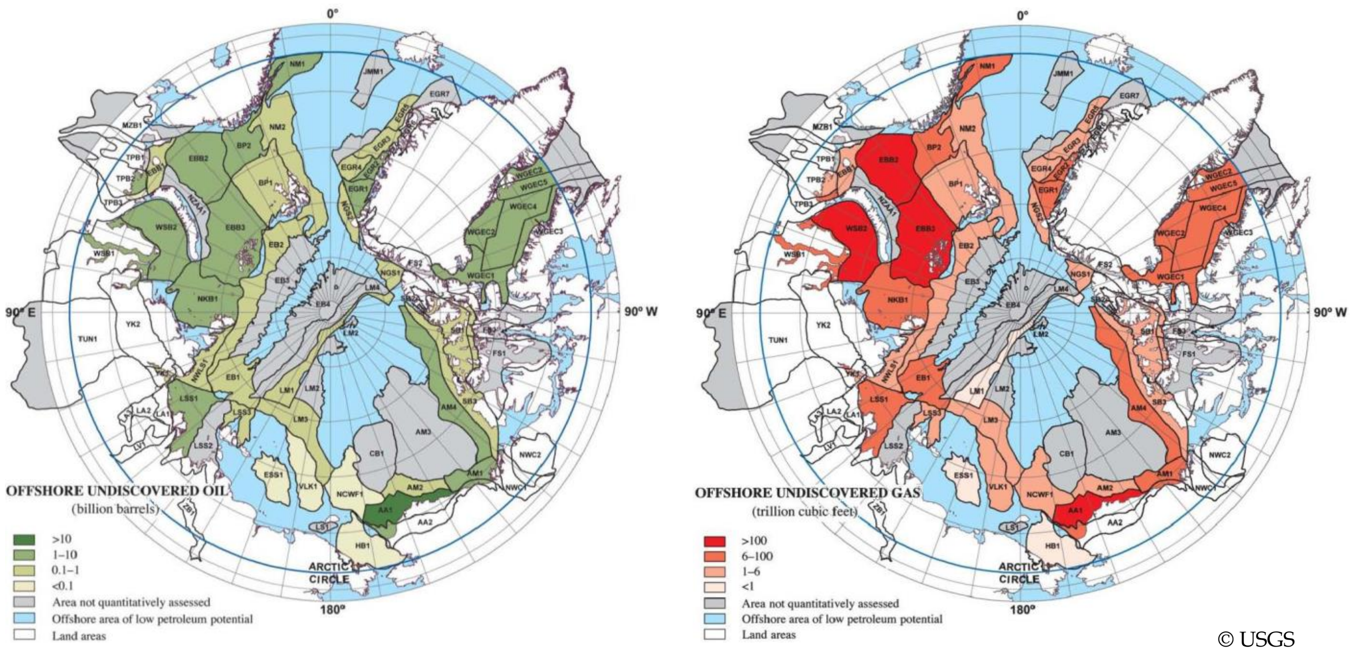


Figure 3.3 Estimates of offshore undiscovered oil and gas (Source: US Geological Survey, 2009).

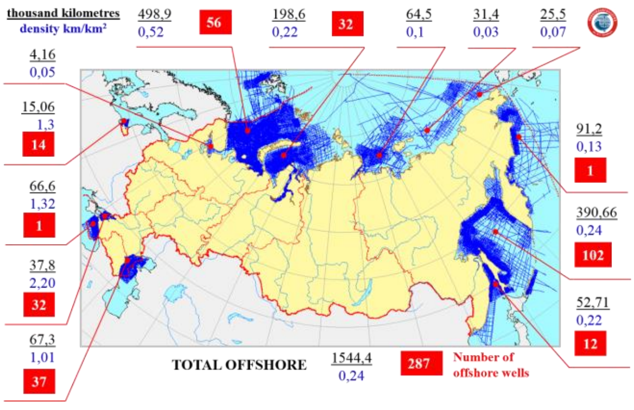


Figure 3.4 Seismic lines and wells on the Russian continental shelf as for 01.01.2015 (Source: VNIIOkeangeologia)

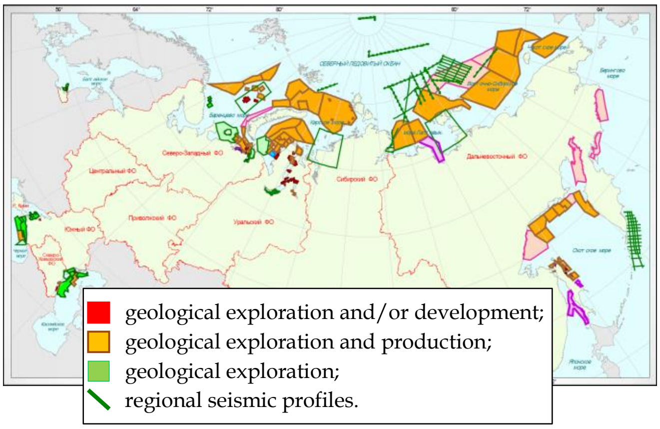


Figure 3.5 Active licences and prospective license blocks on the Russian continental shelf as for 01.01.2015 (Source: VNIIOkeangeologia)

were made 1544.4 thousand kilometres of seismic lines in the Russian sea waters (average density 0.24 kilometres per square kilometre) and drilled 287 offshore wells, including 498.9 thousand kilometres of seismic lines (density 0.52) and 56 wells in the Barents Sea; 198.6 thousand kilometres of seismic lines (density 0.22) and 32 wells in the Kara Sea; 443.4 thousand kilometres of seismic lines (density 0.24) and 114 wells in the Okhotsk and Japan Seas (see Figure 3.4).

In 2014, the Government of the Russian Federation adopted the State Programme 'Renewal and Use of Natural Resources' with sub-programme on geological exploration and renewal of sub-soil resources for 2013-2020. With the sub-programme implementation, it is planned to add country's hydrocarbon resources (D_{1loc}) for 18.4 billion tonnes of oil and gas condensate, and 27.1 trillion cubic metres of natural gas to 2020, including additions to resources on the continental shelf for 5 billion tonnes of oil and gas condensate and 13 trillion cubic metres of natural gas. One of the programme's priority goals is to locate resources offshore to guarantee annual production not less than 65 million tonnes of oil and 230 billion cubic metres of natural gas in 2030.

Rosnedra agency has elaborated a programme for licensing mineral resource areas on the continental shelf to 2020. The licenses are given for the prospective areas for hydrocarbon exploration and production along the whole Russian Arctic coast in the Barents, Kara, Laptev, East-Siberian and Chukchi Seas. Prospective licensing areas are also on the Far Eastern shelf in the Okhotsk Sea.

According to amendments to the continental shelf legislation enacted in 2008, the licenses on Russian continental shelf are granted for exploration and production of oil and gas on non-tender basis. The license holders and users are chosen among the Russian incorporated companies with more than 50% shares or other control by the Russian Federation, and companies with at least 5 years' experience of project development in the Russian continental shelf. Foreign companies may act as operators. Those changes in the legislation granted exclusive rights for oil and gas exploration and production on the Russian continental shelf to the largest Russian companies, state owned Gazprom and Rosneft.

According to Minprirody, by the end of 2010, there were granted 45 licenses on the Russian continental shelf, among them, 12 to the Gazprom Group, 16 to Rosneft, 6 to LUKOIL, 5 for the Production Sharing Agreements (PSA) in Sakhalin, and 14 to other companies.

At the end of 2014, there were 145 active licenses for offshore blocks, including 19 in shallow coastal or transit areas. 24 licences were given for regional research within state contracts and 121 for geological research, exploration and production. 6 new licenses were granted in 2012; 36 in 2013; and 5 in 2014 (see Figure 3.5). Gazprom Group owned licenses for 40 blocks, including 7 in transit areas, and Rosneft had 47 and 2 respectively, including three blocks in a former disputed area in the Barents Sea. The Russian part of that area was divided into three large blocks: Fedynsky in the south with an area of 38.1 thousand square kilometres; Central-Barents in the middle with 15.8 thousand square kilometres; and Perseevsky in the north with 23 thousand square kilometres. In 2012, Rosneft signed cooperation deals with Italian Eni on exploration and development of two southern blocks, and with Norwegian Statoil for the northernmost one. The largest deal on the Russian continental shelf, also known as "The Arctic Deal", was signed by Rosneft with ExxonMobil in 2011 after the similar deal with BP was revoked. At that time, the deal included three blocks in the Kara Sea – Vostochno-Prinovozemelsky-1, -2, and -3 (East of Novaya Zemlya) with a total area of 125 thousand square kilometres; in 2013, 7 more licensed blocks in the Arctic offshore with a total area about 600 thousand kilometres were included into strategic cooperation agreement. Rosneft and ExxonMobil planned to drill 40 exploration wells by the end of 2018. They found oil with the first well, Universitetskaya-1, drilled at the Vostochno-Prinovozemelsky-1 block in the Kara Sea in September 2014, at a time when ExxonMobil had to stop its participation in the joint venture with Rosneft due to sanctions imposed by the US Treasury.

According to Minprirody, license obligations for geological exploration of offshore blocks in the period of 2015-2020 include: 2D seismic for 194.5 thousand kilometres, 3D seismic for 29.7 thousand square kilometres; and 102 exploration wells.

The Russian Federal Law "On Subsoil Resources", states that licences for geological exploration of blocks on the continental shelf are given for 10 years.

3.1.2 OIL AND GAS RESERVES IN THE RUSSIAN PART OF THE BARENTS REGION

The main sources of information for the articles in this section were the reports of the Ministry of Nature Resources and Environment of Russia (Minprirody), the Administration of the Nenets Autonomous District, and the Ministry of Nature Resources and Environmental Protection of the Republic of Komi. We also used press-releases and news from national and regional information agencies.

The hydrocarbon resources in the Russian part of the Barents Euro-Arctic Region are most of all counted with the resources of the Timan-Pechora oil-and-gas bearing province located in the territory of the Republic of Komi, the Nenets Autonomous District and the adjusted continental shelf in the south-eastern part of the Barents Sea – the Pechora Sea. The total area of the province is 446 thousand square kilometres, including 123 thousand square kilometres offshore.

Natural occurrence of oil in Timano-Pechora was first registered in 18th century, and for the first time oil was collected on the Yarega, a tributary of the Ukhta River, back in 1745. The exploration drilling in Timan-Pechora was started in 1890. The first full scale expedition that made a methodical survey of the mineral resources of the Russian European North, including oil was held back in 1929. Then, the first field with light oil, Chibyuskoye was discovered in 1930, and with heavy oil, Yaregskoye – in 1932. Systematic exploration in the Timan-Pechora province has been conducted since that time, and a real breakthrough was made in 1960s with discovery of large prolific oil fields – Western Tebukh, Pashninskoye, Usinskoye, Vozeyskoye, Kharyaginskoye and others; and the Vukhtyl oil

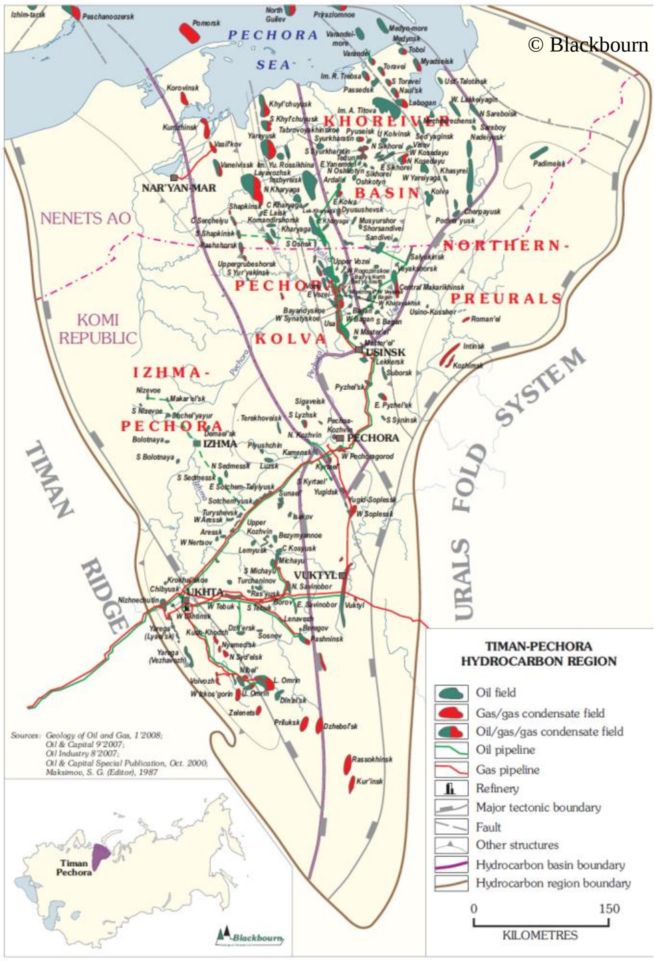


Figure 3.6 Timan-Pechora oil-and-gas bearing province.

and gas field. These discoveries drew attention to the region. New explorations let the industry re-evaluate the volume of the proved oil reserves, and natural gas and condensate reserves, and to run full-scale production.

According to Minprirody 2015 report, recoverable reserves (ABC_1C_2) of oil in the Timan-Pechora province accounted 2.4 billion tonnes, and resources ($C_3D_1D_2$) were estimated at the level of 5.8 billion tonnes. Natural gas recoverable reserves (ABC_1C_2) accounted 760 billion cubic metres and resources were estimated for 5 trillion cubic metres. Timan-Pechora has a significant geological potential of oil reserves and good prospects to increasing hydrocarbon production.

The degree of exploration of initial total in place resources in Timan-Pechora is estimated at 25.2% for oil and 17.5% for natural gas. The discovered hydrocarbon reserves in the province depleted in average for about 33% for oil and 41% for gas, however, the depletion rates differ in southern and northern areas of the province.

Further on, we give description of hydrocarbon reserves and resources in oil-and-gas bearing territories of the Russian part of the Barents Region – Nenets Autonomous District and the Republic of Komi. We based the present description on our previous reports and up-dated the articles.

We also keep an article with an overview of hydrocarbon resources and reserves of the Yamal-Nenets Autonomous District, which is not a part of the Barents Euro-Arctic Region but will play an important role in future increase of oil-and-gas transportation through the Barents Sea and the infrastructure development along the Arctic coast.

Nenets Autonomous District

According to Minprirody, at the beginning of 2014, the total recoverable reserves of hydrocarbons (ABC_1C_2) in the Nenets Autonomous District onshore were estimated to 1.1 billion tonnes of oil and 0.54 trillion cubic metres of natural gas. Administration of the Nenets Autonomous District reported that 90 hydrocarbon deposits have been discovered on the district's territory, including 78 oil, 6 oil and gas condensate, 4 gas condensate, 1 oil-and-gas, and 1 gas field. Two oil fields are located on the territories of both Nenets Autonomous District and the Republic of Komi. At the end of 2014, 105 licences were given for exploration and/or production of hydrocarbon resources. 79 fields were licensed, among them, 39 fields were put in production, others were prepared for production development, under exploration, or conserved. The licenses have been given out for 72 fields that contain almost 93% of discovered reserves of oil and 54% of natural gas.

Seven of the discovered fields are referred to as large ones; each with initial recoverable reserves over 60 million tonnes of standard fuel. Three of them are oil fields – Kharyaginskoye, Toboisko-Myadseiskoye, and named after Roman Trebs; one is oil and gas – Yuzhno Khylchuyu, two are oil and gas condensate – Layavozhskoye and Vaneyvisskoye, and two are gas condensate – Kumzhinskoye and Vassilkovskoye.

The average production rate of proved reserves in the Nenets region is about 20% for oil, and about 1% for natural gas. The Administration of the Nenets Autonomous District estimates that with the present production rate the proved reserves will provide oil for 70 years and gas for 1000 years.

Commercial production on large Yuzhno Khylchuyu oil-and-gas field started in 2008; and on oil fields named after Roman Trebs and Anatoly Titov in 2013. In the coming years, it is planned to start production on Kumzhinskoye and Korovinskoye gas condensate, Vaneivisskoye oil and gas condensate, and Naulskoye oil field.

In the future, oil production in the Nenets Autonomous District will be increasing with involving new fields into exploitation. Vast territories in the western and eastern parts of the Nenets region are not explored yet. Exploration rate of initial total in place resources constitutes about 31% for oil, and 43% for natural gas.

The Republic of Komi

According to Minprirody, at the beginning of 2014, the total recoverable reserves of hydrocarbons (ABC_1C_2) in the Republic of Komi were estimated to 0.9 billion tonnes of oil and 0.2 trillion cubic metres of natural gas.

The Government of the Republic of Komi reported that at the end of 2014, oil reserves were accounted in 139 hydrocarbon deposits, including 122 oil, 9 oil and gas condensate, 5 oil and gas, and 3 gas and oil ones. More than a half of remaining oil reserves are located in three large fields – Yaregskoye, Usinskoye and Vozeyskoye. Gas reserves were accounted in 141 deposits, among them, dry natural gas in 39 and associated (dissolved) gas in 102 deposits. About a half of republic's natural gas reserves is located in Vuktylskoye oil-and-gas condensate field. Small fields (with reserves below 10 million tonnes of standard fuel) comprises more than 80% of available reserves. 8 fields had reserves of more than 30 million tonnes each.

About 95% of hydrocarbon reserves in the republic are placed at the currently developed and prepared for development fields. 85 fields have been registered in production. Total oil reserves depletion for discovered oil fields in Komi is about 50%; gas reserves depletion is about 75%. The average production rate of proved hydrocarbon reserves in the Republic of Komi is 27%.

In 2013, two new oil fields were registered in the Republic of Komi with total oil reserves below two million tonnes; and one more field was discovered in 2014. The territory of the Republic of Komi is characterised by a low concentration of the hydrocarbon resources. New discoveries of oil and gas fields will be in the small size range.

Yamal-Nenets Autonomous District

As we mentioned above, Yamal-Nenets Autonomous District is not a part of the Barents Euro-Arctic Region, but this area in the north of the Western Siberia with adjusted shelf in the Kara Sea will play an important role in future shipments of liquid hydrocarbons through the Barents Sea.

Yamal-Nenets Autonomous District is unique with its hydrocarbon, first of all natural gas, resources. The region gives about 90% of natural gas production in Russia, or 20% in the world.

The first well was drilled in Yamal-Nenets region near the cape Kamenniy back in 1950, but 130 metres well was not deep enough to pass permafrost and get gas. In 1954, the 504 metres well drilled near Noviy Port reached natural gas, but the reserve was not big enough to have commercial value. The first in the Yamal-Nenets region and the Russian Arctic natural gas flow came from 2200 metres deep well drilled in Taz area in 1962, and the gas deposit was called Tazovskoye.

In the period from 1964 to 1969, there were discovered the world largest gas fields: Urengoyskoye with commercial natural gas reserves (ABC_1C_2) of 6.95 trillion cubic metres; Yamburgskoye – 4.27 trillion cubic metres; Zapolyarnoye – 3.22 trillion cubic metres; and Medvezhye – 0.53 trillion cubic metres. In 1970s, there were discovered 9 more unique fields with commercial reserves of natural gas over 500 billion cubic metres each, including Bovanenkovskoye with 4.92 trillion cubic metres of gas. Commercial reserves of the natural gas (ABC_1C_2) at 19 largest gas fields discovered onshore in the Yamal-Nenets Autonomous District and the adjusted shelf in the Kara Sea are estimated at 33.14 trillion cubic metres in total.

Initial on place gas resources of the region are estimated at 147.3 trillion cubic metres.

According to Minprirody, at the beginning of 2014, discovered hydrocarbon reserves (ABC_1C_2) on the territory of the Yamal-Nenets Autonomous District (onshore) account to 4.9 billion tonnes of oil and 39.28 trillion cubic metres of natural gas.

Administration of the Yamal-Nenets Autonomous District reported that in 2014, there were 232 active exploration and production licences owned by 60 companies working in the region; 32 of them carried out geological exploration on 74 licensed blocks.

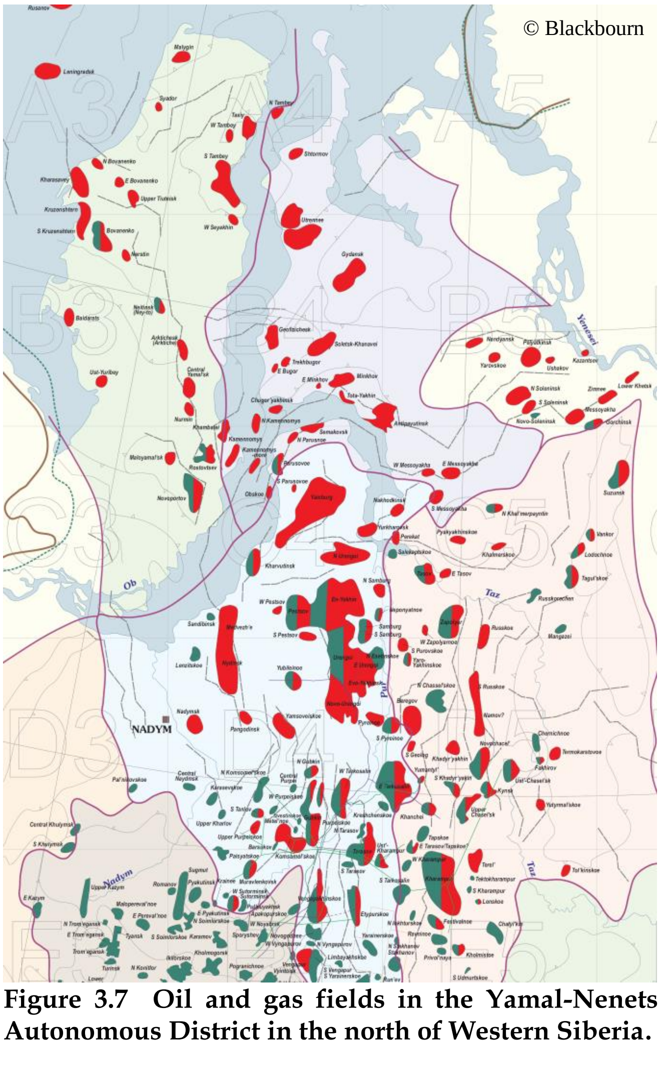


Figure 3.7 Oil and gas fields in the Yamal-Nenets Autonomous District in the north of Western Siberia.

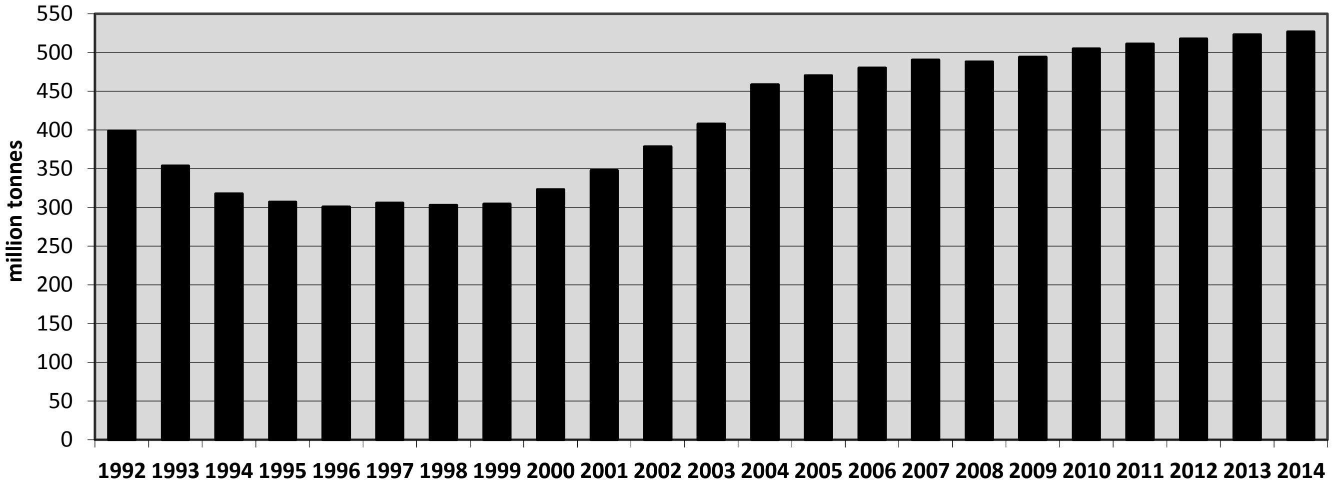


Figure 3.8 Total annual oil and gas condensate production in Russia, 1992-2014 (Source: CDC FEC, Rosstat).

At the end of 2014, 234 hydrocarbon deposits were discovered in the region, including seven new fields added after geological exploration works during the recent five years. 96 fields were in commercial production in 2014.

32 hydrocarbon deposits have been discovered in the Yamal Peninsula, at the northwest of the autonomous district, and the adjusted sea area, including 26 onshore, 4 in the Ob Bay and 2 in the Kara Sea. Yamal gas reserves are estimated to 17 trillion cubic metres and prospective resources over 22 trillion cubic metres.

3.2 OIL AND GAS PRODUCTION

The annual oil production in Russia has been constantly growing for recent 15 years (with the only small decline in 2008 versus 2007). In 2003, the production level reached 408 million tonnes – first time exceeding the 1992 level. In 2009, Russia became the world largest oil producer with 494 million tonnes. And in 2010, 505 million tonnes of oil was produced, the first time in country's history exceeding the level of half a billion tonnes per year. According to BP, Saudi Arabia took over the lead as the world largest oil producer in 2011. Though, Russian annual oil production growth continued, and according to Russian official data, almost 527 million tonnes of oil and gas condensate was produced in the country in 2014 (see Figure 3.8).

Rosneft is the leader in oil production in Russia. Company's annual production significantly increased in 2013, as a results of Rosneft's purchase of TNK-BP, which was the third largest oil producer in Russia in 2012 (see Table 3.3). In 2013 and 2014, Rosneft produced over 190 million tonnes of oil with gas condensate annually or more than one third of country's oil production volumes. LUKOIL is the second largest that produced 86.6 million tonnes of oil in Russia in 2014. Surgutneftegas with 61.4 million tonnes is the third. The other major oil producers are Gazprom Neft, Tatneft, Bashneft, Slavneft and Gazprom – each produced more than 15 million tonnes of oil in 2014. Production Share Agreement (PSA) operators produced about 14 million tonnes of oil annually during the recent three years (see Table 3.3).

Table 3.3 Oil and gas condensate production in Russia by companies (Source: CDC FEC)

Company	Oil production, mln t / year		
	2012	2013	2014
Rosneft	117.5	192.6	190.9
LUKOIL	87.2	86.7	86.6
TNK-BP	72.9	-	-
Surgutneftegaz	61.4	61.5	61.4
Gazprom Neft	31.6	32.2	33.6
Tatneft	26.3	26.4	26.5
Slavneft	17.9	16.8	16.2
Bashneft	15.5	16.1	17.8
Gazprom	14.5	16.3	16.2
RussNeft	13.9	8.8	8.5
PSA	14.1	14.0	14.4
Others	45.2	51.9	54.7
Total:	**518.0**	**523.3**	**526.8**

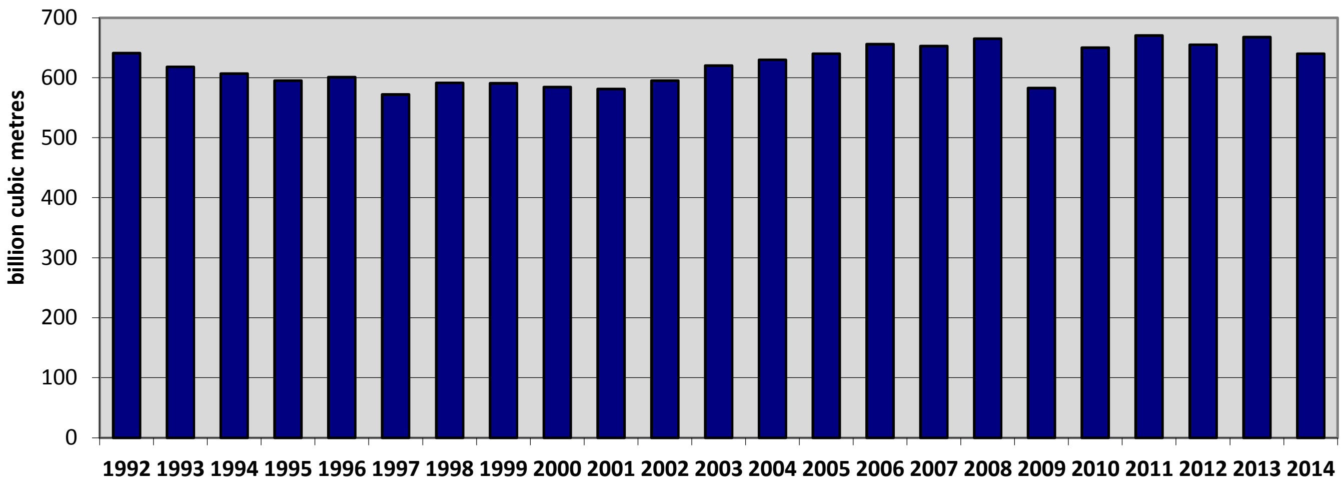


Figure 3.9 Total annual gas production in Russia, 1992-2014 (Source: CDC FEC, Rosstat).

Western Siberia is the major centre of Russia's oil industry. More than 53% of the oil reserves are located there, and since the mid-1980s this region gave about two third of the Russian oil production annually. According to Minprirody, share of the West-Siberian oil-and-gas bearing province in Russia's oil production slightly declined from 72% in 2004 to 64% in 2013. Still, about one half of Russia's annual oil production comes from Khanty-Mansiysk Autonomous District in the Western Siberia. 255 million tonnes of oil were produced there in 2013 and 250 million tonnes in 2014.

Gas production in Russia has been kept on a high level during the recent decades. From 1992 to 2014, between 570 and 670 billion cubic metres of natural and petroleum (associated) gases were produced in Russia annually (see Figure 3.9). From 2002 to 2008, Russia was the largest gas producer in the world. In 2009, gas production dropped to 583 billion cubic metres and that year Russia was the second-largest after USA. In 2010, annual gas production increased to 650 billion cubic metres, and in 2011 reached its historical maximum of 670 billion cubic metres. In 2013, 668 billion cubic metres of gas was produced in Russia; and 640 billion cubic metres in 2014.

State owned Gazprom Company is the largest gas producer in the country. In 2014, Gazprom produced 432 billion cubic metres or 67% of gas produced in Russia (with Gazprom Neft – 444 billion cubic metres). The second Russia's largest gas producer, NOVATEK extracted 53.6 billion cubic metres of gas in 2014. Other independent gas companies produced 45.3 billion cubic metres of gas, and operators of PSA – 27.7 billion cubic metres. Oil companies produced 81.6 billion cubic metres of gas. The largest gas producer among them was Rosneft with 37.3 billion cubic metres, and the second largest was LUKOIL with 18.7 billion cubic metres of gas (see Table 3.3).

According to the Ministry of Energy of Russia, petroleum (associated) gas production increased from 51.6 billion cubic metres in 2011 to 73.5 billion cubic metres in 2014, and utilisation rate in average was improved from 75.5% to 84% during that period.

Most of the Russia's gas is produced in the Western Siberia. In 2014, 516.2 billion cubic metres of gas (81% of the Russian total gas production) was extracted in the Yamal-Nenets Autonomous District.

Table 3.3 Natural and petroleum gas production in Russia by companies (Source: CDC FEC)

Company	**Gas production, bln m³ / year**		
	2012	**2013**	**2014**
Gazprom	478,6	476,2	432,0
NOVATEK	51,1	53,0	53,6
Rosneft	29,2	30,9	37,3
LUKOIL	16,9	18,2	18,7
Surgutneftegaz	12,3	12,1	9,4
Gazprom Neft	8,7	11,4	11,9
PSA	26,2	27,4	27.7
Others	31.5	39.0	49.6
Total:	**654.5**	**668.2**	**640.2**

3.2.1 OIL AND GAS PRODUCTION IN THE RUSSIAN PART OF THE BARENTS REGION

The oil production level in the Timan-Pechora province increased from less than 15 million tonnes in 2002 to 32 million tonnes in 2009, then 13.3 million tonnes was produced in the Republic of Komi and 18.7 million tonnes in the Nenets Autonomous District. In 2010, oil production in both Komi and Nenets regions slightly decreased. Decrease in oil production in the Nenets Autonomous District continued two following years, most of all, due to decline in production at Yuzhno-Khylchuyu field. In 2012, 12.5 million tonnes of oil were produced in the Nenets region. The oil production growth started there a year after when new fields came on stream, and continued in 2014, then 13.5 million tonnes of oil was produced in the District. Annual oil production in the Republic of Komi had a stable growth from 2011, and reached the level of 14.1 million tonnes in 2014 (see Figure 3.10).

The yearly natural and petroleum gas production on the territory of the Republic of Komi

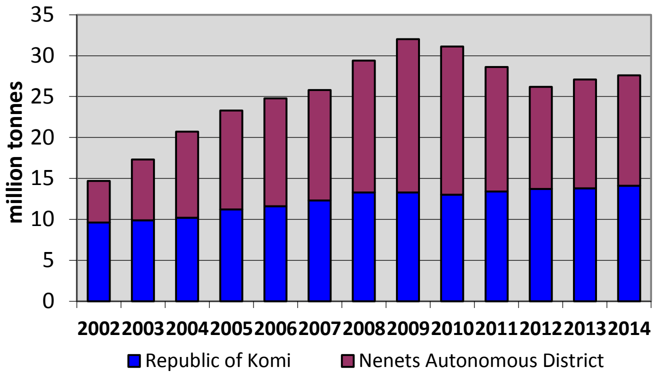


Figure 3.10 Oil and gas condensate production in the Republic of Komi and the Nenets Autonomous District (Source: Government of the Republic of Komi, Administration of the Nenets Autonomous District).

was kept on the level between 3 and 3.5 billion cubic metres for the recent years.

In the Nenets Autonomous District, natural gas is produced in small quantities only for providing the local needs. However, there is a good potential for increasing natural gas production in connection with implementation of infrastructure development projects, like Pechora LNG, and development of offshore areas in south-eastern part of the Barents Sea – the Pechora Sea.

Table 3.4 Energy Strategy 2030 forecasts for oil production in Russia, in million tonnes per year

Region	2015	2020	2030
North West	32-35	35-36	42-43
Volga	49-50	44-45	34-36
Ural	45-47	36-41	25-29
Caucasus	7-11	19-20	21-22
Tyumen region	282-297	275-300	291-292
Tomsk region	12-13	11-12	10-11
East Siberia	21-33	41-52	69-75
Far East	23-25	30-31	32-33
Russia, total	**486-495**	**505-525**	**530-535**

Table 3.5 Energy Strategy 2035 (draft) target/risk scenarios for oil production in Russia, in million tonnes per year

Federal District	2020	2025	2035
Northwestern	35/35	37/37	40/40
Volga	99/99	88/88	68/66
Southern	18/18	18/17	17/15
North Caucasian	2/2	2/2	1/1
Ural	272/260	280/249	288/236
Siberian	67/67	74/74	78/77
Far Eastern	33/31	34/34	38/35
Russia, total	**527/513**	**532/500**	**530/470**

3.3 OIL AND GAS PRODUCTION PLANS

In 2009, the Government of the Russian Federation adopted the Energy Strategy of Russia for the period to the year 2030. The Energy Strategy defined the long term goals of the Russian energy sector development, priorities and tools of state energy policy, as well as formed concepts of oil-and-gas industry development. The Energy Strategy divided the development process of the Russian energy sector in three phases stating criteria for their implementation. The first phase was to be completed in 2015, the second – in 2020-2022, and the third one – in 2030.

According to the 2030 Strategy's forecasts for oil-and-gas sector development, at the first phase, oil production in Russia should be on the levels 486-495 million tonnes; at the second – 505-525 million tonnes; and by 2030 reach the levels of 530-535 million tonnes per year (see Table 3.4). In fact, annual oil production in Russia exceeded the levels of 500 million tonnes in 2010, and 525 million tonnes in 2014.

Table 3.6 Energy Strategy 2030 forecasts for gas production in Russia, in billion cubic metres per year

Region	2015	2020	2030
Tyumen region:	580-592	584-586	608-637
- Nadym-Pur-Taz	*531-559*	*462-468*	*317-323*
- Ob-Taz bay	*0-7*	*20-21*	*67-68*
- Bolshekhetskaya	*9-10*	*24-25*	*30-32*
- Yamal	*12-44*	*72-76*	*185-220*
Tomsk region	6-7	5-6	4-5
European part:	54-91	116-119	131-137
- Caspian region	*8-20*	*20-22*	*21-22*
- Shtockman	*0-23*	*50-51*	*69-71*
East Siberia	9-13	26-55	45-65
Far East:	34-40	65-67	85-87
- Sakhalin	*31-36*	*36-37*	*50-51*
Russia, total	**685-745**	**803-837**	**885-940**

Table 3.7 Energy Strategy 2035 (draft) target/risk scenarios for gas production in Russia, in billion cubic metres per year

Federal District	2020	2025	2035
Ural:	624/608	633/596	639/601
- Nadym-Pur-Taz	*471/471*	*431/431*	*333/333*
- Ob-Taz bay, Bolshekh.	*41/41*	*41/41*	*88/86*
- Yamal	*112/96*	*161/124*	*218/182*
Southern, Caspian	28/28	28/28	26/26
Volga	21/21	20/20	16/16
N.-west, Shtokman	7/6	30/10	61/60
Siberian:	28/27	74/34	93/64
- Tomsk region	*4/4*	*4/4*	*4/4*
- Eastern Siberia	*24/23*	*70/30*	*89/60*
Far Eastern	58/48	73/70	94/87
- Sakhalin	*45/33*	*45/41*	*45/41*
Russia, total	**770/739**	**842/785**	**936/860**

The natural gas production should be on the levels 685-745 billion cubic metres at the first phase; 803-837 billion cubic metres at the second; and 885-940 billion cubic metres at the third phase (see Table 3.6). In the period from 2010 to 2014, annual gas production in Russia was on the levels 640-670 billion cubic metres.

The Government planned to up-date the Energy Strategy of Russia not less than once in five years. In 2014, the Ministry of Energy of Russia published the draft Energy Strategy of Russia for the period to 2035 that was elaborated on the basis of 2030 Strategy. In general, the priority in a new strategy turned from a quantitative increase of production volumes to a qualitative improvement of energy industry. The 2035 Strategy divides the energy industry development process on three phases to be completed by 2020, 2025 and 2035 respectively. The quantitative parameters have also been indicated for target (innovation) scenarios in the new drafted Strategy, and risks were analysed. The 2035 Strategy indicates that realisation of all risks analysed may slow down Russia's industrial development and decrease country's GDP growth on 20% comparing the target (innovation) scenario.

Expected oil and gas production volumes according to the Energy Strategy 2035 (draft) target scenario with and without all risks realised are presented in the Tables 3.5 and 3.7.

3.3.1 OIL PRODUCTION PLANS IN THE RUSSIAN PART OF THE BARENTS REGION

In the coming decade, Timan-Pechora oil-and-gas province can give the annual production of 35-45 million tonnes of oil.

In the Republic of Komi, insignificant oil production change is expected for the period through 2020, with the annual volume of about 14 million tonnes in 2015 and a slight decrease to 11-12 million tonnes in 2020.

The further development of the Komi region oil and gas fields will be accompanied by a structural decline of major reserves with an increasing number of hard-to-extract fields. This will be followed by increase of production costs as well as application of more advanced extraction technologies.

Oil production in the Nenets Autonomous District declined from 18.7 million in 2009 to 12.5 million tonnes in 2012, most of all due to oil reserve evaluation and production changes at Yuzhno-Khylchuyu field. In 2008, proved oil reserves of the deposit were estimated at 70 million tonnes; however, after re-evaluation carried out in 2011, they decreased to 20 million tonnes. The yearly production at the field, in its turn, dropped from 7 million tonnes in 2009 to less than 2 million tonnes in 2012. LUKOIL plans to stabilise the oil production at Yuzhno-Khylchuyu field on the level of 1.5 million tonnes per year.

Oil production in the Nenets started to grow in 2013, when new fields came on stream, including two large oil deposits named after Roman Trebs and Anatoly Titov. 13.5 million tonnes of oil were

Figure 3.11 The annual oil production in the Republic of Komi and the Nenets Autonomous District was over 30 million tons in 2011-2014. Timan-Pechora province can give a stable production of 35-45 million tons of oil per year in 2020-2035. Photo: Production units at Trebs and Titov fields under development.

produced in the Nenets region in 2014, including 0.9 million tonnes at Trebs and Titov fields. According to the project operator Bashneft-Polus, a joint venture of Bashneft and LUKOIL, oil production at the fields should come to a maximum level of 4.8 million tonnes per year in 2020.

The total recoverable oil reserves (C_1C_2) of Trebs and Titov block are estimated to over 140 million tonnes; prospective reserves (C_3) at 74 million tonnes and localised resources (D_{1loc}) at 70 million tonnes of oil. The license for geological exploration and commercial development of the block was issued in 2011. The license is given for 25 years, including the first five years for geological exploration.

3.3.2 OIL PRODUCTION PROSPECTS FOR THE RUSSIAN WESTERN ARCTIC SHELF

The Barents and Pechora Seas

The US Geological Survey 2009 assessed undiscovered conventional petroleum in the Barents Sea at the levels of 1.5 billion tonnes of oil, 11 trillion cubic metres of natural gas, and 270 million tonnes of natural gas liquids. Most of undiscovered hydrocarbon resources are estimated to be in the Russian part of the Barents Sea.

Minprirody estimates hydrocarbon reserves (C_1C_2) in the Barents Sea shelf to 4.5 billion tonnes of oil equivalent and resources ($C_3D_1D_2$) to more than 30 billion tonnes of oil equivalent. Natural gas forms most of these reserves and resources. At the beginning of 2014, Minprirody accounted the Barents Sea gas reserves to 4.78 trillion cubic metres and resources for more than 25 trillion cubic metres.

The commercial oil production offshore in the Russian Barents Sea began in December 2013 with a start of operations at Prirazlomnoye.

Prirazlomnoye oil field is one of the largest found in the Russian western Arctic shelf. Discovered in 1989, the Prirazlomnoye field is located in the Pechora Sea, about 60 kilometres north of the Nenets Autonomous District coast, with the sea depth of 19 metres. Recoverable oil reserves (C_1C_2) of the field were estimated at 72 million tonnes. The field will be in production for 25 years with the maximum production level of 6 million tonnes per year.

Figure 3.12 Commercial oil production started on Yuzhno Khylchuyu oil-and-gas field in 2008, reached its maximum of 7 million tons per year in 2009, and then started to decline rapidly. In 2013, oil production began at two large oil fields named after R. Trebs and A. Titov; in November 2014, cumulative production reached 1 million tonnes. Trebs and Titov fields should give their maximum 4.8 million tonnes of oil per year in 2020.

Figure 3.13 The Prirazlomnaya platform was installed in the Pechora Sea in August 2011 and started commercial oil production in December 2013. The first shipment of the Arctic crude oil was done in April 2014. Prirazlomnoye oil field will be in production for 25 years.

The license for the development of the Prirazlomnoye oil field belongs to the Gazprom Neft Shelf Company (former Sevmorneftegaz), a subsidiary of Gazprom Neft.

Prirazlomnoye oil field was put in commercial production in December 2013. The first shipment of crude oil of a new blend ARCO (Arctic Oil) was done in April 2014. Crude oil from Prirazlomnoye has been shipped for export westwards via the Barents Sea. It can also be sheep eastwards through the Northern Sea Route.

The major part in the future oil shipment in the Pechora Sea is linked to the production at Dolginskoye oil field discovered in 1999. The field is located 90-110 kilometres north of the Nenets Autonomous District coast at sea depths of 30-50 metres. It is the largest among discovered oil fields in the Pechora Sea. The license for oil exploration and production at this field was given to Gazprom in 2005. Now, the license belongs to Gazpromneft-Sakhalin, a subsidiary of Gazprom Neft. In 2014, Gazpromneft-Sakhalin, continued geological exploration of the field – drilled and tested a new (fourth) well using the GSP Saturn jack-up rig, and received a flow of liquid hydrocarbons and also a gas flow that reached 1.5 million cubic metres per day. Initially, recoverable oil reserves (C_1C_2) in Dolginskoye field were estimated at over 200 million tonnes.

In 2014, Gazprom Neft and PetroVietnam agreed to form a joint venture for implementing exploration, production and development projects at the Dolginskoye field and Severo-Zapadniy license block in the eastern Barents Sea.

Another joint venture is established by Rosneft and PetroVietnam to work on Yuzhno-Russkiy and Zapadno-Matveevskiy licensed blocks in the Pechora Sea. Hydrocarbon reserves (C_1C_2) of these two blocks are estimated to 13 million tonnes of oil and 52 billion cubic metres of gas, and resources to 367 million tonnes of oil and 64 billion cubic metres of gas.

Geological exploration is planned by Rosneft on six more licensed blocks in the Pechora Sea – Russkiy, Severo-Pomorskiy-1 and -2, Pomorskiy, Medynsko-Varandeyskiy and Yuzhno-Prinovozemelskiy. In 2014, seismic studies were carried out on Zapadno-Matveevskiy and Yuzhno-Prinovozemelskiy blocks. Exploration drilling is planned on Yuzhno-Russkiy block in 2016-2017.

Rosneft carried out geological exploration works on other licensed blocks in the Barents Sea. In 2013, the company in cooperation with Italian Eni did seismic studies on two out of three blocks in the former disputed area on the boarded with Norway – Fedinskiy and Tsentralno-Barentsevskiy. Seismic studies on the third, northernmost block – Perseevskiy, where Rosneft cooperates with Statoil, were carried out in 2014. That year, Rosneft also worked on Zapadno-Prinovozemelskiy block with estimated recoverable resources to 1.4 billion tonnes of oil and gas condensate, and 1.9 trillion cubic metres of gas.

Figure 3.14 GSP *Saturn* jack-up rig (photo) of the Romanian company GSP Offshore worked in the Pechora Sea for Gazpromneft-Sakhalin drilling and testing an exploration well at Dolginskoye field during summer 2014.

The Kara Sea

The Kara Sea shelf is also rich of hydrocarbon resources. The new oil field was discovered with the first exploration well drilled by Karmorneftegaz, a joint venture of Rosneft and ExxonMobil, at Vostochno-Prinovozemelskiy-1 licensed block in the Kare Sea in 2014.

The Russia's northernmost well (74° North) was drilled at Universitetskaya structure, 250 kilometres northwest of Yamal and 100 kilometres east of Novaya Zemlya coasts at the sea depths of 81 metres. Exploration drilling started in August 2014 using the West Alpha semi-submersible rig of the Norwegian company North Atlantic Drilling. In September 2014, Rosneft announced discovery of a new oil and gas condensate field and named it "Pobeda" (the Victory). The discovery was made when USA and EU banned technology assistance to Russian Arctic offshore. The gas-and-oil field Pobeda has been included in the Russian state register with reserve estimates (C_1C_2) to 130 million tonnes of oil and almost 500 billion cubic metres of gas. Karmorneftegaz planned to drill the Universitetskaya-2 exploration well in 2015. Those plans have been changed and drilling ExxonMobil suspended its cooperation with Rosneft due to sanctions, and Karmorneftegaz terminated contracts with western suppliers. Rosneft plans to drill the second exploration well at Universitetskaya in 2016 and continue geological exploration of licensed blocks in the Kara Sea.

Figure 3.15 Pobeda gas-and-oil field was discovered in September 2014 with the first exploration well drilled at Universitetskaya structure in the Kara Sea using West Alfa rig (photo) of the North Atlantic Drilling. The rig was contracted by Karmorneftegaz, a joint venture of Rosneft and ExxonMobil.

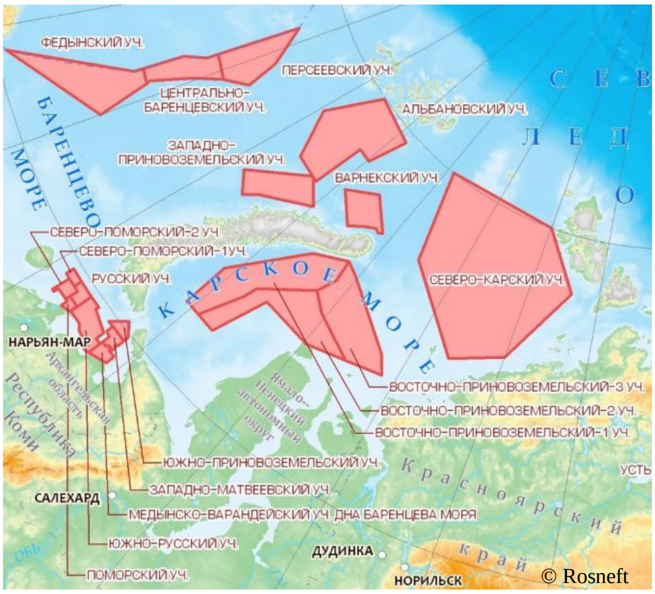


Figure 3.16 License blocks in the Barents, Pechora and Kara Seas owned by Rosneft (map fragment).

3.3.3 GAS PRODUCTION PROSPECTS FOR THE RUSSIAN WESTERN ARCTIC SHELF

Huge hydrocarbon resources discovered and prospected in the Barents, Pechora and Kara Seas are a driving force for future industrial development of the Russian Western Arctic regions. The Shtokman gas and condensate field in the Barents Sea is one of the biggest in the Russian Arctic shelf. The field development project was highly prioritised by authorities and companies in the beginning of 2000s. Now, the project is in another negotiation phase. A high priority is given to Yamal Peninsula and its adjusted shelf areas in the Kara Sea. Russian gas monopolist Gazprom is the owner of Shtokman, where it keeps cooperation with Total, and most of Yamal projects. The biggest Russian oil company Rosneft has started exploration of the Kara Sea shelf in alliance with ExxonMobil. The second largest Russian gas producer NOVATEK went for cooperation with Total and Chinese CNPC on developing Yamal LNG project.

Shtokman, the Barents Sea

The Shtokman project has been prioritised by the authorities and companies, discussed on the political arena and highlighted in media since yearly 2000s. The project development has several challenges – economical, technological, environmental and political. Discussion on a high

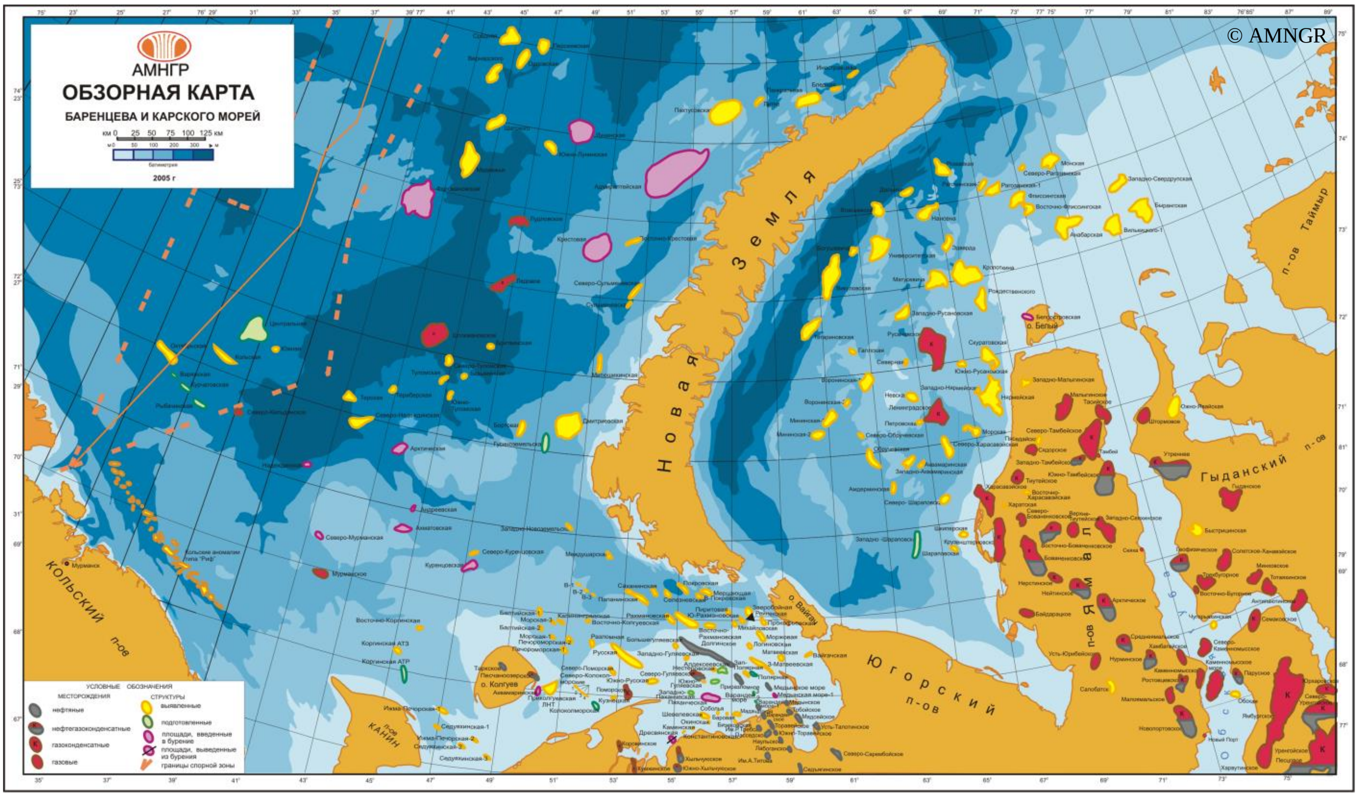


Figure 3.17 Petroleum resources of the Russian Western Arctic shelf (Note: AMNGR map of 2005 edited by authors marking the delimitation line established in the Barents Sea in 2011).

level resulted in 2007 with signing agreements and establishment cooperation between Russian Gazprom, French Total, and Norwegian Statoil at the Phase 1 of the Shtokman field development. In 2008, the Shtokman Development AG was established with 51% shares of Gazprom, 25% of Total, and 24% of Statoil. In 2012, Statoil returned its shares in the Shtokman Development to Gazprom; and in 2015, Total did the same.

Shtokman gas and condensate field was discovered in 1988. The field is located in the central part of the Russian sector of the Barents Sea shelf, at local sea depths of 320-340 metres about 600 kilometres northeast of the city of Murmansk.

The proven reserves (C_1C_2) of the field make up 3.9 trillion cubic metres of gas and 56 million tonnes of gas condensate.

Gazprom holds the exploration and production license for the Shtokman field. Shtokman Development AG, a joint venture of Gazprom and Total will be the owner of the phase 1 project infrastructure during 25 years, starting from the date the field is put on stream

According to the field development solution proposed, annual gas production during the phase 1 of the project should be on the level of 23.7 billion cubic metres of natural gas that will be split for producing 7.5 million tonnes of LNG, and piping 11 billion cubic metres southwards. According to the plans announced in 2011, the supply via the pipeline was to start in 2016, and LNG supply in 2017. The pipeline from Shtokman field was planned to Teriberka, and then to Volkhov to join Nord Stream Gas pipeline. The LNG plant is to be built in Teriberka, 100 kilometres east of Murmansk.

The Shtokman project was planned to be developed in three phases – each for production of 23.7 billion cubic metres of natural gas per year. When the Shtokman project runs on a full scale, the yearly production at the field can be on the level over 70 billion cubic metres of natural gas and 0.6 million tonnes of gas condensate.

The investment decision for the Shtokman project has been postponed several times. Statoil left the project in 2012; after that, Gazprom and Total continued discussions on the project development, but Total pulled out in 2015.

In 2008, Vyborg Shipbuilding Plant started construction of two semi-submersible drilling rigs for Gazflot, a subsidiary of Gazprom, to drill production wells on the Shtokman field. Samsung

Figure 3.18 ***Polyarnaya Zvezda*** **(Polar Star) and** ***Severnoye Siyanie*** **(Northern Light) semi-submersible floating drilling rigs were initially constructed for Shtokman project. In 2014, both rigs worked on Sakhalin-3 project in the Okhots Sea. Photo: two rigs on the road.**

Heavy Industries constructed the topsides of the platforms. The first drilling rig, *Polyarnaya Zvezda* (Polar Star), was delivered in 2010, and the second one, *Severnoye Siyanie* (Northern Light), in 2011. While the Shtockman project was postponed, *Polyarnaya Zvezda* and *Severnoye Siyanie* worked on Gazprom's Sakhalin-3 project in the Okhotsk Sea (see Figure 3.18).

New perspectives for joint oil and gas projects between Russia and Norway were opened with the maritime delimitation treaty that was signed in 2010 and ratified in 2011. The treaty establishes the boundary between two countries in the Barents Sea and the Arctic Ocean. Rosneft and Statoil have established partnership for geological exploration of licensed blocks on both – Norwegian and Russian parts of the Barents Sea.

Yamal and the Kara Sea

Future of Russia's gas production is linked to Yamal Peninsula and the Kara Sea shelf resources.

The Yamal Peninsula is a strategic oil-and-gas bearing region of the country. 32 hydrocarbon fields have been discovered on the Yamal Peninsula and its adjacent offshore areas, including 26 onshore, four in the Ob Bay and two in the Kara Sea with recoverable reserves (ABC_1C_2) and resources (C_3) estimated to 26.5 trillion cubic metres of natural gas, and 1.64 billion tonnes of oil and gas condensate.

Gazprom Group holds the development licenses for gas fields Bovanenkovskoye, Kharasaveyskoye, Novoportovskoye, Kruzenshternskoye, Severo-Tambeyskoye, Zapadno-Tambeyskoye, Tasiyskoye and Malyginskoye. The Bovanenkovskoye field is the biggest one discovered in Yamal with recoverable gas reserves (ABC_1C_2) of 4.9 trillion cubic metres. The gas reserves (C_1C_2) of the Kruzenshternskoye field are estimated at 1.7 trillion cubic metres, and of Kharasaveyskoye at 2 trillion cubic metres. Both fields have onshore and offshore parts (see Figure 3.19). The license for the fourth largest Yamal gas field, Yuzhno-Tambeyskoye, with estimated recoverable reserves (C_1C_2) of 1.3 trillion cubic metres of natural gas is owned by NOVATEK.

With implementation of Gazprom's Yamal megaproject, the onshore fields are to be developed in three production zones – Bovanenkovo, Tambey and Southern. The Bovanenkovo production zone with three basic fields should give the total production up to 220 billion cubic metres of gas and up to 4 million tonnes of condensate per year. The

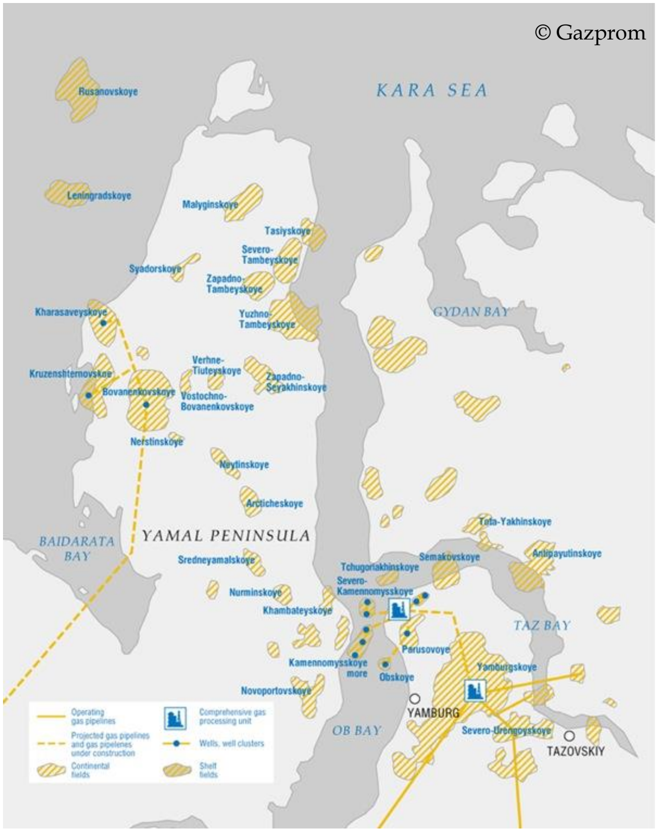


Figure 3.19 Gazprom has started implementation of the Yamal Megaproject – the long-term programme for development of area onshore on the Yamal Peninsula, and offshore in Ob and Taz bays and the southern Kara Sea. Bovanenkovskoye gas field, with gas reserves of 4.9 trillion cubic metres, is the largest discovered in Yamal.

Figure 3.20 Bovanenkovskoye gas and condensate field was put in commercial production in October 2012. More than 38 billion cubic metres of gas was produced at the field in 2014. The maximum gas production level of 115 billion cubic metres per year can be reached in 2017.

Tambey production zone with six fields is projected to produce up to 65 billion cubic metres of gas and up to 2.8 million tonnes of condensate per year. And the Southern production zone with nine fields will produce up to 30 billion cubic metres of gas and up to 7 million tonnes of oil per year.

Bovanenkovskoye gas field was put in commercial production in October 2012. In 2013, Gazprom Dobycha Nadym, a subsidiary of Gazprom, produced 22.8 billion cubic metres of gas on Bovanenkovskoye, and in 2014 38.4 billion cubic metres. The maximum gas production level of 115 billion cubic metres per year can be reached on the field in 2017.

Kharasaveyskoye gas and condensate field can be put on stream in 2018; and Kruzenshternskoye – in 2021. The maximum gas production level on each field is to be 32-33 billion cubic metres per year.

The development of prospected areas offshore Yamal in the Kara Sea is to start after 2025, and in 2030, Gazprom's annual gas production on Yamal and adjusted offshore areas can be on the level of 310-360 billion cubic metres.

Thus, the maximum annual gas production on Yamal is comparable to the volume of Gazprom's current gas supplies to the domestic market, and about a half of today's total natural gas production in Russia.

Most of gas produced in Yamal will be piped to the United Gas Supply System (UGSS) of Gazprom. Natural gas will also be delivered to LNG plant to be built in Yamal by the second largest Russian gas producer, NOVATEK, in cooperation with Total and CNPC.

Yuzhno-Tambeyskoye field located in the east of Yamal Peninsula and the adjusted offshore area in the Ob Bay will be the main gas reserve for Yamal LNG project. The plant will also receive natural gas from Gazprom's fields. In 2013, Gazprom and NOVATEK agreed to form a joint venture for LNG project development on Yamal.

The Government of the Russian Federation adopted the plan for LNG development in Yamal Peninsula in 2010. The LNG plant will be constructed in three phases and have the annual capacity of 16.5 million tonnes when completed. The launch of the first LNG train with the capacity of 5.5 million tonnes per year is planned for 2017.

Gazprom, as well as Rosneft, continues geological exploration of licensed offshore blocks in the Kara Sea. In 2014, MAGE contracted by Gazprom Geologorazvedka, carried out seismic studies on Skuratovskiy and Nyarmeyskiy blocks. Geological exploration works are also planned on Rusanivskiy, Leningradskiy, Severo-Kharasaveyskiy, Obruchevskiy and Nevskiy blocks in the Kara Sea.

The forecasts published in the General Scheme of gas industry development in Russia for the period to 2030, state that annual natural gas production in Yamal onshore can be on the level of 250 billion cubic metres; in Yamal offshore – 30-65 billion cubic metres; in Ob and Taz bays – 75 billion cubic metres in 2030.

Figure 3.21 Kharasaveyskoye gas and condensate field on the western coast of the Yamal Peninsula with estimated recoverable natural gas reserves of 2 trillion tons can be put in commercial production in 2018. Gazprom owns licenses for onshore and offshore areas.

3.4 OIL AND GAS INDUSTRY IN NORWAY

This article is based on fact reports about the Norwegian petroleum sector and press-releases published by the Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate (NPD), as well as the British Petroleum Statistical Review of World Energy released in 2014.

Oil and Gas Reserves and Production

The Norwegian Petroleum Directorate (NPD) estimated that at the end of 2014 the total discovered and undiscovered petroleum resources on the Norwegian continental shelf (see map on Figure 3.23) amounted to about 14.1 billion cubic metres of oil equivalent. 6.4 billion cubic metres of oil equivalent, or 45% of the total resources, have been produced. The total remaining recoverable resources are estimated at 7.7 billion cubic metres. Of this volume, 4.9 billion cubic metres have been discovered, while the estimate for undiscovered resources is 2.8 billion cubic metres. The remaining reserves at the end of 2014 totalled 2.96 billion cubic metres of oil equivalent.

The total growth in discovered resources in 2014 was estimated at 114 million cubic metres of oil equivalent, this was on the same level as in 2013. 45 exploration wells were completed in 2013 and 56 in 2014. Exploration drilling resulted with 20 new discoveries in 2013 (7 in the North Sea, 8 in the Norwegian Sea, 5 in the Barents Sea) and 22 in 2014 (8 in the North Sea, 5 in the Norwegian Sea, 9 in the Barents Sea).

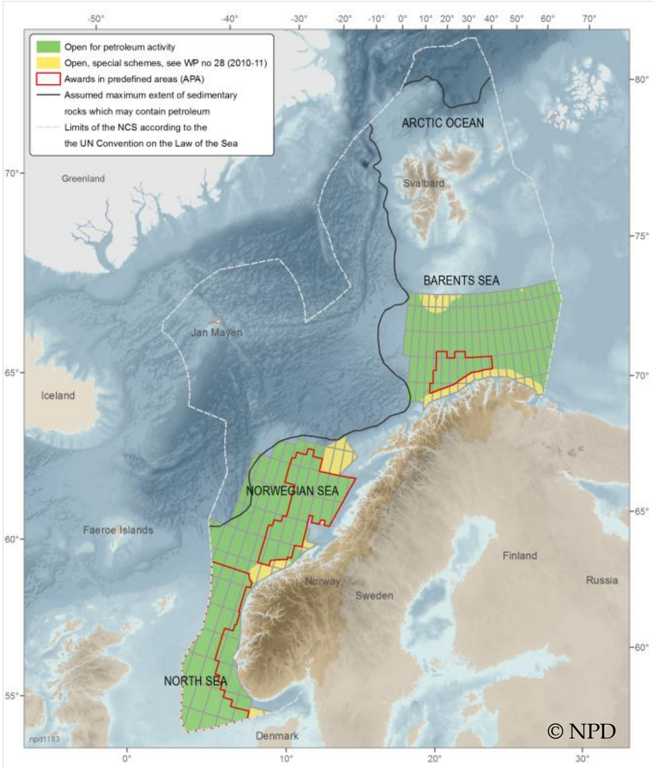


Figure 3.23 Area status on the Norwegian continental shelf, oil and gas fields and licensed blocks in the Barents Sea as of April 2015.

According to the BP Statistical Review of World Energy, at the end of 2013, proved oil reserves in Norway were estimated at 1 billion tonnes, or 0.5% of the world's total oil reserves of 238.2 billion tonnes. Proved natural gas reserves were estimated at 2 trillion cubic metres or 1.1% share of world's gas reserves of 185.7 trillion cubic metres. By these estimates, Norway was the nineteenth country in oil reserves and fifteenth in natural gas reserves.

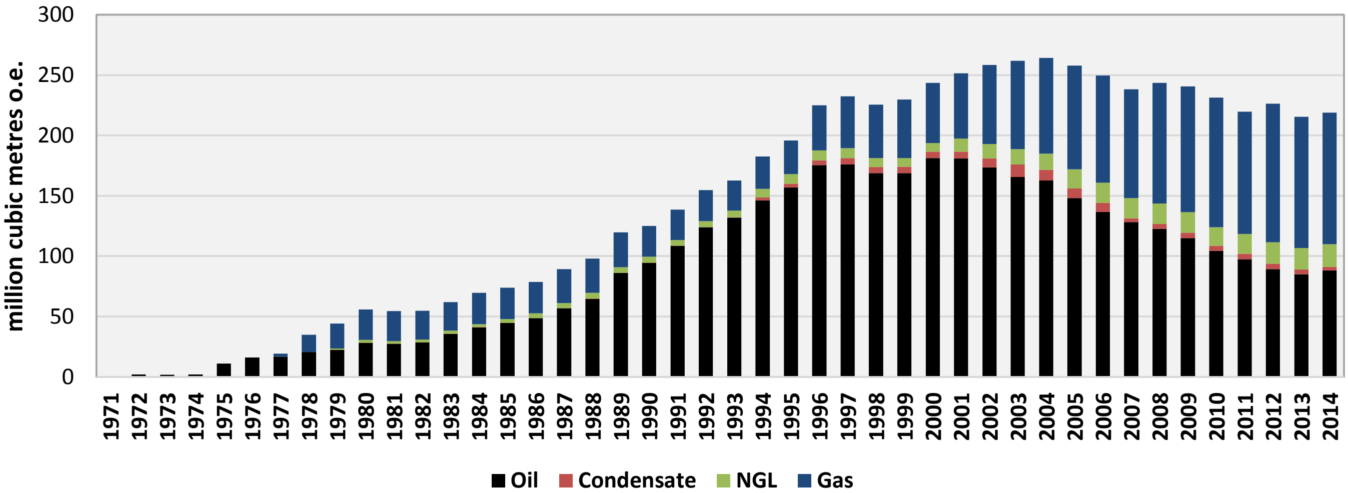


Figure 3.22 Total annual oil and gas production in Norway, 1971-2014 (Source: NPD).

Since production started on the Norwegian continental shelf in 1971, oil and gas have been produced from a total of 96 fields. 78 fields were in production in 2014, among them 61 in the North Sea, 16 in the Norwegian Sea and one in the Barents Sea. Four new fields came on stream in 2014.

In 2014, 216.7 million cubic metres of oil equivalent was produced on the Norwegian continental shelf, of which natural gas accounted 50.2%, oil – 40.7%, and gas condensate and natural gas liquids (NGL) formed remaining 9.1%. Oil and gas production in 2014 declined on about 18% comparing to the record year 2004, when 261.1 million cubic metres of oil equivalent was produced, but rose by 1.4% comparing to 2013 (see Figure 3.22).

According to the BP Statistical Review, Norway was world's seventeenth largest oil producer in 2013 with 83.2 million tonnes or 2.0% share of world's 4130.2 million tonnes. The country was the eighth largest gas producer with 103.5 billion cubic metres or 3.2% share of world's 3369.9 billion cubic metres of natural gas produced in 2013.

NPD estimates that oil and gas production in Norway would continue to decline without new fields or considerable investments to improve recovery from existing fields. Taking into account development activities in recent years, petroleum production is expected to remain relatively stable for the next few years. Production from new fields that come on stream will compensate the decline in production from fields with depleting reserves.

At the end of 2014, according to NPD, 11 fields were under development – 9 in the North Sea, one in the Norwegian Sea and one in the Barents Sea; and over 90 discoveries could be considered for development. In addition, a high level of exploration activities is expected to be in new areas, including the former disputed area in the Barents Sea.

The Barents Sea

The Norwegian sector of the Barents Sea is considered as an immature petroleum province. Snøhvit, which came on stream in 2007, is the only producing field developed so far. The gas from Snøhvit is transported by pipeline to Melkøya and further processed and liquefied to LNG, which is transported by sea tankers to market. The development plan for Goliat oil field was approved by the authorities in June 2009. The Goliat platform

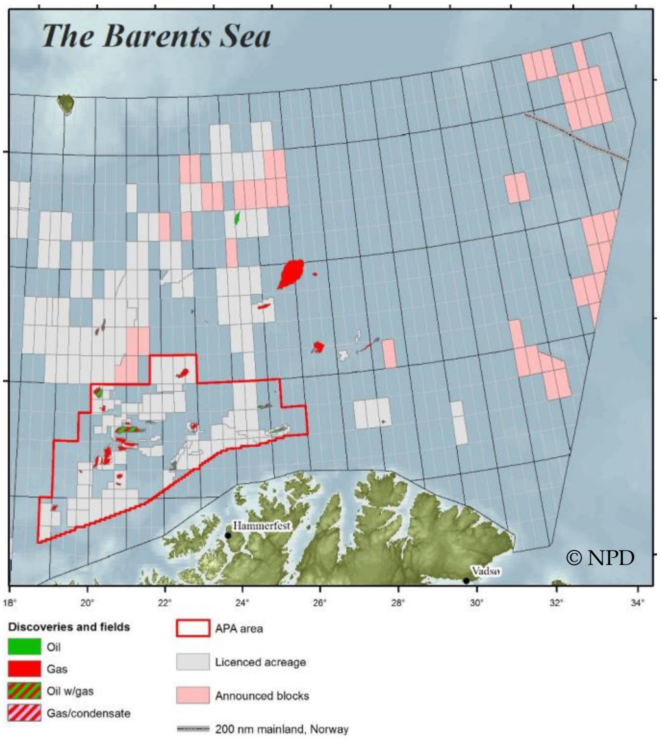


Figure 3.24 The Ministry of Petroleum and Energy of Norway in January 2015 announced the 23rd licensing round with 54 blocks in the Barents Sea.

arrived to the Barents Sea in 2015 and should start producing oil in 2016.

By the results of the recent license round in the Awards in Predefined Areas (APA), announced in 2014, 4 production licenses were issued in the areas in the Barents Sea.

20 licenses for new blocks in the Barents Sea were issued within the 22nd licensing round held in 2013. Russian companies Rosneft and LUKOIL got shares in three licenses. Rosneft got 20% share in the license where Statoil is operator; LUKOIL got 30% in the license operated by Centrica, and 20% in the one operated by Lundin.

In January 2015, the Ministry of Petroleum and Energy of Norway announced the 23rd licensing round. 54 blocks have been announced in the Barents Sea, most of them in the former disputed area on the border with Russia (see Figure 3.24). The new production licenses for these blocks will be awarded in 2016.

According to NPD, 7 million cubic metres of oil equivalent was produced in the Barents Sea (Snøhvit) in 2014. At the end of 2014, original recoverable petroleum resources in the Norwegian part of the Barents Sea were estimated at 1.7 billion cubic metres of oil equivalent, including 1.2 billion cubic metres undiscovered resources.

Oil and Gas Transportation

More than 90% of oil and gas produced in Norway is exported. According to BP Statistical Review, in 2013, the oil and gas consumption in the country were estimated at 10.6 million tonnes of oil and 4.4 billion cubic metres of natural gas. Norway is the third largest gas exporter in the world after Russia and Qatar. In 2014, Norway exported 70 million cubic metres of crude oil and 102.4 billion cubic metres of gas. Most of oil and gas were sold to European countries.

Crude oil from most of fields in the North Sea is offloaded directly to shuttle tankers that deliver cargo to European harbours. In some areas, oil and gas condensate are piped to onshore terminals: Sture, Mongstad and Kårstø in Norway or Teesside in the Great Britain (see Figure 3.25).

Most of Norwegian gas is exported to European countries by pipeline. In 2014, about 5 billion cubic metres produced at Snøhvit field in the Barents Sea was sold as LNG. The Norwegian gas pipeline network has a length of more than 8000 kilometres and a transport capacity of about 120 billion cubic metres per year (see Figure 3.25).

All licensees on the Norwegian shelf are responsible for selling oil and gas they produce. Statoil is also responsible for selling the governmental share of its oil and gas production.

The majority of the gas infrastructure on the Norwegian continental shelf is owned by the joint venture Gassled, while state-owned Gassco is the operator of the gas transport system.

Gassled represents the merger of gas transport facilities into a single partnership. The Gassled ownership agreement came in force in January 2003. At the end of 2014, Gassled was owned by the following companies: Petoro AS, Solveig Gas Norway AS, Njord Gas Infrastructure AS, Silex Gas Norway AS, Infragas Norge AS, Statoil Petroleum AS, Norsea Gas AS, ConocoPhillips Skandinavia AS, DONG E&P Norge AS, GDF SUEZ E&P Norge AS, and RWE Dea Norge AS.

Gassled facilities include: Europipe I, Europipe II, Franpipe, Norpipe, Oseberg Gas Transport, Statpipe, Tampen Link, Vesterled, Zeepipe, Åsgard Transport, Langeled, Norne Gas Transport System, Kvitebjørn Gas pipeline, Kollsnes gas processing plant and Kårstø gas and condensate processing plant. The receiving terminals for Norwegian gas in Germany, Belgium, France and the United Kingdom are, entirely or partly, owned by Gassled.

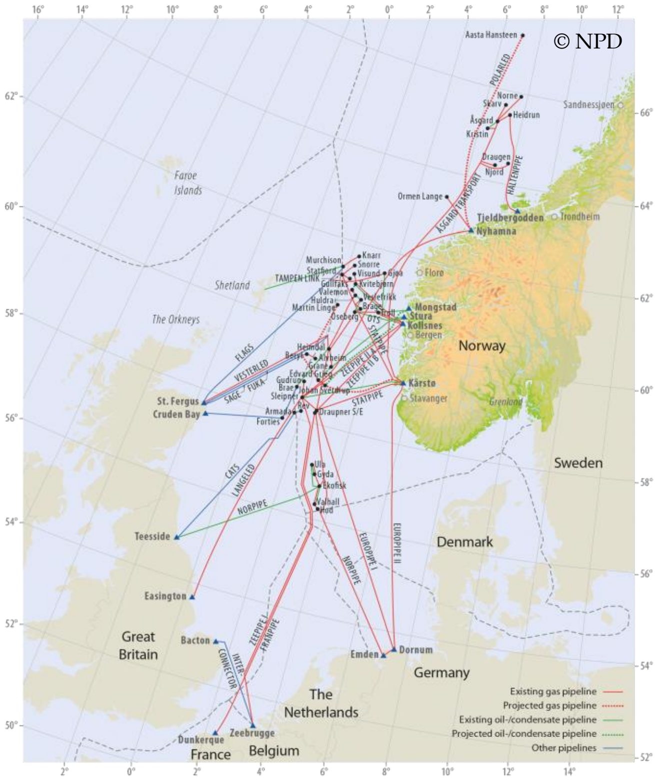


Figure 3.25 Gas, oil and condensate pipelines on the Norwegian continental shelf.

4 Oil and Gas Transport

The description of the transport system in Russia is based on the Transport Strategy of the Russian Federation in the period to 2030, the Strategy for Development of Sea Port Infrastructure of Russia to 2030, the federal programme Development of the Transportation System of Russia 2010-2020, reports and press-releases of the Ministry of Transport of Russia, Federal Service of State Statistics, information from media, and our previous reports on oil and gas transport.

The articles about railways were based on the information from the Russian Railways Company and its departments.

Description of the sea and river transport and ports was based on information of the Federal Agency of Sea and River Transport (Rosmorrechflot), Central Marine Research and Design Institute (CNIIMF), Atomflot and Sovcomflot. We also used information from the United State Information System on World Ocean conditions (ESIMO), news published by Portnews, Infoflot and Morflot agencies.

The description of oil and gas pipeline systems is based on information and news published by trunk pipelines monopolists Transneft and Gazprom and companies running key development projects.

Descriptions of oil loading terminals are based on our previous reports, Oil transport from the Russian part of the Barents Region, and updated using information from press-releases, reports and news of the companies-operators, port authorities, research and consultancy companies, regional information agencies, and local newspapers.

Russia transports petroleum using pipeline and railway, river and sea shipping routes. Trunk pipeline systems play the major role in delivering oil and gas for export.

According to forecasts of the Energy Strategy of Russia for the period to the year 2030, adopted in 2009, annual oil-and-gas production in 2030 should be on the levels of 530-535 million tonnes for oil and 885-940 billion cubic metres for gas. The total annual export volumes of oil and refined products should be on the levels of 315-330 million tonnes, including 222-248 million tonnes of crude oil; export volumes of gas should be at the levels of 349-368 billion cubic metres.

Table 4.1 World production and consumption of oil, including gas condensate, in million tons; and natural gas, excluding gas flared or recycled, in billion cubic metres, in 2013 (Source: BP Statistical Review).

Region -- Country	**Oil production**	***Share %***	**Oil consumption**	***Share %***	**Gas production**	***Share %***	**Gas consumption**	***Share %***
North America	**781.1**	***18.9***	**1024.2**	***24.5***	**899.1**	***26.9***	**923.5**	***27.8***
-- USA	446.2	*10.8*	831.0	*19.9*	687.6	*20.6*	737.2	*22.2*
-- Canada	193.0	*4.7*	103.5	*2.5*	154.8	*4.6*	103.5	*3.1*
South & Cent. America	**374.4**	***9.1***	**311.6**	***7.4***	**176.4**	***5.2***	**168.6**	***5.0***
-- Venezuela	135.1	*3.3*	36.2	*0.9*	28.4	*0.8*	30.5	*0.9*
Europe & Eurasia	**834.8**	***20.2***	**878.6**	***21.0***	**1032.9**	***30.6***	**1064.7**	***31.7***
-- Russia	531.4	*12.9*	153.1	*3.7*	604.8	*17.9*	413.5	*12.3*
-- Norway	83.2	*2.0*	10.6	*0.3*	108.7	*3.2*	4.4	*0.1*
Middle East	**1329.3**	***32.2***	**336.3**	***8.7***	**568.2**	***16.8***	**428.3**	***12.8***
-- Iran	166.1	*4.0*	92.9	*2.2*	166.6	*4.9*	162.2	*4.8*
-- Saudi Arabia	542.3	*13.1*	135.0	*3.1*	103.0	*3.0*	103.0	*3.1*
Africa	**418.6**	***10.1***	**170.9**	***4.1***	**204.3**	***6.0***	**123.3**	***3.2***
-- Nigeria	111.3	*2.7*	14.1	*0.3*	36.1	*1.1*	7.6	*0.2*
Asia Pacific	**392.0**	***9.5***	**1415.0**	***33.8***	**489.0**	***14.5***	**639.2**	***19.0***
-- China	208.1	*5.0*	507.4	*12.1*	117.1	*3.5*	161.6	*4.8*
-- India	42.0	*1.0*	175.2	*4.2*	33.7	*1.0*	51.4	*1.5*
-- Japan	0	*0.0*	208.9	*5.1*	0	*0.0*	116.9	*3.5*
WORLD	**4130.2**	***100.0***	**4185.1**	***100.0***	**3369.9**	***100.0***	**3347.6**	***100.0***

4.1 TRANSPORT SYSTEM IN RUSSIA

Russia traditionally has its most advanced transportation infrastructure in the European part of the country. According to the Ministry of Transport of Russia and the Federal Service of State Statistics (Rosstat), the total annual freight turnover in Russia, including pipelines, railway, automotive transport, inner waterways and sea shipping and aviation, increased with 63% for the recent 15 years. It rose from 3141 billion tonne-kilometres in 1998 to 5115 billion tonne-kilometres in 2013. In 2014, there was a small decline in freight turnover to 5110 billion tonne-kilometres with 11 billion tonnes of cargo transported (see Figure 4.1).

The value of transportation types is determined by their share in the total transportation flow. The major part of the cargo transportation activity in Russia belongs traditionally to pipelines and railways; that share respectively 47.4% and 45.6% in country's annual ton-kilometres freight turnover. In 2014, freight turnover of transportation types was (in billion tonne-kilometres): pipeline – 2423; railway – 2331; motor – 247; marine – 32 billion ton-kilometres; inner water-way – 72; and aviation – 5 (see Figure 4.2).

According to the Ministry of Transport, the major part of cargo volumes is transported by automotive transport. In 2014, automotive transport handled 5414 million tonnes of cargo; industrial railway – 3128 million tonnes; public railway – 1227 million tonnes; pipeline – 1077 million tonnes; inner water-way – 119 million tonnes; marine – 15 million tonnes; and aviation – one million tonne of cargo.

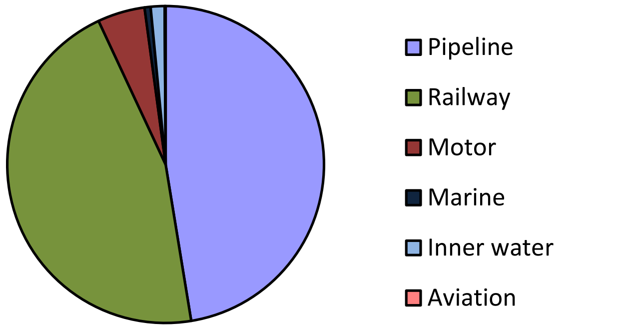


Figure 4.2 Shares in freight tonne-kilometres by types of transport in Russia in 2014 (Ministry of Transport)

The yearly volume of export-import cargo in Russia is more than 600 million tonnes with the major share (about 80%) of export cargoes. The main part of annual exports from Russia is comprised of fuel, including crude oil and refined products, natural gas, and coal. According to Russian Customs and Rosstat, the annual crude oil exports had more than two times increase from 1997 to 2004, growing from the level of 127 million tonnes in 1997 to 260 million tonnes in 2004; crude oil export volumes were on the levels of 240- 260 million tonnes in 2005-2012; then dropped to 237 million tonnes in 2013 and 223 million tonnes in 2014. Export volumes of refined products had a stable growth for the last 15 years, rising from 51 million tonnes in 1999 to 165 million tonnes in 2014.

According to BP Statistical Review, in 2013, Russia was the second largest oil producer (12.9% share) after Saudi Arabia (13.1%); and the fifth in oil consumption (3.7%) after USA (19.9%), China (12.1%), Japan (5.1%), and India (4.2%). That year, Russia was the second largest in both natural gas production (17.9%) and consumption (12.3%), after USA (20.6% and 22.2% respectively) (see Table 4.1).

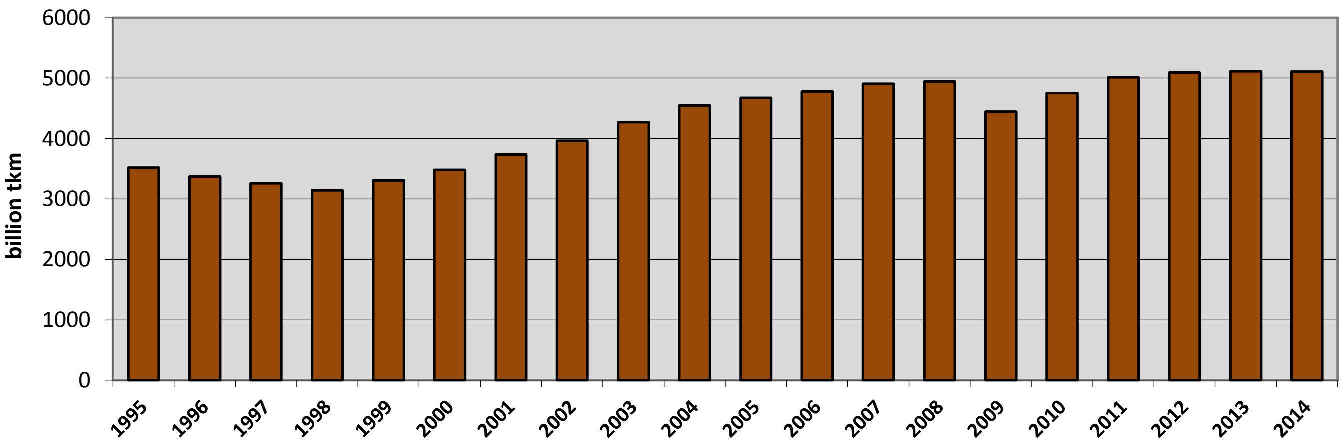


Figure 4.1 The total annual freight turnover in Russia in 1995-2014 (Source: Ministry of Transport, Rosstat).

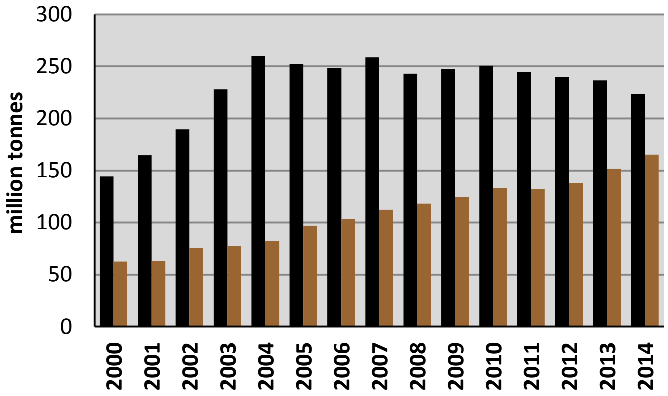


Figure 4.3 Annual exports of crude oil (black) and oil products (brown) from Russia (Source: Rosstat).

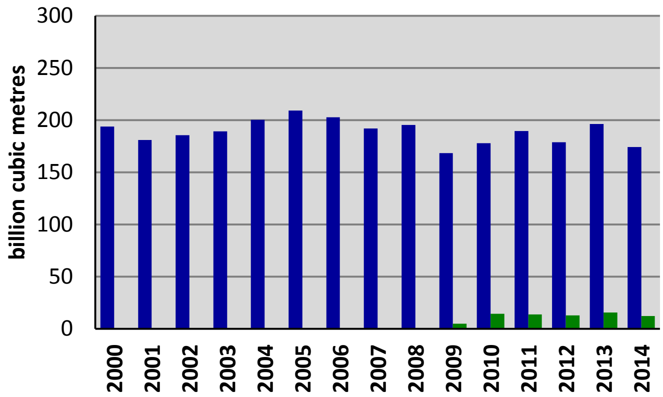


Figure 4.5 Annual exports of natural gas from Russia: dry (blue) and liquefied (green) (Source: Rosstat).

In 2014, Russia exported 223 million tonnes of crude oil; 165 million tonnes of oil products; 174 billion cubic metres of natural gas, and 8.5 tonnes or 20.5 million cubic metres of LNG (equal to 12 billion cubic metres of natural gas). Russian petroleum export volumes in 2014 versus 2013 decreased for crude oil, natural gas and LNG, and increased for oil products (see figures 4.3 and 4.5).

The Government of the Russian Federation adopted the Transport Strategy of the Russian Federation for the period to 2030, proposed by the Ministry of Transport, as well as approved the Federal Programme, Development of the Transport System of Russia in the period 2010-2015. The Federal Programme has been revised several times and extended to 2020.

In the Transport Strategy 2030, the Ministry of Transport gave three scenarios of the Russian transport system development: inertial, energy-resource, and innovation ones.

All three ways of the Russia's transport system development include:

- implementation of large transport projects ensuring resources development and hydrocarbon extraction in new production regions, like oil in Eastern Siberia and gas on the Arctic Shelf; and construction of trunk pipelines;
- transport infrastructure development for realisation of transit potential of economics;
- reconstruction and building up transport infrastructure securing transportation safety, modernisation of transport means;
- development of export infrastructure with focus on sea ports.

The energy-resource scenario of the transport system development also adds on among other directions:

- diversification of export routes for Russian hydrocarbon deliveries;

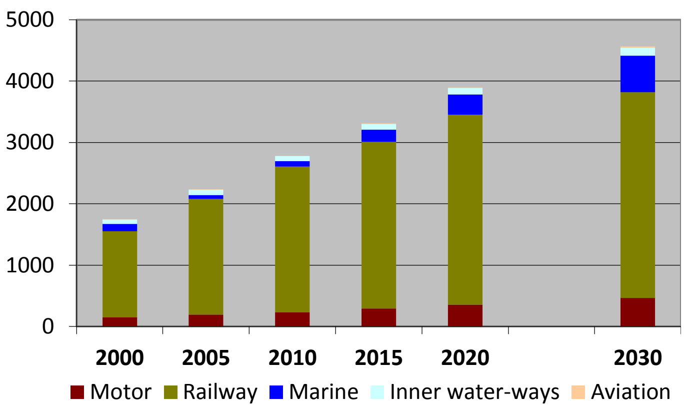


Figure 4.4 Dynamic of annual freight turnover, in billion tonne-kilometres, in Russia by the innovation scenario of the Transport Strategy 2030.

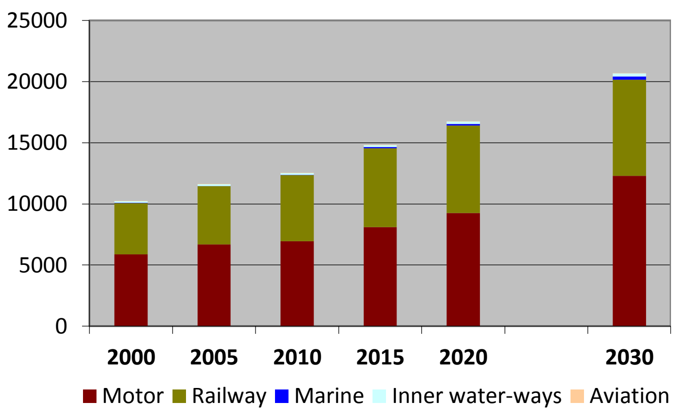


Figure 4.6 Dynamic of annual cargo volumes in million tonnes, to be transported in Russia by the innovation scenario of the Transport Strategy 2030.

Figure 4.7 Transport infrastructure of Russia in 2010-2030 according to the Transport Strategy of the Russian Federation for the period to 2030, adopted in 2008.

- increase of deliveries of processed goods, including oil products;
- establishment of specialised sea ports with logistic hubs.

The Ministry of Transport has prioritised the third, innovation way of the Russian transport systems development that in addition to above mentioned elements includes:

- increase of high technological products exports;
- increased role of transport-and-logistic infrastructure in goods transportation;
- development of large transport-and-logistic and production junctions in Northwest region, Southern region and Far East;
- development of the Northern Sea Route.

According to the new Russian Transport Strategy, in 2030 the annual volume of cargo deliveries by all public-use types of transport (excluding pipelines) should be on the levels 18-20 billion tonnes, with annual freight turnover on the levels 3.8-4.5 trillion ton-kilometres.

The Federal Programme Development of the Transport System of Russia in 2010-2020 consists of seven sub-programmes:

- development of export of transport services;
- railway transport;
- automotive transport;
- sea transport;
- inland waterway transport;
- civil aviation;
- state control and supervision in transport.

Each sub-programme consists of a number of big prioritised projects and parameters to reach on certain stages of the sub-programme implementation.

The project in the sub-programme Development of export transport services are grouped in the following main directions:

- development of transport corridor Transsib (West–East) on the way Europe–Russia–Japan with branches to China, Kazakhstan, Mongolia and Korean Peninsula;
- development of the transport corridor North–South on the direction Northern Europe–Russia–Iran–India with branches to Caucasus, Persian Gulf and Central Asia;
- development of the transport route Northern Europe–Asian Pacific with the Northern Sea Route;
- development of the international transport route Europe–Western China through Russia to the border with Kazakhstan.

The project of the infrastructure development of the Murmansk Transportation Junction is one of the prioritised investments projects within this sub-programme.

With the Federal Programme implementation, the annual transit cargo volume should grow from 30 million tonnes in 2009 to more than 50 million tonnes in 2020; and the annual cargo transhipment volumes in the Russian sea ports should rise from 500 million tonnes in 2009 to 635 million tonnes in 2015 and reach 863 million tonnes in 2020.

4.1.1 RAILWAYS

Railway transport is a main mean of public commercial deliveries in Russia. Primarily, it can be explained by the country's geographical features. The length of railway tracks puts Russia on the second place in the world after the USA. Operational length of the public use railways in Russia is more than 85 thousand kilometres, and the industrial ones – 42 thousand kilometres.

Both Russian public-use and industrial railways transport more than 3 billion tonnes of cargo per year. In 2014, public-use railways delivered 1227 million tonnes of cargo with major shares of coal – 315 million tonnes or 26% share, and petroleum – 257 million tonnes or 21%.

Figure 4.9 Railways share almost a half in total Russian freight tonne-kilometres. In 2014, public-use railways transported 1227 million tonnes of cargo, including 257 million tonnes of petroleum.

In Russia, 85% of the railways are located in the European part of the country. Historically, both the major communications networks and freight traffic in Russia were built around the country's export-imports to the west and south where large ports and the main trade partners were located. Now, Russia focuses on developing eastern directions.

Figure 4.8 The scheme of prospected development of railways in Russia (maximal scenario). Black-and-grey lines – existing railways; colour lines – planned and prospected railways. (Source: Russian Railways)

The October Railways

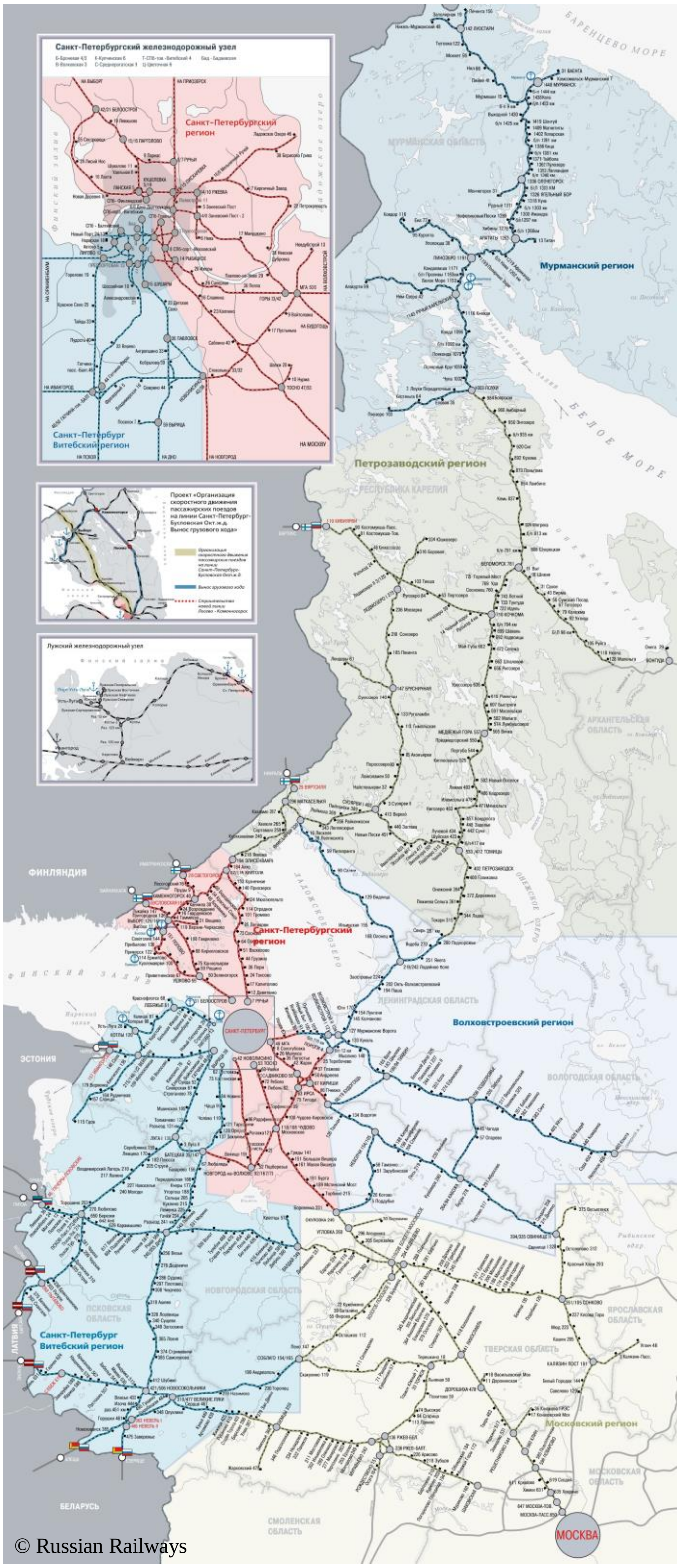
In 1851, Moscow–Saint Petersburg railway was put in operation. Today, this route is the fastest and major communication channel of the October Railways, a branch of the state public-use railway monopolist Russian Railways. The October Railways' main line goes from Moscow through Tver, Pskov, Novgorod, Leningrad, Vologda and Murmansk regions and the Republic of Karelia. It has the operational length of 10 371 kilometres and carries more than 200 million tonnes of cargo a year (276.9 million tonnes in 2014, according to the October Railways).

The railway carries 75% of all cargo volumes transported in the Northwest Federal District of Russia. The October railway shares about 40% of all export-import transports of the Russian railways. It delivers export cargoes to the ports of Saint-Petersburg, Vyborg, Vysotsk and Ust-Luga in the Baltic Sea; Vitino and Kandalaksha in the White Sea; and Murmansk in the Barents Sea.

Increasing export-import capacities of the Baltic Sea port terminals is of the strategic interest for Russia. Development of the Ust-Luga port terminals, including oil, gas condensate and coal ones, with the connected railway infrastructure has been one of the most prioritised investment projects of the Russian Railways the recent years. The plan is to increase the annual cargo transports approaching Ust-Luga by railway from 10 million tonnes in 2010 to almost 100 million tonnes in 2020.

Another important export direction is northwards to the Barents Sea ports. At present, the major part of freight traffic going north along the October railways is connected to fossil fuels – petroleum products and coal going for export.

Since 1995, the export oil was delivered to the Beloye More station – Vitino port in the White Sea; since 2004, export petroleum have been carried to the port of Murmansk; and since 2006 also further north to Mokhnatkina Pakhta near Severomorsk in the Barents Sea. There were plans to use railway for delivering petroleum cargo all the way to Pechenga in the northwest of the Murmansk Region close to the border with Norway, and to build new port facilities in Pechenga Bay of the Barents Sea.



© Russian Railways

Figure 4.10 The October railway goes from Moscow to the ports on the Baltic, White and Barents seas.

In 2003, the railway delivered to Vitino seaport almost 6 million tonnes of export crude oil (about 100 000 railway tank cars), and in each year in the period of 2008-2013, October railway carried 4-6 million tonnes of petroleum cargo northward to the export sea port terminals in the Murmansk Region. In 2014, less than one million tonnes of export oil products were delivered to Murmansk and Mokhnatkina Pakhta terminals; the gas condensate was redirected from Vitino to Ust'-Luga.

Figure 4.11 The October railways deliver export cargoes to the port terminals on the Baltic, White and Barents seas. The annual cargo transports approaching Ust'-Luga (photo) in the Baltic Sea by railway may reach 100 million tons in 2020.

Figure 4.13 Since 1995, the export oil was delivered by October railways to the Vitino port in the White Sea (photo). In 2003, Vitino shipped 5.7 million tonnes of oil for export; in 2014, it did not ship petroleum, as gas condensate went to Ust'-Luga in the Baltic Sea.

In 2005, the electrification of the October railways was completed all the way to the city and the port of Murmansk. Electrical power has given the possibility to enlarge the carrying capacity of cargo trains by 1.5 times.

The project on development of the Murmansk transport hub has been included in the federal target programme Development of the Transport System of Russia 2010-2020. The project consists of modernisation and construction activities divided on three phases. The first phase includes construction of the railway from Vyhodnoy station to Lavna on the western coast of the Kola Bay. The project is to be completed, then the freight turnover capacity of the Murmansk port should reach the level of 70 million tonnes per year.

The October Railways and the Northern Railways grids join on the borders of the Republic of Karelia and the Arkhangelsk Region, Tver and Yaroslavl regions, and in the Vologda Region.

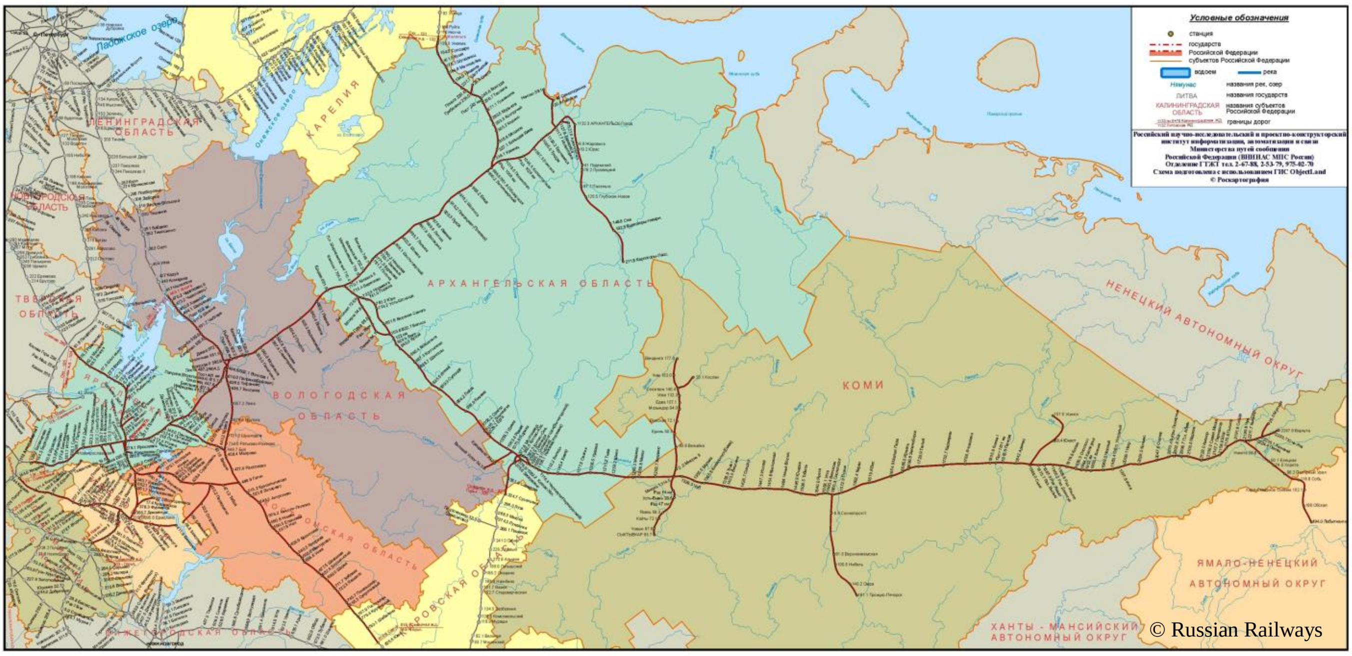


Figure 4.12 The Northern railways run in the Northern and North-Eastern Russia, through the territories of Yamalo-Nenets Autonomous Region, the Republic of Komi, Arkhangelsk, Vologda, Kostroma, Ivanovo and Yaroslavl regions. In 2014, the Northern railways transported 62.6 million tons of cargo, including 17.3 million tons of crude oil and petroleum products.

The Northern Railway

In 2018, the Northern railways will turn 150 years. The Northern railways go along the oldest animal-drawn path from Moscow to Arkhangelsk, which connected the north of the country with its central provinces back in 1500s. Nowadays, the Northern railways run in Northern and North-eastern Russia, through the territories of Yamalo-Nenets Autonomous District, the Republic of Komi, Arkhangelsk, Vologda, Kostroma, Ivanovo and Yaroslavl regions. The Northern railways has a favourable geographical position as it passes through the location of the major oil pipeline junction; the Ukhta-Yaroslavl-Kirishi trunk pipeline joins the pipeline that goes through Surgut-Yaroslavl-Polotsk. The Baltic Pipeline System originates in Yaroslavl.

According to the Russian Railways, the operational length of the road is 5961 kilometres and it carries between 60 and 70 million tonnes of cargo annually. In 2014, the Northern railways carried 62.6 million tonnes of cargo, where oil products shared about 28% (17.3 million tonnes), timber 14% (9 million tonnes, and coal 11% (6.9 million tonnes).

Figure 4.14 New rail lines are built for development of Yamal oil-and-gas resources. The lines will go to the large gas and oil fields in the peninsula and to new ports and terminals on the Kara Sea coast.

Figure 4.15 A 525-kilometres rail line between Obskaya and Bovanenkovo stations was put on stream in 2010. Photo: 4-kilometres long railway bridge via Yuribey River in Yamal Peninsula.

In 2014, Arkhangelsk port terminals received 2.8 million tonnes of export cargoes by railway, including 2.4 million tonnes of petroleum that was transhipped in Talagi terminal on the White Sea coast. While in 2005, the Northern railway delivered more than 4 million tonnes of export crude oil and products from Privodino in the south of the Arkhangelsk region and Yaroslavl to the terminal in Talagi.

Belkomur has been one of the most prospective projects for the Northern railways. It combines construction of a railway from Ural to the White Sea via the Republic of Komi, and a new deep-sea port in Arkhangelsk. According to the Strategy of development of railway transport in the Russian Federation to 2030, construction of Belkomur railway should be realised in 2016-2030.

By this strategy, a 612-kilometres long railway from Sosnogorsk in the Republic of Komi to Indiga in the Nenets Autonomous District, and a new port on the Barents Sea coast are also to be built in the period from 2016 to 2030. Another rail line should go from Vorkuta to Ust-Kara on the Kara Sea.

The Northern railways freight turnover will be significantly increased with development of Yamal oil-and-gas resources. Gazprom is implementing Yamal Megaproject that includes construction of 572-kilometres long Polar rail line from Obskaya to Bovanenkovo and Karskaya stations to connect the Northern railways with large gas fields. The 525-

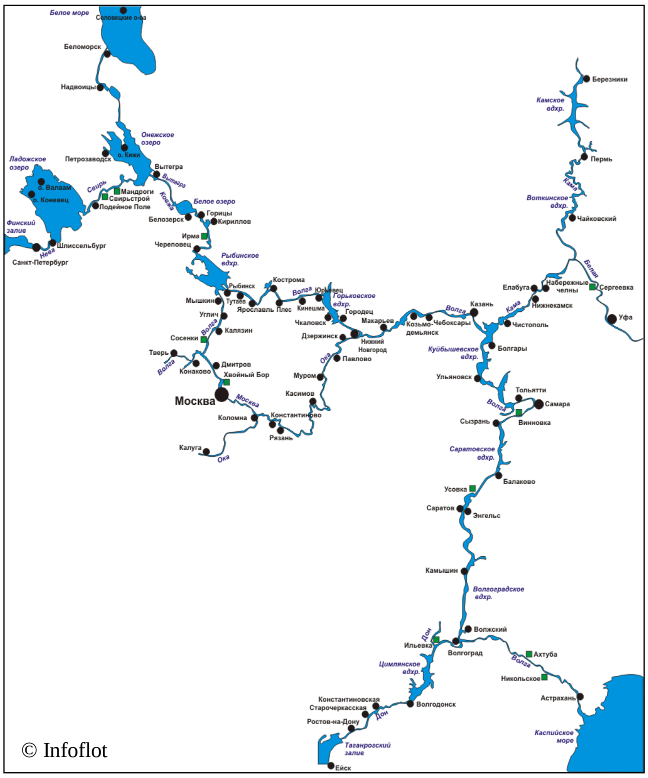


Figure 4.16 In the European part of Russia, the navigable rivers and canals connect the Azov, the Caspian, the Baltic and the White seas.

kilometres rail line from Obskaya to Bovanenkovo was put in operation in 2010. It is planned that rail lines will also go to Kharasavey on the western coast of Yamal and to Tambey and Noviy Port on the eastern coast (see Figure 4.14). A large multifunctional railway terminal will be built at Obskaya station of the Northern railway.

It is also planned to connect Northern and Sverdlovsk railways in the North building rail lines from Obskaya eastwards to Salekhard, Nadym, Noviy Urengoy, Igarka and Dudinka within the large Northern Latitudinal Passage project.

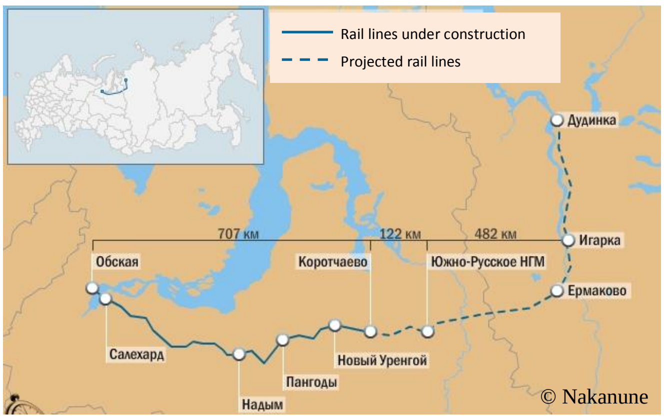


Figure 4.17 The Northern Latitudinal Passage rail lines should connect Obskaya and Dudinka.

4.1.2 INLAND WATER-WAYS

The length of the inland water-ways used in Russia for navigation on a regular basis totals 101 668 kilometres, more than a half of which, or 52 030 kilometres, according to statistical data of the Federal Agency of Sea and River Transport of Russia (Rosmorrechflot), is in rivers of Siberia and Far-East. The freight turnover of inland water-way transport accounted 72 billion tonne-kilometres in 2014. That year, 144 million tonnes of cargo was transported by rivers and canals. Petroleum cargoes share was 7%, or 10 million tonnes. 18 million tonnes of cargo, including 1.9 million tonnes of petroleum products, were delivered to the Far North regions.

The largest rivers of Siberia and the Far East are the Ob, the Irtysh, the Yenisey, the Lena, and the Amur. All these rivers serve the oil-and-gas industrial projects. In the European part of Russia, the major navigable river is the Volga, which incorporates other water routes: the Volga-Baltic and the Volga-Don canals (see Figure 4.16). The total extent of the Volga-Kama basin is 3500 kilometres. The annual turnover of goods transported by Volga-Kama basin amounts to 50% of the total inner water-ways transportation turnover in Russia.

In the Russian part of the Barents Region, the main navigable river is the Northern Dvina that carries cargo to Arkhangelsk and Kotlas. The Pechora River freights goods to Naryan-Mar and other Nenets Autonomous District settlements. The large Ladoga and Onego lakes are also used for cargo transportation.

The White Sea-Baltic canal played an important role in freight transportation to the north during the Soviet time. The canal was opened for navigation back in 1933. The first delivery of oil by the White Sea-Baltic canal took place in 1970, then the river-sea tanker *Nefterudovoz-3* of Volgotanker passed hundreds kilometres by Volga River, the White Sea-Baltic canal, and the White Sea and arrived Kandalaksha port in the Murmansk Region. The White Sea-Baltic canal was involved in export oil shipments in 2003; then Volgotanker delivered 220 000 tonnes of fuel oil by the canal to the Onega Bay of the White Sea where cargo was transhipped into sea tankers and carried for export. The operations were stopped due to oil spill accident happened in September 2003 (see the 2005 report).

During the recent 15 years, river tankers also delivered crude oil by Lena and Ob rivers to terminals in Laptev and Kara seas, where oil was transhipped to sea tankers and sent for export via the Barents Sea.

According to Rosmorrechflot, at the end of 2014, the river fleet of Russia accounts 24 737 ships with a total deadweight almost 9 million tonnes. The average age of river-sea class ships exceeds 30 years.

According to the Russian Transport Strategy – 2030 innovation scenario, the annual cargo volume transports by the inland waterways should reach the levels of 203 million tonnes in 2020, and 262 million tonnes in 2030. And the Federal programme of the transport development states that 110 new ships should be delivered for the river fleet of Russia in the period of 2010-2020, including 31 tankers to replace *Volgoneft*-type ones. The reconstruction of the White-Sea Baltic canal, with modernisation of 15 out of 19 water-locks, is also planned within the programme.

4.1.3 SEA TRANSPORTATION

The first seaport of Russia, Arkhangelsk, had its 430th year anniversary in 2014. At the end of 2014, the sea transportation system of Russia accounted 67 seaports, including 18 along the Arctic coast – from Beringovsky and Provideniya in the east to Vitino and Murmansk in the west.

The cargo turnover of the Russian seaports has grown steadily during the recent decade. According to the Federal Agency of Sea and River Transports of Russia (Rosmorrechflot), in 1999, the annual cargo turnover was 162 million tonnes; in 2010, it exceeded 500 million tonnes; and in 2014 it reached 623 million tonnes. In 2014, 85% of the Russian import-export sea cargoes were handled in the Russian ports and 15% in foreign ones, versus 46% and 54% respectively in 2000.

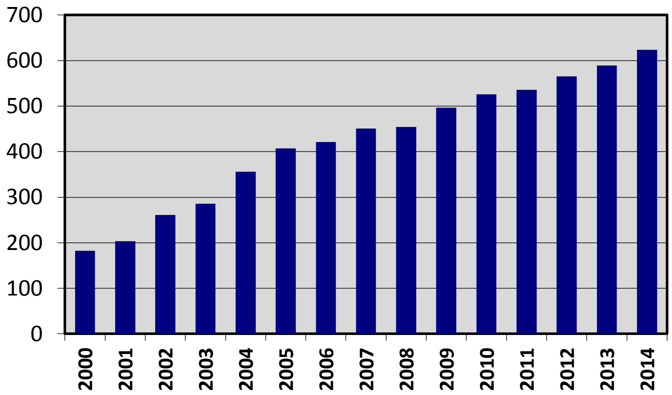


Figure 4.18 Annual cargo turnover of the Russian seaports, million tonnes (Source: Rosmorrechflot).

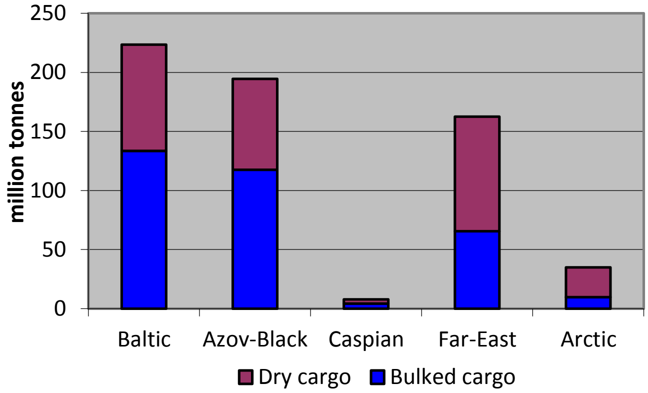


Figure 4.19 Structure of cargo turnover in the Russian seaports in 2014 by regional sea basins (Source: Association of Sea Ports of Russia).

Bulked cargo formed about 53% of the volumes shipped in the Russian seaports, or 331 million tonnes in 2014, including 187 million tonnes of crude oil, 128 million tonnes of refined products and 12 million tonnes of LNG. Coal with 116 million tonnes was the biggest dry cargo transhipped. Export cargoes shared about 79% of total annual turnover or 492 million tonnes, import cargoes – 7% or 43 million tonnes.

The Baltic region seaports take the leading position in the ports cargo turnover. In 2014, the Baltic seaports transhipped 223 million tonnes of cargo (or 36% of the Russian seaports freight turnover), where Ust'-Luga handled 76 million tonnes, Saint-Petersburg – 61 million tonnes, and Primorsk – almost 54 million tonnes. The Azov-Black Sea ports transhipped 195 million tonnes (31%), where Novorossiysk was the biggest with 122 million tonnes. The Far-East region ports transhipped almost 163 million tonnes (26%). Caspian ports handled less than 8 million tonnes.

The Arctic seaports transhipped 35 million tonnes of cargo in 2014 that was 24% less than in 2013 when they handled 46 million tonnes. Decrease in annual cargo turnover came due to drop of petroleum cargo transhipped in the ports of Murmansk (from 10.9 million tonnes in 2013 to 1.4 million tonnes in 2014); Arkhangelsk (from 2.8 to 2.4 million tonnes), and Vitino (from 2.3 million tonnes to 0). Varandey increased crude oil shipments from 5.4 to 5.9 million tonnes.

According to Rosmorrechflot, the total capacity of 67 seaports of Russia accounts about 900 million tonnes. In 2014, the overall capacity was increased with 22.5 million tonnes with construction of new facilities in the ports of Murmansk (increase with 2 million tonnes), Ust'-Luga (6.5), Vysotsk (4.5), Kaliningrad (3.5), Novorossiysk (5), Taman (0.5) and Temryuk (0.5).

In the "Transport Strategy of the Russian Federation for the period to 2030", the priority is given to the increase of seaports' capacities. According to the innovation scenario of the Transport Strategy – 2030, the volume of annual cargo turnover in the Russian seaports should reach the level of 1025 million tonnes in 2030.

Development of port capacities in the Russian part of the Barents Region is directly connected to the increase of hydrocarbon exports. In 2010, the seaports of Varandey, Arkhangelsk, Vitino and Murmansk, directly or through the offshore terminals in the open areas of the Barents Sea, exported 15 million tonnes of crude oil and petroleum products. In 2011-2014, annual volumes of hydrocarbons exported to the western market through the Barents Sea were between 10 and 15 million tonnes. With implementation of oil-and-gas and infrastructure development projects in the North, the Russian Arctic ports may have capacities to tranship up to 100 million tonnes of liquid hydrocarbon products annually.

The Russian controlled transport fleet, at the beginning of 2015, accounted 1387 ships with the total deadweight of 20.3 million tonnes, as stated in Rosmorrechflot report. In 2014, there were built 19 new transport ships for Russia with a total deadweight of 600 thousand tonnes.

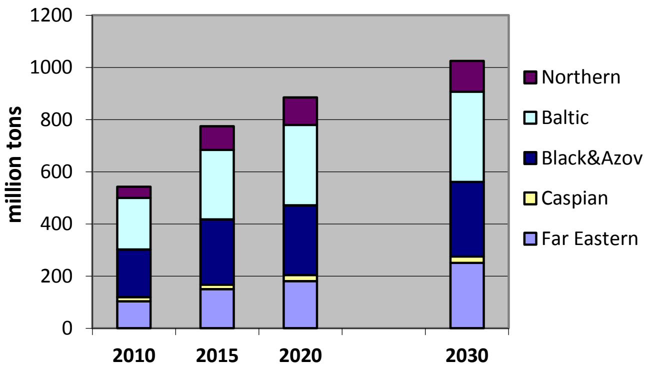


Figure 4.20 Prospected annual cargo turnover of the Russian seaports by basins, according to the Transport Strategy – 2030.

Figure 4.21 In 2010, Sovcomflot, the world's number one operator of the Arctic shuttle tankers, received two 70 000 tonnes deadweight double acting ice-class tankers, *Mikhail Ulyanov* and *Kirill Lavrov*, built at the Admiralty Shipyards in St Petersburg. In 2015, these tankers were serving Prirazlomnoye project delivering Arctic crude oil from the Pechora Sea to the Western Europe. Photo: *Mikhail Ulyanov* receives oil from Prirazlomnaya platform.

State owned Sovcomflot Group is the largest Russian shipping company, the world's second biggest tanker operator by vessels number and the third by a total deadweight, the biggest operator of Aframax tankers, and the number one Arctic shuttle tanker operator according to Clarkson agency. At the end of 2014, Sovcomflot's fleet comprised 152 vessels with a total deadweight of 12.7 million tonnes and an average age of tankers of 8 years. In 2012-2014, Sovcomflot received 15 new vessels from shipyards in Russia, Finland, Korea and China with an overall deadweight of 1.6 million tonnes. Two ice-class (Ice 2) LNG carriers *Velikiy Novgorod* and *Pskov* with a cargo capacity of 170 200 m^3 each, and a 321 200 deadweight tonnes VLCC SCF *Shanghai* – the largest tanker in Russia, joined Sovcomflot fleet in 2014. 10 more vessels with an overall deadweight of 423 thousand tonnes should be delivered by the end of 2017. Sovcomflot runs Baltic, Far Eastern and Arctic sea transportation of hydrocarbons serving such projects as Sakhalin-I, Sakhalin-II, Varandey, Prirazlomnoye. The company also plays an important role in utilising and developing the Northern Sea Route (NSR). In 2010, the first time in history a heavy-tonnage vessel – 117 000 tonnes deadweight Aframax tanker SCF *Baltica* carried 70 000 tonnes of gas condensate from the port of Murmansk in the Barents Sea to the Chinese port of Ningbo along the NSR assisted by nuclear

Figure 4.21 The ice-class (Ice-1A) seismic research vessel *Vyacheslav Tikhonov* was built for Sovcomflot in 2011. In 2014, the vessel was involved in seismic surveys in the Kara Sea (photo) carried out by Murmansk Marine Geological Expedition (MAGE) for Gazprom Geologorazvedka.

icebreakers *Taymir*, *Rossiya* and *50 Let Pobedy*. In 2011, the Sovcomflot's 162 000 tonnes deadweight Suezmax tanker *Vladimir Tikhonov* loaded with 120 000 tonnes of gas condensate made an NSR's deep-water route north of the New Siberian Islands on the way from Europe to Asia. The tanker was escorted by *50 Let Pobedy* and *Yamal* icebreakers. In 2014, Sovcomflot's research vessel *Vyacheslav Tikhonov* carried out geophysical exploration in the Kara Sea within the NSR water area.

Figure 4.22 The Russian Arctic navigation is supported by a total of nine icebreaker liners, including five nuclear-powered ones. The biggest in the world icebreaker, *50 Let Pobedy*, was completed in the Baltic Shipyard – Shipbuilding in St Petersburg in 2007 and delivered to state-owned Atomflot. Photo: *50 Let Pobedy* at the North Pole expedition.

The Northern Sea Route: Status and Prospects

The Central Marine Research and Design Institute (CNIIMF) report (extracts) to Akvaplan-niva by Alexander Buyanov, Head of the Marine Fleet Development Department.

The Development Strategy for the Arctic Zone of the Russian Federation defines the Northern Sea Route (NSR) as a national and international maritime artery oriented towards all-year-round navigation.

Covering the water area of the Exclusive Economic Zone of Russia between the Kara Gate in the West and the Bering Strait in the East, the NSR offers navigable paths to be followed based on the existing ice conditions, as well as fleet's capacity and icebreaking capability. The NSR runs for about 3500 nautical miles.

The fact that the efforts to foster the promotion of the NSR have become a national priority can be confirmed by the following documents elaborated and approved on the federal level during recent years: Framework for the Russian Federation National Policy for the Arctic until 2020 and beyond (approved on 18 September 2008); Strategy for the Development of the Arctic Zone of the Russian Federation and National Security Efforts for the period up to 2020 (approved on 20 February 2013); Federal Law Concerning Introducing Amendments to the Russian Federation's Acts Pertaining to the Governmental Regulation of Commercial Navigation Within the Northern Sea Route (dated 28 June 2012); Social and Economic Development of the Arctic Zone of the Russian Federation for the period up to 2020 (National Program approved on 21 April 2014); Rules of Navigation within the Water Area of the Northern Sea Route (approved on 17 July 2013).

The Arctic marine transport system comprises the following:

- The Northern Sea Route's water area (covering a set of several navigable waterways, see Figure 4.23);
- Fleet of transport ships, icebreakers and support vessels;
- Onshore infrastructure with its ports; navigation, hydrographic and hydro-meteorological support equipment; communications system; etc.

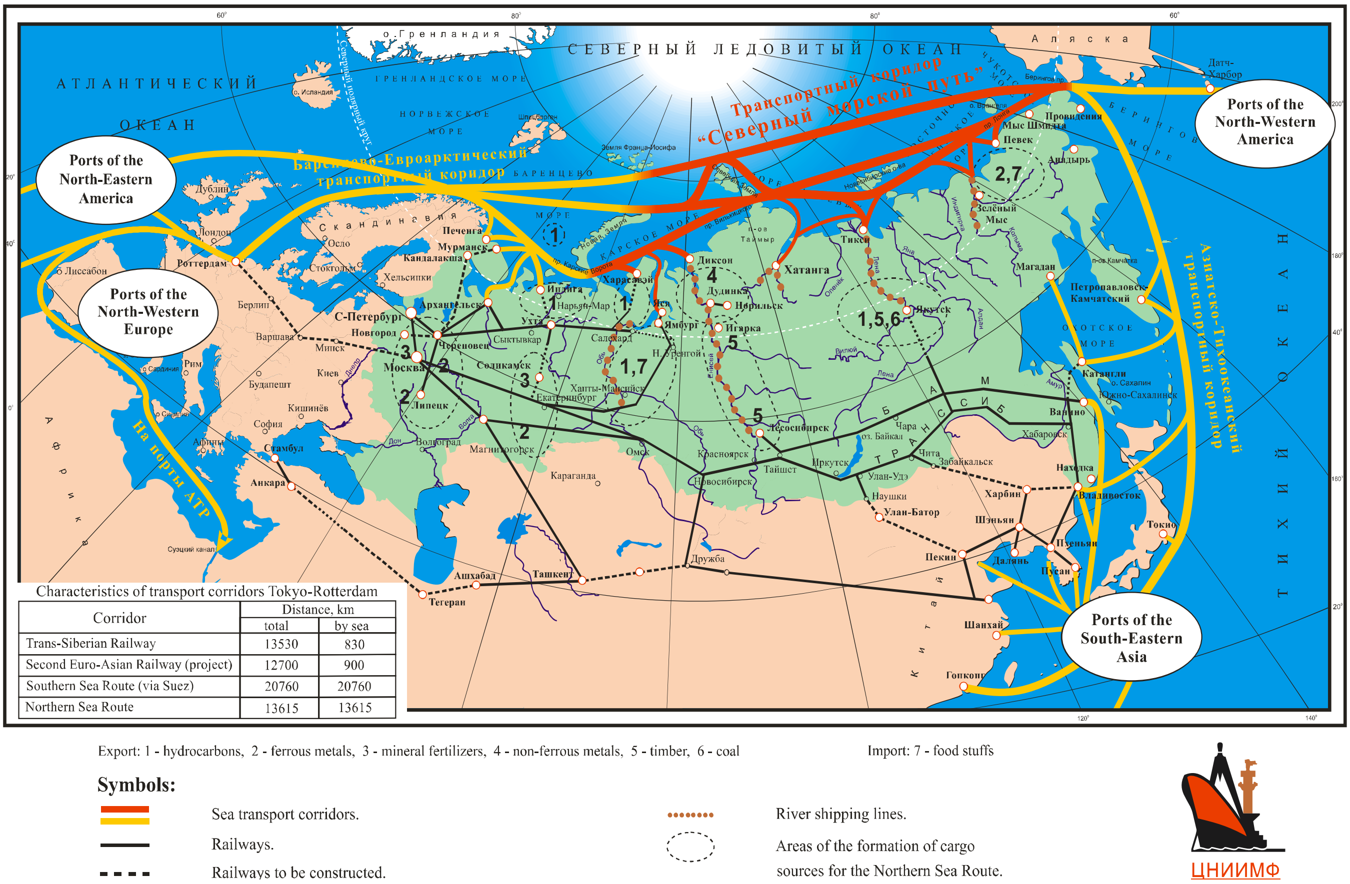


Figure 4.23. Navigable paths within the Northern Sea Route water area.

The most common navigation path along the NSR is the one running along the northern coast of Russia, flowing through a number of Arctic straits. It has been thoroughly studied navigationally and hydrographically, is covered by large-scale navigation charts and is sufficiently supported by navigational aids. This waterway is suitable for vessels with a maximum draft of 12 metres, as the Sannikov straits and the area around the Medvezhy Isles, the two major constraints, would be impossible for vessels with deeper drafts to pass.

Heavy-tonnage vessels, with deeper drafts, can use the paths running at higher latitudes, northwards off the New Siberian Islands. Navigationally, however, the higher latitude paths remain under investigated and require more hydrographic surveys.

Freight transportation within the Arctic waters requires carrier-icebreakers and icebreaker assistance. As for 2015, the Arctic transport fleet numbers 204 carrier ships with a total deadweight of 3.4 million tonnes. 174 of these, their deadweight

Table 4.2. Russia's transport fleet with ice-class Arc4-Arc7 (at the end of 2014).

Ice Class	Quantity	Deadweight, tonnes	Gross tonnage, GT
Russian flag			
Arc4	116	1 167 695	889 629
Arc5	43	290 189	293 193
Arc6	5	358 049	248 523
Arc7	10	177 049	166 035
Sub-total:	**174**	**1 992 982**	**1 597 380**
Foreign flags			
Arc4	24	1 225 991	702 965
Arc5	6	225 667	139 672
Sub-total:	**30**	**1 451 658**	**842 637**
TOTAL:	**204**	**3 444 640**	**2 440 017**

totalling 2.0 million tonnes, fly the Russian flag (see Table 4.2). The ships navigating the NSR waterways include supply vessels, timber carriers, tankers, bulk cargo and container ships. All of them have to be of appropriated ice-class (Arc4 to Arc7) and suitable for all-year-round operation in the Arctic environment.

New vessels are being built on order from shipping, petroleum and mining companies such as LUKOIL, Gazprom, Rosneft and Norilsk Nickel MMC (see Table 4.3). A total of 14 ships (9 tankers and 5 container carriers) have been built in recent years.

The demand in new vessels depends on project needs. To ensure transportation of Arctic hydrocarbons, the projects under development have either placed or planned to place orders for design and construction of:

- Arc 4, 170 000 m³ capacity LNG carrier for shipping gas from Sabetta – 12 vessels;
- Arc 7, 40 000 tonne deadweight tanker for shipping crude oil from Novy Port, Ob Bay – 6 vessels;
- Arc 7, 40 000 tonne deadweight tanker for shipping crude oil from a cluster of Payakha fields, the Yenisey River estuary – 4 vessels.

Given the ice conditions along the NSR, the navigational safety cannot but rely on a mighty fleet of icebreakers. As of 2015, the Arctic navigation is supported by a total of 9 icebreaker liners (5 nuclear- and 4 diesel-powered). Three more 60 MW nuclear-powered icebreakers are expected to join the Arctic fleet by 2020 (see Figures 4.24 and 4.25).

The design concept of new icebreaker has been developed by the Central Marine Research and Design Institute (CNIIMF). This multipurpose

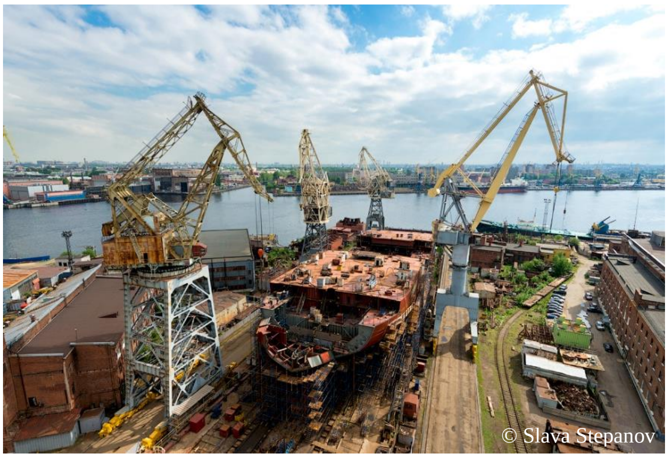


Figure 4.24 The first nuclear-powered 60MW icebreaker of LK-60 type should be completed and delivered to Atomflot in 2017. Photo: LK-60 under construction at the Baltic Shipyard - Shipbuilding in St Petersburg.

double-draft nuclear-powered icebreaker will be the first ever to navigate high seas and river estuaries, as it has two operating drafts of 10.5 and 8.5 metres. The first icebreaker of this type is being built by the Baltic Shipyard – Shipbuilding based in St Petersburg. The three new icebreakers will be able to replace five nuclear-powered icebreakers to be decommissioned before 2023, as they expire, including the three Arktika-type and the two Taimyr-type ones (see Figure 4.25 for timeline for decommissioning of Arktika- and Taimyr- and launching of LK-60-type icebreakers).

The prospects of the offshore development in the Arctic would require two more icebreakers of the above type to be built before 2030. The all-year-round navigation within the NSR and the offshore development efforts would also require a mother icebreaker with a shaft power of 110-130 MW. 2014 saw the start of its design phase.

Table 4.3. Major Russian companies owning vessels with ice-class Arc4-Arc7 (at the end of 2014).

Company name	Number of vessels	Total deadweight, thousand tonnes	Total gross tonnage, thousand GT	Mean age (by deadweight)
Sovcomflot, JSC	19	1237.2	753.0	7.6
Primorsk Shipping Company, JSC	7	587.8	323.7	6.3
Murmansk Shipping Company, JSC	19	369.7	272.2	24.3
Far Eastern Shipping Company, JSC	13	155.7	121.1	15.7
Norilsk Nickel MMC, JSC	6	110.0	101.2	5.6
Northern Shipping Company, JSC	22	109.0	95.7	23.7
Sakhalin Shipping Company, JSC	13	92.9	88.9	22.5
Rosneft, JSC	3	92.2	60.0	5.0
Vostokflot, LLC	6	54.1	43.9	31.1

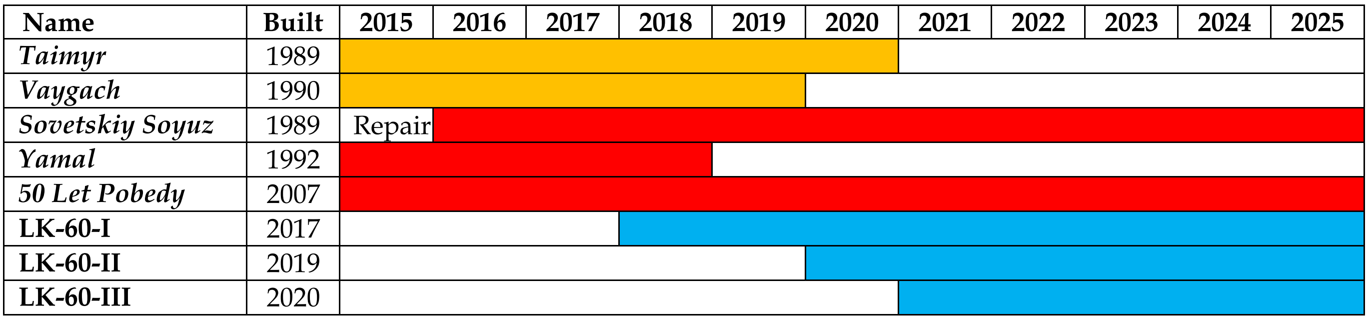


Figure 4.25. Planned timeline for decommissioning and launching nuclear-powered icebreakers in 2015-2025 (Source: Atomflot).

The key ports along the NSR include Igarka, Dudinka, Dikson, Tiksi, Pevek and Providenie. With exception of Dudinka, owned by Norilsk Nickel MMC, all the Arctic ports seem to remain the NSR's most underdeveloped assets, which is due to poor funding allocations received by them in prior periods. A set of measures to refurbish and promote the Arctic ports are currently under elaboration, some targeting the re-equipment of existing port facilities.

The freight volume levels along the NSR rely on the following transport processes: 'Northern Supply Haul' (delivery of good to Arctic territories); freight shipping and Arctic coastal navigation; Arctic offshore fields development; channelling of transit freight through the NSR (see Figure 4.26. for the dynamics of freight traffic on the NSR).

The maritime cargo flows bound for the ports and port locations along the NSR are coming either from the east or from the west. The most common cargoes include coal, sawn timber, constructional materials, food and vehicles. The outgoing cargo flows are mainly bound for the western destinations – via the ports of Murmansk and Arkhangelsk, or for export – like nickel matte, copper-nickel ore and non-ferrous metals being shipped from Dudinka. The major portion in the freight volume belongs to export hydrocarbons being sourced on the Arctic coast of Russia (see Figure 4.47 and Table 4.4 for 2013 freight flow volumes channelled through the port localities along the NSR).

2010-2014 saw the NSR in use again for transit carriages suspended in the early 1990s.

The revival of international commercial operations on the NSR was marked by a voyage from the port of Masan in the Republic of Korea to Yamburg roads in the Ob Bay of the Kara Sea undertaken in 2009 by two *Beluga* vessels assisted by two nuclear-powered icebreakers *50 Let Pobedy* and *Rossiya*. 2010 saw four transit voyages through the NSR in total – two carrying 70 000 tonnes of gas condensate and 41 000 tonnes of iron-ore concentrate, and the other two in ballast.

In 2011, the NSR was transited 34 times – by loaded or vessels in ballast and research ships. The giant *Vladimir Tikhonov* (Sovcomflot-owned,

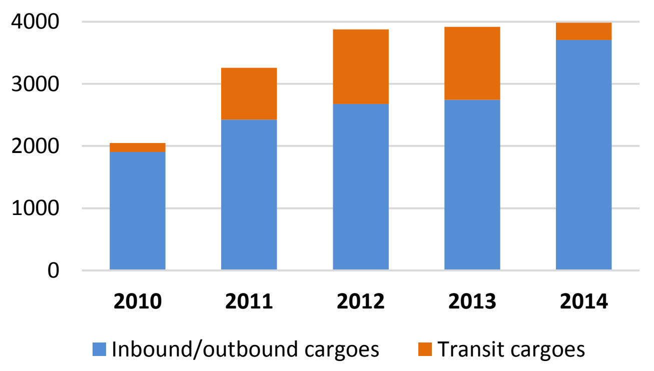


Figure 4.26 Dynamics of annual freight traffic along the Northern Sea Route in 2010-2014 (thousand tonnes).

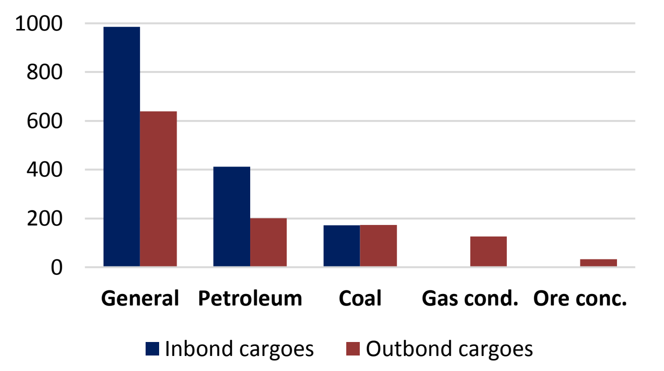


Figure 4.27 Freight volumes via ports and port locations along the Northern Sea Route by cargo types in 2013 (thousand tonnes).

Table 4.4 Freight flow volumes (outbound/inbound) via port locations along the Northern Sea Route in 2013 (tonnes).

Port/port locality	Outb.	Inbound	Total
Baydaratsky Bay	0	49 875	49 875
Dixon	21 196	21 895	43 091
Dudinka	764 071	430 430	1 194 501
Zeleny Mys (Kolyma)	65 340	69 930	135 270
Kara Sea (seaborne)	0	734	734
Cape Bykov (Lena)	6 482	5 867	12 349
Cape Bilings	0	5 148	5 148
Cape Zhelaniya	0	46	46
Cape Chelyuskin	0	1 909	1 909
Cape Schmidt	0	9 793	9 793
Naiba (Buor-Khaya)	0	7 708	7 708
Nizhneyansk	142 296	186 616	328 912
Numgi (Ob Bay)	110 702	0	110 702
Bolshevik Island	0	1 270	1 270
Pevek	61 892	257 709	319 601
Indigirka (bay bar)	0	27 567	27 567
Sabetta	0	398 401	398 401
Tiksi	1 756	33 193	34 949
Ust-Kara	0	1 481	1 481
Wellen	0	5 100	5 100
Khatanga	0	556	556
Yugorsky Shar	0	4 880	4 880
Yurung-Khaya (Anabar)	0	36 162	36 162
Yara-Yakha (Ob Bay)	0	12 830	12 830
Total:	1 173 735	1 569 098	2 742 834

162 000 deadweight tonnes) followed the high-latitude path west to east, carrying 120 800 tonnes of gas condensate to Thailand. Refrigerator ships also started to use the NSR as way to deliver fish from the Far Eastern region of Russia to Saint-Petersburg, four voyages were done in 2011.

46 transit voyages were performed in 2012, 33 loaded vessels carried 1.26 million tonnes of cargo. The NSR was for the first time navigated by the *Ob River* gas carrier that then transported 134 500 m^3 of LNG from Norway to Japan.

2013 saw 71 transit voyages carrying a total of 1.36 million tonnes of cargo, including the three Korea-bound shipments of gas condensate and fuel (see Figure 4.26 for the freight volumes transported along the NSR in 2010-2014).

Atomflot reported that nuclear-powered icebreakers piloted 129 vessels with a total gross tonnage of 1.7 million GT within the NSR in 2014. International cargo transits through the NSR accounted 274 thousand tonnes (see Figure 4.26).

Referring to the NSR as an Arctic transport system suggests that its sustainable operation would require a large-scale investment outlay seeking the construction of reinforced ice class ships, nuclear-powered icebreakers, as well as the refurbishment of the Arctic ports. The expensive maintenance of icebreakers, navigational and hydrographic facilities, and search and rescue teams is inevitable also.

The Strategy for the Development of the Arctic Zone of the Russian Federation 2020 targets the following operational sides of the Northern Sea Route which are seen as conducive to its functioning as an attractive transport corridor:

1. *Navigational safety assurance and management*

The efforts to assure the safety of navigation along the NSR involve establishment in March 2013 of Federal State-Financed "Administration of the Northern Sea Route". The NSR Administration's duties with immediate effect on the operations within the NSR include:

- organisation of navigation within the NSR;
- expert advice on navigation routes plotting based on weather, ice and navigational conditions.

Another document to govern the navigational safety assurance is the newly developed "Rules for Navigation within the Northern Sea Route", approved in July 2013 (hereinafter, the Rules of Navigation), which seeks revision of the entire governmental regulation of the navigation within the NSR.

Federal Law 132-FZ and the Rules of Navigation no longer oblige ship owners to use icebreaker assistance. The NSR Administration being responsible for navigation permits issuance, the decision as to using the icebreaker assistance is solely at the discretion of ship owners. Skipping the icebreaker assistance surely improves the cost-efficiency of ships but decreases the navigational safety.

Figure 4.28. 162 000 deadweight tonnes tanker *Vladimir Tikhonov* loaded with 120 800 tonnes of gas condensate made the Northern Sea high-latitude path under pilotage of *50 Let Pobedy* (photo) and *Yamal* in 2011.

2. *Advanced technology-based icebreaker fleet*

The efficient operation of the NSR means that the navigation within it is safe. The safety of navigation, in turn, directly links to the availability and the condition of icebreaker fleet. The Russian icebreaker fleet improvement purposes are the priority with several national programs and receive funding from federal-level budget.

3. *Integrated safety of entire Arctic navigation*

The issues of navigational safety come to the foreground with the NSR seeing more vessels using it. These include efforts to maintain the navigational and hydrographic support at very high level, to establish traffic monitoring systems, and to foster international cooperation on global navigation tracking. The NSR's paths are installed with over one and half thousand navigational equipment items and 6 GLONASS/GPS stations. A network of shore-based monitoring and correcting stations is being deployed and commissioned also, with the database of NSR electronic navigation charts to be developed. At the same time, there are plenty of areas yet to be covered with advanced technical facilities as some of the visual navigation control aids remain inoperable.

Emergency preparedness efforts are being channelled to the Arctic also, supported by the search and rescue (SAR) teams and assets under the Ministry of Transport of Russia. The Ministry of Emergencies of Russia (Emercom) has also started work to cover the Arctic coasts with a network of SAR centres.

4. *Icebreaker assistance tariff setting and regulation*

Icebreaker assistance along the NSR can be referred to as domain of natural monopolies. Pilotage services are provided, among others, by Atomflot, based on the relevant tariffs and tariff application rules approved by the Federal Tariff Service in March 2014.

Icebreakers are paid for providing pilotage along the NSR, based on the scope of services actually rendered with account of a ship's dimensions (GT) and ice class, distance and navigation season. The setting of nuclear-powered icebreaker assistance tariffs is rate-of-return method-based. These tariffs are marginal, their level can be fixed and must in any case be lower than the threshold level.

The current icebreaker assistance payment system is designed to boost the traffic volume along the NSR. Russian oil and gas producing companies claim that it may well add to cost-effectiveness of their Arctic hydrocarbon transportation operations, provided that the navigational and hydrographical support remains high quality.

Yet, the proceeds being generated by icebreaker assistance services may not be said to fully cover the icebreaker fleet maintenance expenditure, including maintenance of laid-up ships. To improve the cost-benefit ratio, donations are annually allocated from the federal-level budget. The icebreaker assistance payment system is going to be monitored by federal authorities who seek analysis of its performance and tariff system improvement proposals.

Once achieved, the above tasks can be said to have contributed to the Northern Sea Route's freight traffic volume and transit cargo flows, the increase in which cannot but boost the route's overall performance.

Figure 4.29. There were fewer international transits along the Northern Sea Route in 2014 comparing to three previous years. Photo: the caravan piloted by *50 Let Pobedy* through ice in autumn 2014.

Figure 4.30 The scheme of oil and oil products trunk pipeline system in Russia.

4.1.4 TRUNK PIPELINES

Trunk pipelines form the main routes for transportation of Russian crude oil, oil products and natural gas.

The history of the pipeline transport in Russia is more than a century old, and started with the industrial development of Baku and Grozny oil fields in the south. The first Russian field pipeline Balakhany-Baku (10 kilometres long) was built back in 1878, and launched construction of the giant network of pipelines that are operating nowadays. By the end of 1914, the total length of the Russian oil and oil product pipelines was 1279 kilometres. In comparison, at the same time the total length of the pipelines in the USA was 14 000 kilometres, including 7000 kilometres of trunk pipelines. Today, the length of Russian trunk pipelines for transportation of crude oil, oil products and gas makes 220 000 kilometres.

Russian trunk pipeline systems are operated by state owned Transneft and Gazprom. Transneft delivers for export about 45% of Russian crude oil and light refined products; and Gazprom exports about 25% of country's natural gas by its trunk-line system.

Pipeline Transportation of Oil

About 88% of crude oil and 27% of oil products produced in Russia is transported by trunk oil pipelines of state owned Transneft Company founded by the Government of the Russian Federation. Transneft Company was formed on the basis of Glavtransneft - the Head production administration on transportation and delivery of oil of the Ministry of oil industry of the USSR, which operated from 1970 to 1991. In 2008, Transnefteprodukt Company – operator of oil products trunk pipelines in Russia, became a part of Transneft.

In 2014, Russia oil production was on the level of 527 million tonnes, Transneft piped 461 million tonnes of Russian crude oil, and in addition received about 18 million tonnes from Kazakhstan and Azerbaijan. That year, 214 million tonnes of crude oil was piped for export and 262 million tonnes delivered to Russian refineries.

The system of pipeline transport in Russia includes about 350 000 kilometres of technological pipelines (oil collection, delivery of water to maintain pressure in the horizons and to transport finished oil), about 2500 kilometres of long-distance pipelines belonging to oil companies, including

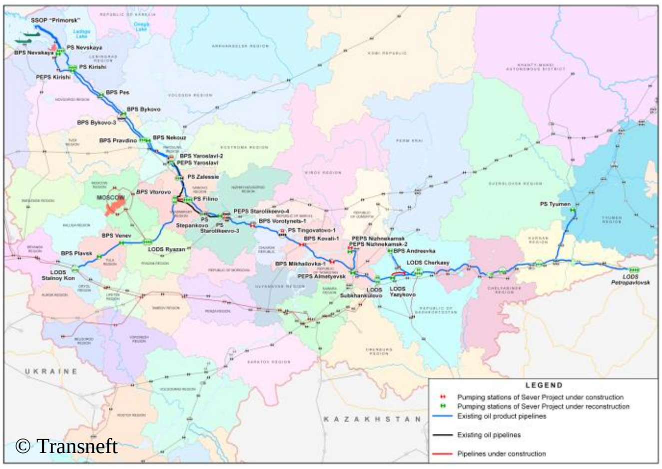


Figure 4.31 The Sever project of Transneft is aimed to increase annual export volumes of diesel fuel via Primorsk in the Baltic Sea from 8.5 million tonnes to 15 million tonnes in 2016 and 25 million tonnes in 2018.

foreign ones (Usa-Ukhta, Sakhalin–Di-Castri, Caspian Pipeline Consortium), as well as 54 000 kilometres of crude oil and 19 000 kilometres of oil products trunk pipelines operated by Transneft Company. Transneft controls sea ports and export oil terminals in Kozmino in the Far East and Primorsk in the Baltic, and has shares in Novorossiysk and Ust'-Luga. In 2014, Transneft exploited 72 200 kilometres of trunk oil and oil products pipelines and 495 pumping stations. The overall capacity of trunk pipeline system was loaded on 90%.

Construction and development of oil and oil products trunk pipeline systems in the Northwest – Baltic Pipeline System (BPS-1 and -2) and the Sever

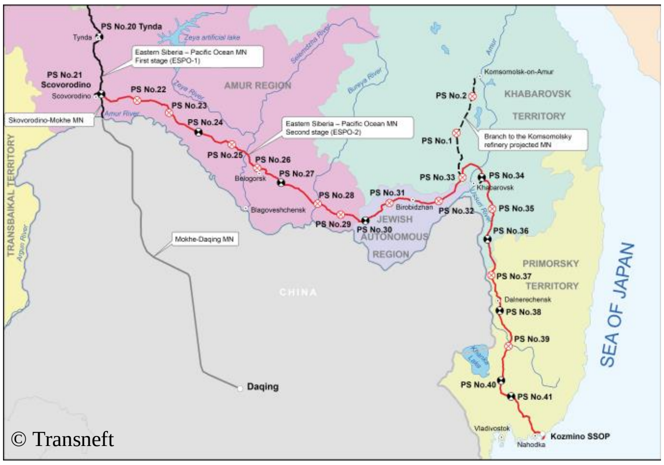


Figure 4.32 Eastern Siberia–Pacific Ocean (ESPO) 4740-kilometres long pipeline is the largest project of Transneft. In 2009, ESPO-1 Taishet-Skovorodino section came on stream, and in 2012, ESPO-2 Skovorodino-Kozmino (map) was commissioned.

(North) project; and in the Southeast – East Siberia–Pacific Ocean (ESPO) pipelines have been the main investment export oriented projects of Transneft during the recent years.

In 2009, Taishet-Skovorodino section (ESPO-1) of 4740-kilometres long ESPO pipeline was commissioned. In 2010, an ESPO branch from Skovorodino to the border with China was completed and construction of Skovorodino-Kozmino section (ESPO-2) was launched. In 2012, ESPO-2 with a capacity of 30 million tonnes was commissioned. In 2014, the capacity of ESPO-1 was extended to 58 million tonnes of oil per year.

The Baltic Pipeline System (BPS-1) capacity with the oil terminal in the port Primorsk was increased from 12 million tonnes in 2001 to 75 million tonnes in 2007. In 2008, the project on building a 1016-

Figure 4.33 The port of Primorsk, owned by Transneft, exports crude oil and diesel fuel. In 2018, the port annual capacity will reach 100 million tonnes.

kilometres long BPS-2 from Unecha on the border with Belorus to Ust'-Luga port in the Baltic Sea was launched. Construction of the 30 million tonnes capacity oil trunk pipeline and the terminal in Ust'-Luga was completed in 2012.

The above mentioned projects are also prioritised ones in the Transneft development strategy. In 2014, the Company approved the Strategy and the Long-term Development Programme of Transneft for the period to 2020. The Strategy includes:

- increase of capacities of ESPO-1 to reach 80 million tonnes and ESPO-2 to 50 million tonnes;
- increase of the Sever oil products pipeline to reach 25 million tonnes;
- construction of oil pipelines in the Yamal-Nenets and Krasnoyarsk regions in Siberia;

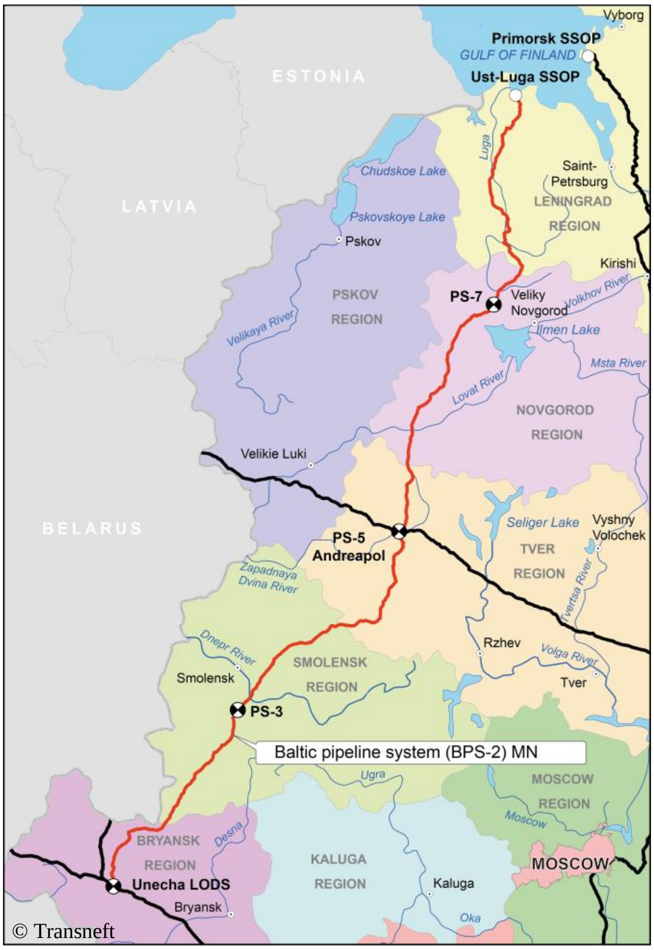


Figure 4.34 The Baltic Pipeline System-2 (BPS-2) project was launched in 2008. The construction of the 1000-kilometres long oil trunk pipeline with a capacity of 30 million tonnes per year was completed in 2012.

- construction of oil products trunk pipeline Volgograd-Novorossiysk within the Yug (South) project.

In addition to above mentioned targets of the Strategy, the Long-term Programme includes:

- construction of 35 (45) million tonnes Zapolyarye-Purpe and 8 (15) million tonnes Kuyumba-Taishet oil pipelines;
- reconstruction of oil trunk pipelines in Western Siberia;
- reconstruction of oil products trunk pipelines and improvement of connection with refineries.

In the south, the capacity of the Caspian Pipeline Consortium (CSP) will be enlarged from 28 million tonnes to 67 million tonnes per year.

According to the Strategy, in 2020, Transneft should pipe 494 million tonnes of oil and 59 million tonnes of oil products; operating almost 55 000 kilometres of trunk oil pipelines and more than 20 000 kilometres of trunk oil products pipelines.

Pipeline Transportation of Gas

Natural gas produced in Russia is delivered to the trunk pipelines of the gas supply system operated and owned by Gazprom.

United Gas Supply System (UGSS) of Russia is the world's largest gas transportation system that comprises of gas extraction, processing, transmission, storage and distribution facilities. According to Gazprom, the UGSS infrastructure includes 170 700 kilometres of gas trunk pipelines and laterals; 250 line compressor stations with gas pumping units, 26 underground gas storages with the total capacity of 71 billion cubic metres.

The average distance over which gas is delivered to Russian consumers is about 2500 kilometres and to foreign consumers, about 3300 kilometres. The distance of gas transportation from the northern fields in the Tyumen Region to the remotest importing countries such as France and Italy, is more than 5000 kilometres. In 2014, Gazprom exported 159.4 billion cubic metres of gas beyond the former Soviet Union. 35% of natural gas delivered to Europe was piped via the Blue Stream and Nord Stream trunk lines.

Gazprom brought to full capacity the Blue Stream pipeline going from Russia to Turkey by the Black Sea in 2005 to implement the company's plans on export routes diversification. Another Black Sea pipeline, South Stream, was planned for delivering Russian gas to the south European countries. In 2014, a new project, Turk Stream, was initiated to construct a 63 billion cubic metres capacity pipeline from Russia to Turkey by the Black Sea instead of South Stream.

Figure 4.35 In 2020, Transneft should pipe 494 million tonnes of crude oil and 59 million tonnes of oil products, operating 75 000 kilometres of oil and products trunk pipelines. Photo: ESPO.

Figure 4.36 The scheme of the United Gas Supply System of Gazprom.

The 1224-kilometres long Nord Stream twin pipeline runs through the Baltic Sea from Vyborg in Russia to Lubmin in Germany. Works on building the pipeline started in 2005; and in 2010, the construction was launched in the Baltic Sea. The Line 1 of the Nord Stream was completed in 2011, and the Line 2 – in 2012. Each line has a transport capacity of 27.5 billion cubic metres of natural gas per year. Nord Stream receives natural gas from UGSS. Yuzhno-Russkoye field in Yamal-Nenets region is the key gas resource for the pipeline. Nord Stream will also export gas from fields in the Yamal Peninsula and its adjusted shelf in the Kara Sea.

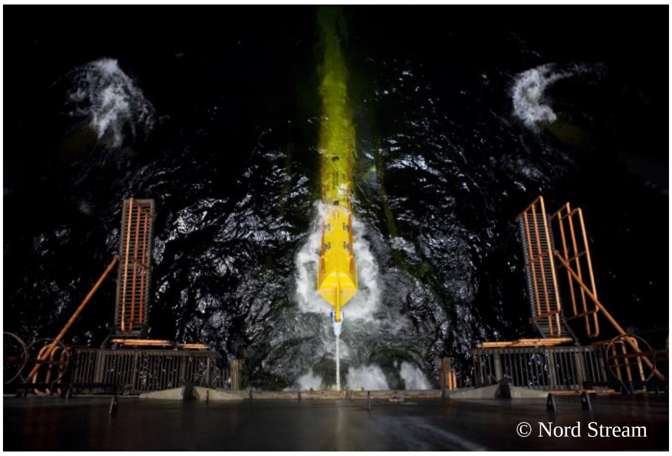


Figure 4.37 In April 2012, the last section of the Nord Stream Line 2 laid by the *Castoro Sei* was lowered onto the seabed of the Baltic Sea (photo).

Gazprom also plans to construct Nord Stream-2 pipeline from Russia to Germany by the Baltic Sea with the projected capacity of 55 billion cubic metres of gas per year.

Gazprom realises the Eastern Gas program with construction of gas trunk-lines and LNG plants in the Eastern Siberia and the Far East taking into account potential gas exports to China and other Asia-Pacific countries. 2014 saw welding of the first joint of the Power of Siberia – a 4000-kilometres long trunk-line with a capacity of 61 billion cubic metres that will go from the Irkutsk region to Yakutia and Vladivostok and have a branch to China with expected export volumes of 38 billion cubic metres of gas per year. The Altay, or the Power of Siberia-2 – a 2600-kilometres long trunk-line stretching from Pur-Pe in Yamal-Nenets region to the western border with China, is developed to export 30 billion cubic metres of gas per year from the Western Siberia to Chinese market.

According to Energy Strategy of Russia, in 2030, Russia can produce up to 940 billion cubic metres of natural gas, and export 368 billion cubic metres.

4.2 OIL TRANSPORTATION ROUTES IN THE BARENTS REGION

In 2002, 5 million tonnes of Russian oil were transported for export along the Norwegian coastline; in 2003, the amount increased to 8 million tonnes; and in 2004, it almost reached 12 million tonnes. In the period from 2004 to 2009, Russian export petroleum cargo flows through the Barents Sea were on the levels between 10 and 15 million tonnes per year. Historical maximum was recorded in 2010, when over 15 million tonnes of Russian oil and products were shipped, half of it was crude oil offloaded at Varandey terminal in the Pechora Sea. 2011 saw significant decrease of petroleum cargo shipping volumes due to decline of oil production at one field in the Nenets region that delivered crude oil to Varandey.

In 2014, Prirazlomnaya platform in the Pechora Sea started offloading crude oil, however, overall annual volume of Russian petroleum shipped for export through the Barents Sea dropped to less than 10 million tonnes that year due decrease of oil cargoes delivered to port terminals in the White and Barents Seas by railway.

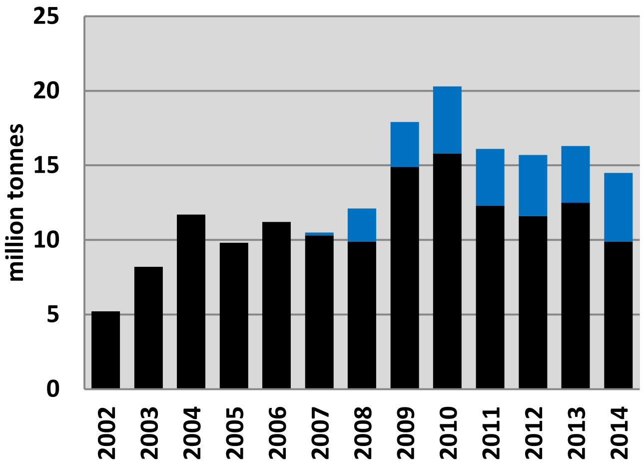


Figure 4.38 Russian oil and petroleum products (black) and Norwegian liquefied gas (blue) exported through the Barents Sea annually in 2002-2014.

Oil and gas terminals in the Russian Arctic are being developed. In five-ten years' perspective, the total capacity of these terminals can reach the level of 100 million tonnes per year.

In 2007, the Norwegian LNG plant in Melkøya in the Barents Sea started to produce and ship liquefied gas in 2007. In 2014, this plant offloaded more than 4.5 million tonnes of petroleum cargoes.

Table 4.5. The annual volumes in thousand tons of crude oil, petroleum products and liquefied gas shipped from the Russian and Norwegian Arctic coast terminals for export via the Barents Sea in the period from 2002 to 2014. Numbers in the left column indicate terminal locations shown on the map in the figure 4.39.

#	Locations	Oil shipment volumes in thousand tonnes per year												
		2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	The Laptev Sea													
(1)	Tiksi	60′	-	-	-	-	-	-	-	-	-	-	-	-
	The Kara Sea													
(2)	Dudinka	20′	30′	30′	30′	30′	30	40′	60′	60′	90′	90′	120′	120′
(7)	Cape Kamenny	110′	220′	240′	360′	450′	230′	240′	260′	270′	190′	150′	110′	220′
	The Pechora Sea													
(9)	Varandey	200′	400′	560′	600′	500′	580′	1900′	7380′	7440′	3910′	3120′	5380′	5880′
(10)	Prirazlomnaya	-	-	-	-	-	-	-	-	-	-	-	-	260′
(11)	Kolguyev	120′	100′	80′	80′	70′	70′	70′	60′	40′	40′	40′	40′	40′
	The White Sea													
(13)	Arkhangelsk	1930′	1500′	3630′	4400′	3100′	3200′	2350′	1200′	1250′	1490′	2240′	2700′	2230′
(14)	Osinki Islands	-	320′	-	-	-	-	-	-	-	-	-	-	-
(15)	Vitino	2900′	5700′	3700′	1600′	4760′	3940′	4400′	4360′	4380′	4220′	3770′	2280′	-
	The Barents Sea													
(17)	Murmansk	-	-	3500′	2700′	1500′	1220′	510′	480′	1160′	920′	1140′	700′	270′
(17)	Mokhn. Pakhta	-	-	-	-	730′	980′	440′	1040′	1220′	1460′	970′	1040′	660′
(21)	Melkøya (LNG)	-	-	-	-	-	200′	2200′	3000′	4500′	3830′	4120′	3800′	4580′

Figure 4.39 Map with locations of terminals described in this report. The Laptev Sea: (1) – Tiksi port. The Kara Sea: (2) Dudinka port, (3) Tanalau, (4) Arctic LNG-1, (5) Arctic LNG-2, (6) Arctic LNG-3, (7) Cape Kamenny and Novy Port terminals, (8) Sabetta port and Yamal LNG. The Pechora Sea: (9) Varandey terminal, (10) Prirazlomnaya platform, (11) Kolguyev terminal, and (12) Indiga port and Pechora LNG. The White Sea: (13) Talagi terminal near Arkhangelsk, (14) Osinki terminal, and (15) Vitino port. The Barents Sea: (16) Teriberka and Shtokman LNG, (17) Murmansk and the Kola Bay terminals, and (18) Pechenga port in Russia; (19) Kirkenes and Bøkfjord terminal, (20) Honningsvåg and Sarnesfjord terminal, (21) Hammerfest and Melkøya LNG, and (22) Goliat platform in Norway. Blue circles show locations of LNG plants and terminals; filled red and blue circles show locations with terminals in operation in 2015.

The terminals listed in the table 4.5 received crude oil and petroleum products by pipelines, railways and river routes, and sent cargo for export directly or via offshore transhipment terminals in Russian and Norwegian ice-free Barents Sea areas. These offshore transhipment terminals do not add on volumes and are not listed in the table. The table 4.6 shows existing and projected capacities of the Russian and Norwegian Arctic terminals shipping oil and gas products for export via the Barents Sea.

It is not guaranteed that these volumes of petroleum cargo, indicated in the table below, will be transported in ten years' perspective, but when plans of state and private companies to construct and expand pipelines, railways, ports, and terminals are completed, Russia will have facilities to export over 100 million tonnes of oil-and-gas by northern routes.

In 2002, the big Russian private oil companies proposed to construct a trunk oil pipeline from the Western Siberia to Murmansk with the capacity of 120 million tonnes. This initiative has not been realised. State-owned and private oil companies have been using railway to deliver petroleum cargoes to Northern ports. With modernisation of the Russian railway system, rail has a capacity to bring up to 40 million tonnes of oil and products to the ports of the White and Barents seas. Besides that, up to 12 million tonnes of crude may come from onshore fields in the northern part of the Nenets Autonomous District via the Varandey

Table 4.6 Existing and projected capacities of Russian and Norwegian Arctic oil-and-gas terminals.

Terminals	Capacity, thousand tonnes		
	2002	2014	2025
Tanalau	-	-	*8 000'*
Novy Port	500'	600'	*8 500'*
Sabetta (LNG)	-	-	*16 500'*
Varandey	1 500'	12 500'	*12 500'*
Prirazlomnaya	-	7 000'	*7 000'*
Indiga (LNG)	-	-	*5 000'*
Arkhangelsk	2 500'	4 500'	*5 000'*
Vitino	4 000'	10 000'	*10 000'*
Teriberka (LNG)	-	-	*-*
Murmansk	2 000'	8 000'	*8 000'*
Mokhn. Pakhta	-	2 500'	*5 000'*
Lavna	-	-	*25 000'*
Pechenga	-	-	*30 000'*
Melkøya (LNG)	-	5 000'	*5 000'*
Goliat	-	-	*5 000'*

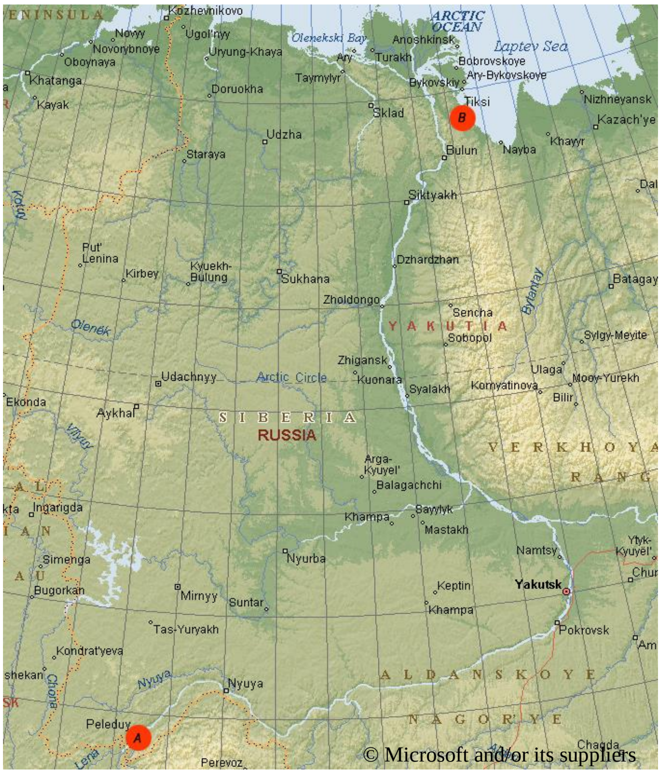


Figure 4.40 The Republic of Sakha in Eastern Siberia. (A) Vitim river terminal and (B) Tiksi port.

terminal in the Pechora Sea, and offshore Prirazlomnoye field will add on 6 million tonnes when reaches maximum production level. Up to 15 million tonnes of oil may be shipped in Ob and Yenisey terminals in the Kara Sea. New terminals can be built in the Kola and the Pechenga bays of the Barents Sea. New LNG plants may be constructed on Kara, Pechora and Barents coasts

It is seen from the above mentioned plans that even without the trunk pipeline to the Russian Arctic coast, shipments of oil and gas cargoes through the Barents Sea will increase significantly. The pressure on the marine environment will be growing with increase of petroleum exploration and production activities offshore. Development of the Northern Sea Route as Russian and international shipping lane brings new perspectives for Arctic oil and gas transportation.

In the following articles, we describe oil and gas offloading terminals (east to west order) in the Laptev, Kara, Pechora, White and Barents seas. Most of the terminals are in operation, some have been closed but represented significant interest, others are projected, but all of them were and are to ship crude oil, oil products, gas condensate or liquefied gas for export via the Barents Sea.

4.2.1 THE LAPTEV SEA

Tiksi

The Tiksi port has not been shipping oil for export along the Northern Sea Route since 2002. However, we keep the Tiksi article to show one of the most complicated logistic system built for delivering East Siberian oil to the western market.

The commercial sea port in Tiksi, in the north of the Republic of Sakha (Yakutia), was built in 1934, first of all, for carrying commercial cargo and essential supplies from the European part of Russia to Yakutia, and exporting coal and wood along the Northern Sea Route.

In 2001, the company Sakhaneftegaz in cooperation with the Murmansk Shipping Company started oil offloading in Tiksi for shipping it for export via the Northern Sea Route. The first 19 000 tonnes of crude from Talakanskoye oil field in the Eastern Siberia were shipped to the tanker *Magas* and sent to the western market.

The oil produced at Talakanskoye field was delivered via 110-kilometre local oil pipeline to the oil refinery and the terminal in Vitim on the Lena River. From there, oil was transported down by the river with *Lenaneft* tankers of the Lena River Shipping Company to oil storage facilities in the port of Tiksi. In Tiksi, oil was shipped to sea tankers up to 20 000 tonnes deadweight and delivered through 9 time zones to Rotterdam. The capacity of this transportation scheme was about 100 000 tonnes per year.

In the summer navigation of 2001, the port of Tiksi offloaded 38 000 tonnes of crude oil for export, and in 2002 – 58 000 tonnes.

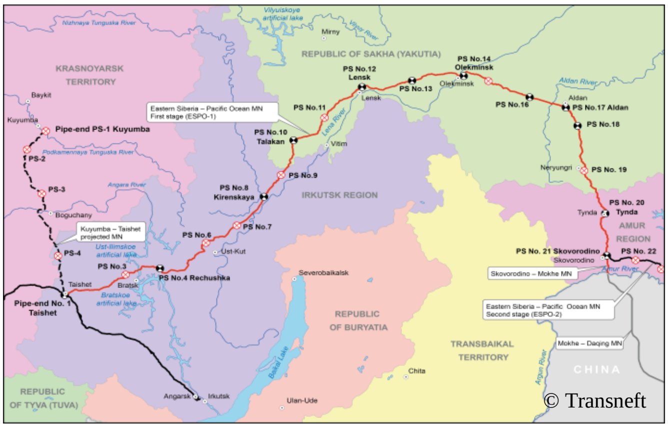


Figure 4.41 In 2002, Talakan oil went to the western market via Tiksi and the Northern Sea Route. Since 2008, Talakan crude oil has been piped eastwards by East Siberia – Pacific Ocean trunk line.

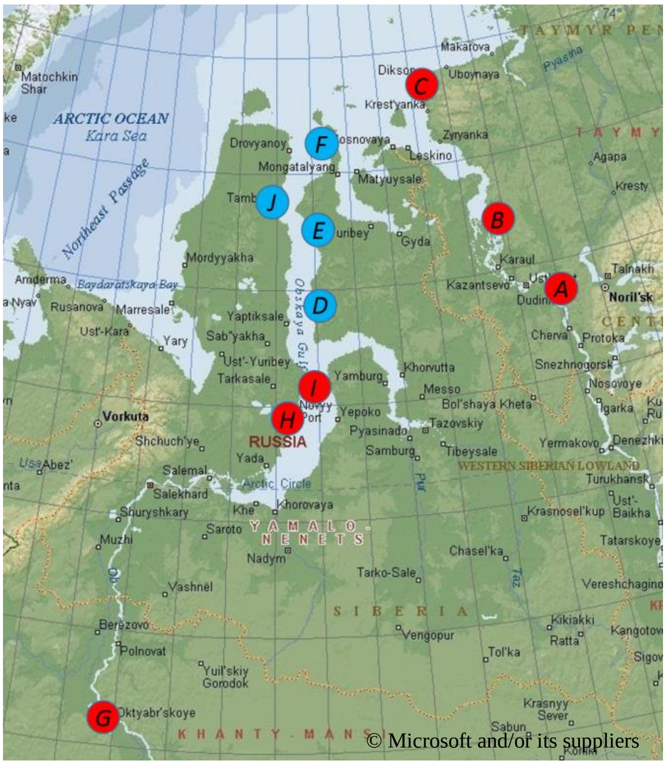


Figure 4.42 The Kara Sea with existing and planned terminals. (A) Dudinka port, (B) Tanalau, (C) Dikson port, (D) Arctic LNG 1, (E) Arctic LNG 2, (F) Arctic LNG 3, (G) Andra, (H) Novy Port, (I) terminal near Cape Kamenny, (F) Sabetta port and Yamal LNG.

Talakanskoye oil and gas field is the largest discovered in Yakutia with recoverable reserves of 124 million tonnes of oil and 47 billion cubic metres of gas. The maximum oil production level is over 7 million tonnes per year.

The export transportation scheme for Talakanskoye oil was changed with launching East Siberia–Pacific Ocean pipeline system (ESPO) project of Transneft.

In 2007, construction of 540 kilometres pipeline from Ust'-Kut to Talakanskoye, the part of 4740 kilometres long ESPO, was launched. In 2008, Surgutneftegas put Talakanskoye in commercial production and crude oil from the field was piped by 1100 kilometres long part of ESPO to Taishet. In 2009, ESPO-1 from Taishet to Skovorodino was completed. Crude oil piped to Skovorodino by ESPO was offloaded to rail tanks and transported to Kozmino terminal on the Okhotsk Sea coast. In 2010, Transneft built ESPO pipeline branch from Skovorodino to China. In 2012, ESPO-2 from Skovorodino to Kozmino was commissioned.

The export direction for oil from Talakanskoye and other East Siberian fields is eastwards – to Asia Pacific region.

4.2.2 THE KARA SEA

Dudinka, the Yenisey River

Dudinka sea and river port on the Yenisey River, the main transport facility of Norilsk Nickel, sends gas condensate for export via the Northern Sea Route and the Barents Sea. Natural gas produced by Taimyrgas, subsidiary of Norilsk Nickel, at Pelyatkinskoye and Soleninskiye gas and condensate fields in Taimyr has been used for energy supply of Norilsk town and Norilsk Nickel smelter while gas condensate, in volumes from 20 to 120 thousand tonnes per year, sent for export.

In 2010, Norilsk Nickel placed an order at Nordic Yards in Germany for construction of a tanker for year-round operations in Arctic waters being able to break through 1.5 metres thick ice. A 18 900 tonnes deadweight double acting Arc7 ice-class tanker was delivered to Norilsk Nickel in 2011 and called *Enisey*. The same year, *Enisey* brought the first export cargo of gas condensate from Dudinka to Porvoo in Finland. In 2013 and 2014, *Enisey* delivered 120 thousand tonnes of gas condensate from Dudinka for export annually.

Rosneft had plans to construct a 700-kilometres long pipeline from Vankor group of oil fields northwards to Dudinka and Dikson, and an oil offloading terminal in Dikson. In 2006, plans were changed and another pipeline southwards was designed. In 2009, a 560-kilometres long Vankor–Purpe pipeline was commissioned and connected oil fields with Transneft trunk line system. Vankor crude oil has been exported eastwards via the Eastern Siberia–Pacific Ocean pipeline.

Figure 4.43 In 2011, Norilsk Nickel received the Arc7 ice-class tanker *Enisey* of 18 900 tonnes deadweight. In 2014, *Enisey* delivered 120 000 tonnes of gas condensate from Dudinka to West European ports via Murmansk. Photo: *Enisey* tanker in the port of Murmansk.

Figure 4.44 The sea and river port of Dudinka on the Yenisey River is the main transport gate of Norilsk Nickel. The Company uses its Arctic fleet – ice-class container carriers and an oil product tanker, to export its production via the Northern Sea Route and the Barents Sea.

Dikson with its unique location is seen as a perspective port and terminal for serving oil-and-gas industry developments in the north of Western Siberia and the Kara Sea. Dikson Island, a settlement and a port, is located in the north-eastern part of the Yenisey Gulf of the Kara Sea on Taimyr Peninsula. The settlement on Dikson Island appeared in 1915. In 1934, the state started the construction of the Dikson seaport as a main port on the line of the Northern Sea Route for supplies of passing ships. In 2013, the marine rescue coordination centre was established in Dikson – the only marine rescue coordination centre along the Northern Sea Route working all-year-round.

When new oil and gas fields are developed in Taimyr Peninsula and adjusted Kara Sea shelf, new projects for constructing facilities and oil terminals in the port of Dikson may be realised.

Figure 4.45. Dikson sea port (photo) hosts the state marine rescue coordination centre and may become a service base for future oil and gas projects offshore.

Tanalau, the Yenisey River

Independent Petroleum Company (IPC), the oil-and-gas exploration and production company established in 2012, plans to construct an oil terminal on the Tanalau Cape in the Yenisey River estuary, north of Dudinka, for offloading crude oil to be produced on Payakhskoye and Severo-Payakhskoye fields in Taimyr. Recoverable oil reserves of these fields are estimated at 107 million tonnes. Exploration and production licenses are owned by IPC-TaimyrNeftegazdobycha, subsidiary of IPC.

The oil terminal Tanalau is planned with an overall capacity of 3.8 million tonnes per year and a perspective to enlarge it to 5 million tonnes. The designed terminal facilities include oil offloading berth, an ice barrier, auxiliary berth, maneuvering and operational area offshore; a tank farm for 20-30 thousand cubic metres with a pipeline to offloading berth, administrative buildings, including the ones for customs and border control, onshore. The terminal will be connected with Payakhskoye and Severo-Payakhskoye fields by a pipeline. Oil terminal Tanalau should be able to receive tankers up to 40 000 tonnes deadweight and operate all-year round.

Cape Kamenny and Novy Port, the Ob Bay

In 1999, the RITEK Company, owned by LUKOIL, ran the first oil transhipment operation in the Ob Bay, offloading 1850 tonnes of crude oil, and introduced the northern scheme of export transportation. The oil, produced at Sredne-Khulymskoye and Sandbinskoye oil fields in the Western Siberia, is delivered via local pipelines to the petroleum storage facilities in Andra on the Ob River and Numgi on the Nyda River coasts. There, oil is shipped to river-sea tankers of *Lenaneft* type (2100 tonnes deadweight) of Irtysh River Shipping Company, and transported down by the river to the Ob Bay of the Kara Sea.

In 1999-2005, oil delivered to the Ob Bay was transhipped from river to sea going tankers offshore near the Cape Kamenny. In the navigation of 2006, *Severomorsk* tanker (40 000 deadweight tonnes) was moored in the Ob Bay and used as Floating Storage and Offloading vessel (FSO). Sea shuttle tankers, such as *Khatanga* (14 900), *Saratov* (19 800) and *Varzuga* (11 300) carried oil from the Ob Bay via the Kara Gate to FSO *Belokamenka* in the Kola Bay of the Barents Sea.

Figure 4.46 RITEK has been running oil transhipment operations at the offshore terminal on the road in the Ob Bay near Cape Kamenny since 1999. In 2014, *Ice Condor*, former *Magas*, was involved in shipping crude oil of RITEK and Gazprom Neft from the Ob Bay to West European ports. In February 2015, *Ice Condor* received Novy Port crude oil within the first winter offloading operation in the Ob Bay (photo).

In 2008 and 2009, tankers *Khatanga*, *Indiga* and *Aleksandr Sledzyuk* of the Murmansk Shipping Company received crude oil from river tankers and shuttled between Ob and Kola bays. Since 2010, RITEK has being using 20 000 tonnes deadweight sea tankers *Bozdag* (former *Usinsk*), *Ginaldag* (former *Saratov*), *Berengaria* (former *Kaliningrad*) and *Green Forest* (former *Magas*) to deliver crude oil from the Ob Bay directly to West European ports during summer navigation.

Operations in the Ob Bay are supported by *Taimyr* and *Vaygach* nuclear-powered ice-breakers.

In 2006, RITEK exported a record-high 454 500 tonnes of crude oil via the terminal in the Ob Bay, when *Severomorsk* worked there as FSO. In 2007, the volumes dropped to 234 000 tonnes; in 2008-2010 they were kept on the levels of 240-280 thousand tonnes per year, and then after that decreased as RITEK optimised its export schemes using railways. In 2013 and 2014, RITEK exported 110 000 tonnes of oil per year via the terminal in the Ob Bay.

During the summer navigation of 2014, the similar to RITEK's oil transportation scheme in the Ob Bay was used to export crude oil produced by Gazrpomneft Novy Port, a subsidiary of Gazprom Neft, at Novoportovskoye oil and gas condensate field on the Yamal Peninsula. In 2013 and 2014, *Ice Condor* (former *Magas* and *Green Forest*) was involved in oil transhipments in the Ob Bay. In 2015, *Ice Condor* received Novy Port crude oil within the first winter offloading operation.

Novy Port, the Ob Bay

Gazprom Neft is building a new Arctic oil terminal near the Cape Kamenny in the Ob Bay. The terminal is constructed to offload oil produced at Novoportovskoye oil and gas condensate field located about 30 kilometres from the shore line of the Ob Bay and 100 kilometres from the the future Arctic terminal at the Cape Kamenny.

Novoportovskoye is one of the largest discovered fields of oil and gas condensates in Yamal-Nenets Autonomous District with recoverable reserves for more than 250 million tonnes of oil and condensate and 320 billion cubic metres of gas. Gazprom Neft Novy Port started oil production from the first exploitation well at Novoportovskoye in 2012, completed pilot production drilling in 2013, and began commercial drilling in 2014. The Company plans to put the field in commercial production in 2016 and produce 2.8 million tonnes of oil that year; the maximum production level of 8.5 million tonnes per year should be reached after 2020.

In 2013 and 2014, part of the oil produced at Novoportovskoye field was transported by motor vehicles to the nearest railway station Payuta.

In August 2014, Gazprom Neft ran the first oil offloading operation in the Ob Bay. Crude oil of a new Novy Port blend was piped the 103-kilometres long pipeline, the first line with the capacity of 600 000 tonnes per year, to the Cape Kamenny and loaded to 2000 deadweight tonnes *Lenaneft* tankers of Ob-Irtysh River Shipping Company. *Lenaneft* offloaded crude oil at the terminal in the Ob Bay to sea tankers SCF *Yenisey* and SCF *Pechora* of Sovcomflot. 47 000 deadweight tonnes sea tankers

Figure 4.47 In August 2014, Gazprom Neft ran the first operation on offloading Novy Port crude oil in the Ob Bay for sea transportation. Photo: *Lenaneft* river tanker receives Novy Port crude oil in the Ob Bay via a temporary pipeline.

received about 27 000 tonnes of crude oil each to pass through shallow waters in the Ob Bay and deliver cargo to Western Europe. During the summer navigation of 2014, Gazprom Neft completed four transhipment operations in the Ob Bay and exported 110 000 tonnes of Novy Port crude oil westbound via the Kara and Barents seas.

In February 2015, Gazprom Neft started the first winter oil offloading operation in the Ob Bay. 19 800 deadweight tonne *Ice Condor*, former *Magas*, was piloted by *Taimyr* ice-breaker to the terminal location near the Cape Kamenny where was loaded by Novy Port crude oil and delivered cargo to the Western Europe. 20 000 deadweight tonnes *Ice Eagle*, former *Astrakhan*, was the second tanker involved in winter oil shipping in 2015. *Astrakhan* and *Magas*, 1A Super ice-class tankers, were built in 2000 by Admiralty Shipyards in St Petersburg for LUKOIL-Arctic-Tanker. Gazprom Neft managed seven winter oil loading operations in the Ob Bay from February to May 2015 and sent 110 000 tonnes of Novy Port crude oil to West European ports.

In 2012, Gazprom Neft launched the project on construction of a new Arctic oil terminal at the Cape Kamenny in the Ob Bay for all-year-round operations. The designed terminal includes an 80-metres high Arctic loading tower with mooring system offshore; onshore storage facilities and pumping stations; pipeline (two lines) running 3 kilometres onshore and 7.9 kilometres offshore connecting the storage facilities with the offloading tower. The overall capacity of the designed terminal is 8.5 million tonnes per year. The terminal should be commissioned by the end of 2015 and start offloading Novy Port oil in 2016.

In 2015, Gazprom Neft started construction of the second line of the oil pipeline from Novoportovskoye field to the storage facilities at the Cape Kamenny to increase the pipeline capacity from 600 000 tonnes to 5.5 million tonnes per year; and completed pre-construction works at the Arctic terminal installing the offloading tower offshore.

A road-terminal with FSO *Umba* in the Kola Bay of the Barents Sea should be put in operation in 2016 and tranship Novy Port crude oil.

Gazprom Neft has ordered two new-generation diesel-electric icebreakers of Aker Arc130A project to serve the Arctic terminal in the Ob Bay. The icebreakers have been designed by Aker Arctic in Finland and will be built at Vyborg Shipyards in the Leningrad Region in Russia.

Sabetta port and Yamal LNG

The largest project under implementation in the Ob Bay is construction of the Sabetta port and Yamal LNG. The Yamal LNG project has been initiated by the second largest Russian natural gas producer NOVATEK, and being developed by a joint venture between NOVATEK (60%), French Total (20%) and Chinese CNPC (20%).

The Yamal LNG project is based on the resources of the Yuzhno-Tambeyskoye (South-Tambey) field located in the north-east of the Yamal Peninsula. Proved and probable reserve of the field according to the Petroleum Resources Management System (PRMS) are estimated at 926 billion cubic metres of natural gas and 30 million tonnes of condensate. The potential production at the fields amounts to about 27 billion cubic metres of natural gas per year with a duration for more than 20 years. According to the plan, that was adopted by the Government of the Russian Federation in 2010, the LNG plant with the overall capacity of 16.5 million tonnes per year is being built at the Yuzhno-Tambeyskoye field on the coast of the Ob Bay. The plant is constructed in three phases – three trains of 5.5 million tonnes annual capacity each are to be commissioned by 2020. The first train is planned to be launched in 2017. When Yamal LNG works on full scale, it should feed more than 200 sea going gas carriers per year.

Construction of the new seaport Sabetta was launched in July 2012, and in October 2012, Sabetta received first cargo vessels. The seaport is being

Figure 4.48 In 2015, Gazprom Neft completed pre-construction works of the Arctic terminal offshore in the Ob Bay. The terminal is designed for all-year-round operations and has a capacity of 8.5 million tonnes per year. Photo: *Oleg Strashnov* installing the oil offloading tower at the Arctic terminal in the Ob Bay.

Figure 4.49 A 50-kilometres long sea channel is being built in the Ob Bay to approach the Sabetta seaport. The volume of dredging works will total about 70 million cubic metres. Photo: dredging operation in the Ob Bay in August 2014.

built on the western coast of the Ob Bay to serve the Yamal LNG project. The port has got its name after the Sabetta settlement nearby that had no connecting infrastructure.

During the preparatory phase of the Sabetta seaport project in 2012-2013, the technological channel of 3.9 kilometres long, 240 metres wide and 12.4 metres deep was made and berths built to receive cargoes for construction of the port, the LNG plant and the related infrastructure. Within the main construction phase in 2014-2017, there will be built more than 50 kilometres long channel in the Ob Bay: 6 kilometres long, 495 metres wide and 15.1 metres deep approach channel in the port; and 49 kilometres long, 295 metres wide and 15.1 metres deep sea channel. The volume of dredging works will total about 70 million cubic metres.

The 975-meters long quay wall of the port will consist of four berths: the first berth with a 208-metres long adjacent wall to receive river-sea ships; the second berth for multi-purpose semi-submersible vessels with a 260-metres long wind wall; the third berth with a 300-metres long was to receive semi-submersible vessels with an open deck; and the fourth berth with a 207-metres long wing wall to serve harbour workboats.

The port fleet services, including tug and icebreaker assistance in the port of Sabetta are provided by Atomflot. In 2015, Atomflot ordered a harbour icebreaker for Yamal LNG project to be built at the Vyborg Shipyards. 10 MW diesel powered icebreaker should be delivered in 2018.

The Sabetta international airport has been constructed as a part of Yamal LNG project and received the first commercial service in February 2015. It is also planned to connect Sabetta with the railway grid building a 180-kilometres long rail road from Bovanenkovo to Sabetta.

It is planned that the production of Yamal LNG will be shipped for export all-year-round; part of the navigation season – eastbound, and the rest - westbound through the Northern Sea Route. The project operator plans to use a fleet of 15 Arctic LNG carriers with 172 600 cubic metres (about 75 thousand tonnes) cargo capacity each. In 2014, Yamal LNG short-listed three shipping companies – Russian Sovcomflot, Japanese Mitsui OSK and Canadian Teekay LNG to reach 45-years long contracts on LNG shipping. These companies were to order construction of new Arctic LNG fleet. The same year, Sovcomflot ordered a prototype vessel to be built at the Daewoo Shipbuilding & Marine Engineering in Korea and delivered in 2016. Yamalmax – a 300-metres long, 50-metres wide with the 12 metres draught double-acting LNG carrier will have the ice-class Arc7 to pass through up to 2.1-metre thick ice.

Figure 4.50 The 975-metres long quay wall of the Sabetta seaport is constructed to receive cargo to build Yamal LNG and to ship its production in the future.

Figure 4.51 Yamal LNG is designed in three phases – three trains to be built. When completed, the plant will produce 16.5 million tonnes of LNG per year.

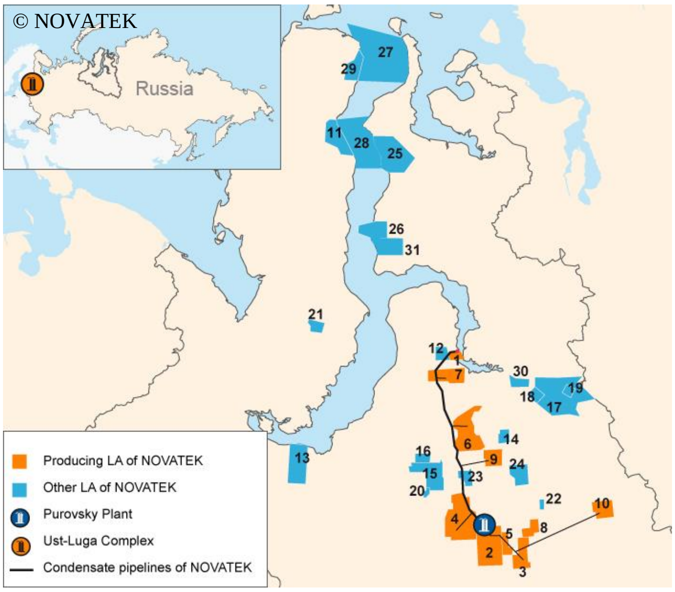


Figure 4.52 Assets of NOVATEK with license areas in Yamal-Nenets Autonomous District. Yamal LNG is constructed on the basis of Yuzhno-Tambeyskoye field (number 11) on Yamal Peninsula. Three Arctic LNGs can be built based on gas resources of other license areas in the Ob Bay and the Gydan Peninsula - Geophysicheskiy (26) and Trekhbugorniy (31) of the Arctic LNG 1; Salmanovskiy (Utrenniy) of the Arctic LNG 2; and Severo-Obskiy (27) of the Arctic LNG 3.

Arctic LNG 1, 2 and 3

NOVATEK has initiated three more LNG projects in the Yamal-Nenets Autonomous District. Arctic LNG projects were launched at the Gydan Peninsula at the eastern coast of the Ob Bay based on natural gas resources of the related fields. Arctic LNG 1 Company, a subsidiary of NOVATEK, owns exploration and production licenses on Trekhbugorniy and Geophysicheskiy license areas; Arctic LNG 2 – on Salmanovskiy (Utrenniy) license area; and Arctic LNG 3 – on the northernmost Severo-Obskiy license area (see Figure 4.52). In 2014, three above mentioned Arctic LNG companies received the right to export LNG. The initial plans were to start construction of the Arctic LNG based on resources of Salmanovskoye (Utrennee) and Geophyzicheskoye gas and condensate fields in 2018 and complete three phases of the project – build three trains with the capacity of 5-5.5 million tonnes of LNG per year each, in 2025. These plans have been postponed.

In 2015, Arctic LNG 2 started construction of berthing facilities on the eastern coast of the Ob Bay to receive cargoes for development of Salmanovskoye (Utrennee) field. These berths are within the water area of the Sabetta seaport.

4.2.3 THE PECHORA SEA

Varandey

Opening a Varandey terminal with an oil offloading installation 20 kilometres offshore in the Pechora Sea in 2008 was one of the most significant event happened in the Russian Arctic oil shipment. The 12 million tonnes offshore terminal has been sending up to 8 million tonnes of crude oil per year for export via the Barents Sea.

The first oil offloading terminal near Varandey in the Pechora Sea was completed and put in operation in 2000. The construction and development of the terminal was carried out in stages. In 2000, the first line of the terminal was completed and the first 10 000 tonnes of crude oil were shipped. In 2002, Murmansk Shipping Company built the second line of the Arctic offshore oil offloading terminal in Varandey. The offshore installation consisted of an underwater solid steel structure, 12 metres in diameter, about 3 metres in height, and more than 100 tonnes of weight. The special mooring unit and the sub-sea pipeline (4.8 kilometres long, 270 mm in diameter and with the operating pressure of 30 atmospheres), supported an offloading rate of 5000 tonnes of oil per hour. The system was capable of operating all-year-round.

The offshore terminal was connected to the onshore oil depot of Naryanmarneftegaz Company, that received oil from the northern oil fields of the Nenets Autonomous District - Varandeyskoye, Toraveyskoye, Myadseyskoye, Toboyskoye via the local pipeline system. The first Varandey terminal shipped crude to ice-reinforced tankers of up to 20 000 tonnes deadweight.

Figure 4.53 Varandey offshore terminal (photo) with the annual capacity of 12 million tonnes is the main oil offloading facility in the Pechora Sea.

Figure 4.54 Nenets Autonomous District and the Pechora Sea – the south-eastern part of the Barents Sea. The existing and prospected oil and gas terminals: (A) Varandey offshore terminal, (B) Prirazlomnaya oil platform, (C) Kolguyev Island terminal, (D) Pechora LNG (E) one of possible locations for the end terminal of the formerly planned Kharyaga–Indiga trunk oil pipeline.

Oil spill prevention and response services at the first Varandey terminal were provided by the Murmansk Basin Emergency and Salvage Department (MBESD) (now, after reorganisation, it is called the Northern branch of the Marine Rescue Service of Rosmorrechflot). In summer, the MBESD specialised vessel *Agat* was on watch during each oil shipment; in winter oil spill combat equipment was located on the icebreaker *Kapitan Nikolaev* that supported offshore operations.

In 2002, the first Varandey terminal offloaded 200 000 tonnes of crude oil from Timano-Pechora for export; in the period from 2003 to 2007 – from 400 to 600 thousand tonnes per year. In 2008, the Murmansk Shipping Company terminal shipped 170 000 tonnes of oil, and was closed in March, since the new Varandey terminal of LUKOIL was to be opened.

In 2002-2005, crude oil was transhipped at FSO *Trader* (RPK-1); and in 2006-2008 – at FSO *Belokamenka* (RPK-3) in the Kola Bay.

In 2004, LUKOIL Company presented a new project for construction of 12.5 million tonnes terminal in Varandey to ship crude oil from the northern Timano-Pechora province, most of all, from oil fields of the joint LUKOIL and ConocoPhillips Northern Territories project. The Northern Territories project included Khylchuyu, Yuzhno Khylchuyu, Yareygyuskoye and Inzyreyskoye fields, prospects in the northern part of Kolvinskiy megaswell and Khoreyverskaya hollow. Maximum annual oil production of the Northern Territories project was planned on the level of 10 million tonnes.

Oil from these fields is piped to the Varandey terminal. A 162-kilometres long pipeline from Yuzhno Khylchuyu field to Varandey oil depot was completed in 2008. In 2012, LUKOIL commissioned a 158-kilometres long Kharyaga – Yuzhno Khylchuyu pipeline that connected Kharyaga and

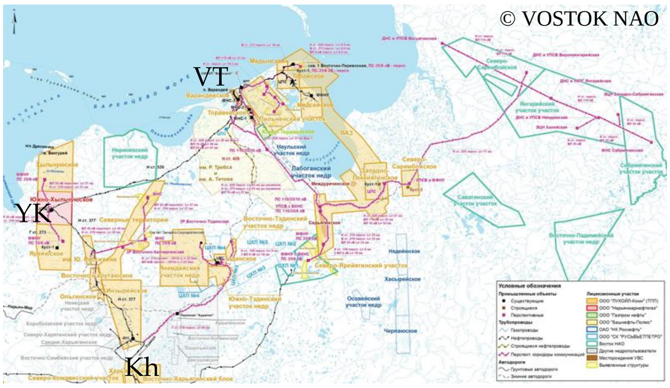


Figure 4.55 The local pipelines connect the Varandey terminal oil depot (VT) with oil fields of the Nenets Autonomous District, including Yuzhno-Khylchuyu (YK) and Kharyaga (Kh). The map of VOSTOK NAO, a joint venture of LUKOIL and Bashneft, shows licensed areas, existing and planned pipelines.

smaller oil fields on the pipeline's way with the Varandey terminal.

The first and second production lines at Yuzhno Khylchuyu were put on stream in 2008. In 2009 and 2010, Naryanmarneftegaz produced about 7 million tonnes of oil per year at the field and piped it to Varandey oil depot. In 2011, annual production at Yuzhno Khylchuyu dropped to 3.3 million tonnes, and in 2012 – to less than 2 million tonnes. That caused significant decrease of oil offloading volumes at the Varandey terminal. LUKOIL plans to stabilize the annual production at Yuzhno Khylchuyu on the level of 1.5 million tonnes.

LUKOIL has built the specialised seaport of Varandey to offload Timano-Pechora oil for export. Varandey oil terminal includes onshore oil depot with the total capacity of 325 000 cubic metres; 22.6 kilometres long sub-sea oil pipeline (two lines with diameter of 820 mm); and the Fixed Offshore Ice-Resistant Offloading Terminal (FOIROT).

FOIROT was designed in an octagonal shape. The construction is 43 metres wide in its base structure, and 55 metres high. The base structure supports topsides consisting of turret, helicopter deck, and offloading boom. Weight of the construction is about 13 000 tonnes. FOIROT has been installed 20 kilometres off the shore with the sea depths of 17 metres to receive 70 000 tonnes deadweight tankers. Crude oil comes to the offshore terminal from the onshore oil depot by sub-sea pipeline in heated condition. The system is looped with the shore – when oil is not loaded to a tanker it circulates around to maintain required temperature in the pipeline. No special cargo pumps are provided at FOIROT – necessary pressure is created at the onshore facility. The offloading speed of the Varandey terminal is 8000 tonnes per hour. LUKOIL-Kaliningradmorneft launched construction of FOIROT at its Steel Fabrication Yard in 2006. Construction works were completed in 2007, and the same year FOIROT was installed on its place in the Pechora Sea. The year after, LUKOIL started large-tonnage oil export from Timano-Pechora oil-and-gas province.

In June 2008, the new Varandey terminal shipped crude to the first 70 000 tonnes ice-class tanker *Vasily Dinkov* of Sovkomflot that delivered oil to the Canadian port of Come by Chance in Newfoundland.

Sovcomflot signed a long-term contract for transporting oil from the Varandey terminal in 2005. The same year, Sovcomflot ordered construction of three ice-class double action tankers at Korean Samsung Heavy Industries. Two 70 000 tonnes deadweight, conventional ice-breaking tankers *Vasily Dinkov* and *Kapitan Gotsky* were delivered in 2008, and the third one, *Timofey Guzhenko* came in 2009.

In addition to new ice-class tankers, in 2008, two ice-breaking ships were completed by Singaporean Keppel Singmarine for LUKOIL to support Varandey operations – the multi-purpose icebreaking supply vessels *Toboy*, and the multi-purpose icebreaker *Varandey*.

According to LUKOIL, the environmental safety system at Varandey has three levels of security and is fully automated. Oil spill prevention and response services at the Varandey terminal are provided by LUKOIL in cooperation with the Marine Rescue Service of Rosmorrechflot. The

Figure 4.56 The 158-kilometres long, 4 million tonnes capacity pipeline from Kharyaga to Yuzhno Khylchuyu was commissioned in 2012 and connected Kharyaga oil field with the Varandey depot (photo).

Figure 4.57 LUKOIL received two ice-breaking ships – *Toboy* and *Varandey*, in 2008 to support year-round operation at the Varandey terminal. Photo: *Varandey* on duty when *Kapitan Gotsky* approaches FOIROT.

Figure 4.58 Oil produced at big oil fields named after Roman Trebs and Anatoly Titov will be shipped via the Varandey terminal. Photo: construction of a 43-kilometres pipeline connecting two oil fields.

Varandey terminal hosts regular, including international ones, training exercises aimed at tanker accident and oil spill management.

In 2008, the newly opened Varandey terminal sent 1.7 million tonnes of crude oil for export; most of it (1.6 million tonnes) was transhipped at FSO *Belokamenka* in the Kola Bay. In 2009, when Yuzhno Khylchuyu came on full scale, Varandey offloaded 7.4 million tonnes of crude oil, and in 2010 – almost 7.5 million tonnes. In 2011, oil offloading volumes at Varandey dropped to 3.9 million tonnes and in 2012 – to 3.1 million tonnes following decline of oil production at Yuzhno Khylchuyu. In 2013, when Kharyaga crude oil was piped northwards to Varandey instead of southwards to Transneft trunk oil pipeline system, Varandey offloaded 5.4 million tonnes of oil, and in 2014 – 5.9 million tonnes.

Crude oil from Varandey terminal is delivered by three 70 000 tonnes ice-class shuttle tankers westwards for transhipment in the ice-free areas of the Barents Sea. Until 2014, Varandey oil was handled at FSO *Belokamenka* in the Kola Bay. Since January 2014, shuttle tankers from Varandey deliver crude oil for transhipment at STS terminals in the Northern Norway.

The Varandey terminal oil shipment volumes will be increased with start and growth of commercial production at big oil fields named after Roman Trebs and Anatoly Titov, and development of the local oil pipeline grid connecting other onshore and offshore oil fields with the terminal. According to LUKOIL, the Varandey terminal capacity can be increased to 25 million tonnes per year when needed.

Prirazlomnoye

In 2011, Varandey terminal was registered in the Guinness Book of Records as the world's northernmost oil terminal operating all year round. The same year, Prirazlomnaya platform was installed in the Pechora Sea north of Varandey's FOIROT; and in 2014, it offloaded its first oil of a new Arctic crude blend ARCO.

Prirazlomnoye is one of the largest oil fields opened in the Pechora Sea shelf. It was discovered in 1989. The field is located at the distance of about 60 kilometres from the shore, with the sea depth of 20 metres, the winter temperatures down to -50°C and ice thickness up to 1.6 metres. Initial geological oil reserves of the field are estimated as 231.1 million tonnes. The cumulative oil production for the operation period of 25 years should amount to 72 million tonnes with the maximum annual production about 6 million tonnes.

The license for development of Prirazlomnoye oil field belongs to the Gazprom Neft Shelf Company, former Sevmorneftegaz, subsidiary of Gazprom Neft.

The offshore ice-resistant fixed platform Prirazlomnaya is a central oil production and offloading unit of the field. The platform was constructed at the Sevmash enterprise in Severodvinsk from 2002 to 2010; in the fall of 2010 it was delivered to the Factory # 35 in Murmansk for foundation concreting and modernisation works; and the year after the platform was installed at its location in the Pechora Sea where was completed. Prirazlomnaya platform started commercial oil production in December 2013.

Figure 4.59 Prirazlomnaya offshore ice-resistant oil-producing platform was delivered to its location in the Pechora Sea in August 2011, and started commercial oil production in December 2013.

Figure 4.58 The Prirazlomnaya platform was built at Sevmash enterprise (photo) in Severodvinsk from 2002 to 2010. In 2010, the platform was towed from the White Sea to the Barents Sea for ballasting at the Factory # 35 in Murmansk.

Figure 4.59 In August 2011, when ballasting and modernisation works at the Factory # 35 were completed, Prirazlomnaya platform was towed from Murmansk to Prirazlomnoye oil field in the Pechora Sea (photo).

Prirazlomnaya is designed for year-round exploitation drilling by the vertical and horizontal methods. The platform consists of gravity type caisson and topsides. Caisson is a steel base, which serves as support for topsides, incorporating equipment and facilities for oil production and processing. It has a square configuration – 126 metres wide in the bottom side and 102 metres wide in the upper part. The wall along the perimeter of caisson top serves as ice and wave deflector. Topsides have facilities for well drilling and production, produced oil treatment and shipment, power supply of all kinds of production, personnel placing. Platform topside facilities partly consist of rebuilt topsides of the Hutton platform that operated in the Northern Sea and was bought in Norway in 2002, supplemented with intermediate deck. Intermediate deck is the level between caisson and the top side where tanks for potable water, diesel oil, and different drilling liquids are built in. The platform is equipped with drill derrick, two cranes, flare tower, winter operation containers, oil shipment units, evacuation ground and helicopter landing site.

The total weight of the platform 506 000 tonnes (117 000 tonnes without concrete ballast), its flare tower raises above the water surface over 120 metres. The crude oil storage capacity is 124 000 cubic metres, and maximum oil production output – 20 700 cubic metres per day.

The initial plan was to complete the construction and install the platform in the Pechora Sea in 2004, but the project was delayed. In 2006, Prirazlomnaya was assembled in the united structure – the topside units were installed on the caisson.

In November 2010, Prirazlomnaya platform was towed from Severodvinsk to Murmansk. The platform was carried to the distance over 800 kilometres through the White and Barents seas by 6 tugboats: *Vladislav Strizhov* versatile icebreaker, and tug-supply vessels *EMMS*, *Pasvik*, *Neftegaz 57*, *Neftegaz 61*, and *Kapitan Martyshkin*; and the voyage took 8 days. The operation on sea transportation of 140 metres wide and 120 000 tonnes heavy construction was done first time in Russia.

Prirazlomnaya was delivered to the shipyards of the Factory # 35 in Murmansk for concrete ballasting and technical works. There, the platform was loaded with 130 000 tonnes of ballast to increase its draft from 7.7 to 15.7 metres. The ballasting and technical works at the Factory # 35 were completed in August 2011, and then the platform was towed from Murmansk to its production location in the Pechora Sea making the distance of about 1200 kilometres. The towing operation was run by four tugboats: *Vladislav Strizhov* versatile icebreaker, tug-supply vessels *Kigoriak*, *Neptun* and *Iims*.

The gravity-type Prirazlomnaya rig was anchored to the seabed (in addition to its weight) with 2.5 high and 25 metres wide stone berm.

In May 2013, Gazprom Neft Shelf received Prirazlomnaya platform from Sevmash; in July the same year – started drilling the first well, and in December – began commercial production at the Prirazlomnoye oil field.

In 2014, Gazprom Neft Shelf produced 300 000 tonnes of oil at Prirazlomnoye. In 2015, the annual oil production should be doubled. The maximum production of about 6 million tonnes of oil per year should be reached after 2020.

In 2005, Gazprom and Sovcomflot signed an agreement upon development and implementation of the oil transportation scheme for Prirazlomnoye oil field. The oil transport scheme includes two ice-reinforced shuttle tankers of 70 000 tonnes deadweight; 1-2 ice-reinforced shuttle tankers of 20 000 tonnes deadweight; FSO not less than 220 000 tonnes deadweight; four line tankers of about 150 000 tonnes deadweight; icebreakers; tugboats; oil spill response vessels; service and supply vessels.

Two icebreaking supply vessels to serve Prirazlomnaya – *Vladislav Strizhev* and *Yuriy Topchev* were built at Havyard in Norway and delivered to Sovcomflot in 2006.

Admiralty Shipyards in St. Petersburg constructed two 70 000 tonnes double acting ice-class tankers for Sovcomflot operations at Prirazlomnoye. Two tankers, *Mikhail Ulyanov* and *Kirill Lavrov*, were delivered to Sovcomflot in 2010.

In April 2014, Prirazlomnaya platform offloaded its first cargo of oil of a new Arctic crude oil blend ARCO to *Mikhail Ulyanov* that carried cargo to the port of Rotterdam. During 2014, there were four shipments of Prirazlomnoye oil to the Western Europe for a total of 260 000 tonnes.

With increased oil production at Prirazlomnoye, *Mikhail Ulyanov* and *Kirill Lavrov* will shuttle between Prirazlomnaya and a new terminal in the Kola Bay of the Barents Sea. Gazprom Neft builds a transhipment terminal installing a 300 000 deadweight tonnes tanker *Umba*, former *Berge Kyoto*, in the Kola Bay. The road-terminal RPK Nord with FSO *Umba* should be put in operation in 2016 and tranship crude oil from Prirazlomnaya and Novy Port terminals.

Figure 4.61 In April 2014, Prirazlomnaya offloaded its first cargo of oil to 70 000 tonnes deadweight ice-class tanker *Mikhail Ulyanov* (photo). During 2014, *Mikhail Ulyanov* ran four voyages in total delivering Arctic oil from Prirazlomnoye to Rotterdam.

Crude oil produced in the Pechora Sea can also take an eastern direction and be delivered to Asia Pacific markets via the Northern Sea Route.

Oil spill prevention and response services at Prirazlomnaya are provided by Gazprom Neft Shelf and Ecoshelf-Baltic in cooperation Marine Rescue Service of Rosmorrechflot, Tsentrospas, LUKOIL and others. Since 2012, Gazprom Neft Shelf arranged oil spill response exercises in the Pechora Sea. The large ones, called Arctic-2014, were held in August 2014 under the Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic.

Figure 4.60 In August 2014, large-scale exercises Arctic-2014 were held at Prirazlomnaya with search-and-rescue, fire-fighting and oil spill response actions. Exercises involved personnel and facilities of Russian federal authorities, petroleum and transportation companies, and were observed by representatives of the Arctic states.

Kolguyev Island

The Peschanoozyorskoye oil and gas condensate field with recoverable reserves of about 11 million tonnes of oil was discovered at Kolguyev Island in 1982 and put in commercial production in 1987 by Arktikmorneftegazrazvedka (AMNGR). That year the first oil from Kolguyev was shipped to a sea tanker. Annual oil production reached the level of 125 400 tonnes in 2001, and then started declining.

Oil production at Peschanoozyorskoye field is carried out by Arctic Oil Company (that got the license from AMNGR), subsidiary of Zarubezhneft, on the central block and Arcticneft Company, subsidiary of Urals Energy, on the western and eastern blocks.

All oil produced in Kolguyev is delivered by local pipelines up to 5-kilometres long to the oil processing facilities located in the centre of the field. Further, the crude is piped 12 kilometres north to the export tank farm or sent to one of two Crude Oil Topping Units (COTU) and refined into oil products. The export storage tank farm has a capacity of 75 000 cubic metres.

Crude oil is exported via offloading terminals located offshore and adjacent to the oil tank farm and COTUs. Offshore oil terminals allow shipping tankers with maximum 40 000 tonnes deadweight and 10.5 metres draft. Tankers are moored to buoys, and a rubber loading pipeline to get crude from the shore. Oil from Kolguyev is delivered to Murmansk either for transhipment or customs clearance before going westwards. Crude oil exports from the island are limited as by oil reserves, as by a short navigation summer season that may last from two to six months a year.

Figure 4.62 Local pipelines connect production facilities of Peschanoozyorskoye oil and gas condensate field with oil tank farm located in the central block of the field.

In 2014, AMNGR produced 18 000 tonnes of oil at Kolguyev, and Arcticneft – 32 000 tonnes; most of crude oil produced was shipped for export.

Oil from Kolguyev is offloaded to up to 40 000 tonnes deadweight tankers, like CPO *Finland*, and exported either with transhipment in the Kola Bay or directly to the ports in the Western Europe. Kolguyev crude oil export volumes decreased from 120 000 tonnes in 2002 to 40 000 tonnes in 2014.

Indiga

Indiga is a small remote village located in the western non-industrial part of the Nenets Autonomous District in the outlet of the Indiga River. During recent years, it has been seen as a perspective area for building a seaport with an oil terminal, LNG plant and railway station, and

Figure 4.61 Oil produced at Kolguyev is exported via offshore terminals. Photo: 35 000 tonnes deadweight *Ras Maersk* loaded at Arcticneft terminal in 2012.

Figure 4.63 Indiga village on the Barents Sea coast has been seen as a prospective location for building a sea port, an oil terminal and an LNG plant.

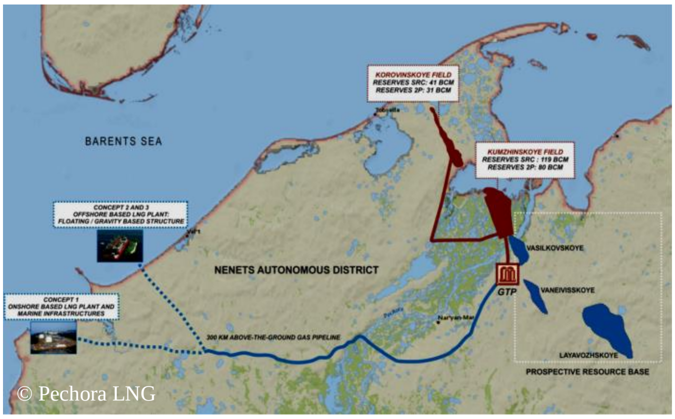


Figure 4.64 The scheme with alternate concepts of construction of gas pipelines, LNG plant and offloading facilities within the Pechora LNG project.

bringing trunk oil pipeline, gas pipeline and a new line of the Northern railway there.

The Kharyaga–Indiga oil pipeline project was elaborated as a follow up of the Western Siberia–Murmansk pipeline proposal. Transneft had a plan to build a 395 kilometres long pipeline from Kharyaga to Indiga with a capacity of 12 million tonnes. Since 2012, Kharyaga oil is piped to the Varandey terminal of LUKOIL.

CH-Invest and EvroSeverNeft companies of ALLTECH Group, operators of Kumzhinskoye and Korovinskoye gas and condensate fields, have launched the Pechora LNG project that includes construction of 400-kilometres gas pipeline, 100-kilometres methanol pipeline, gas treatment plant, LNG plant with the capacity of 4 million tonnes at the first phase and prospective capacity of 8 million tonnes of LNG per year, and LNG offloading facilities near Indiga. The project also includes construction of 180 000 cubic metres ice-class gas carriers. Three alternate LNG plant concepts have been proposed – building an onshore, floating or gravity-based plant offshore.

The Pechora LNG can also receive natural gas from Vasilkovskoye, Vaneivisskoye and Layavozhskoye fields. Depending of the resource bases involved in the project, Pechora LNG can receive from 4 to 13.4 billion cubic metres of natural gas per year, and produce from 2.6 to 8 million tonnes of LNG respectively. The Pechora LNG has not received the right to export LNG.

In 2014, Rosneft and ALLTECH agreed to cooperate with regard to Pechora LNG project and to create a joint venture for the project implementation with the major share of Rosneft.

4.2.4 THE WHITE SEA

Talagi

Arkhangelsk was founded in 1584, and historically it was built and developed as a Russian port on the White Sea. Arkhangelsk has an advanced transport infrastructure and plays an important role in delivering goods via the Northern Sea Route – fuel and supplies for the remote regions of the Russian Arctic.

The oil depot in Talagi, a place in 16 kilometres from the town of Arkhangelsk, is the largest one in the Arkhangelsk Region. The owner and operator of the petroleum depot is RN-Arkhangelsknefteprodukt, subsidiary of Rosneft. The company was founded on the basis of the Arkhangelsknefteprodukt, the state enterprise established in 1966 for supplying the Arkhangelsk Region with petroleum products. RN-Arkhangelskneftprodukt incorporates 11 oil depots with total capacity about 230 400 cubic metres, and 54 gasoline stations.

Since 2002, RN-Arkhangelskneftprodukt has been involved in the petroleum shipment for export. The crude oil produced in Timano-Pechora province by RN-Severnaya Neft Company of Rosneft was piped via the Transneft trunk pipeline Usa–Ukhta–Yaroslavl to the Privodino rail station where it was loaded to rail tank cars and transported north by the Northern railway to the oil depot in Talagi; there, crude oil was offloaded to shuttle tankers that delivered export cargo to the FSO *Belokamenka* in the Kola Bay for transhipment.

Figure 4.65 Since 2002, RN-Arkhangelsknefteprodukt has been running year-round shipments of export crude oil and petroleum products to sea tankers at its terminal in the Northern Dvina River. Photo: 30 700 tonnes deadweight tanker RN *Privodino* in Talagi.

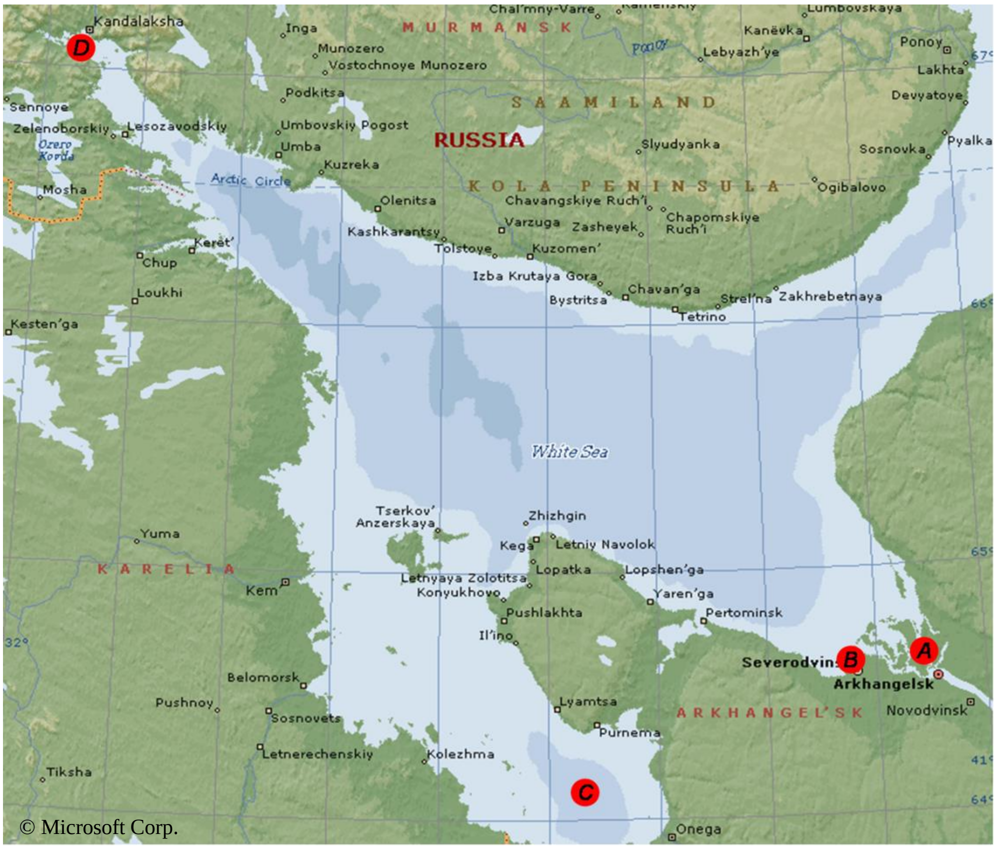


Figure 4.66 The White Sea ports and terminals: (A) terminal in Talagi near Arkhangelsk, (B) the town and port of Severodvinsk, (C) the Osinki terminal in the Onega Bay, (D) Vitino port near Kandalaksha. The terminals in Talagi and Vitino worked by the similar transportation scheme. Crude oil and petroleum products were delivered by railway, there it is offloaded to oil depot and further shipped for exported by sea tankers either directly or with transhipment in the ice-free areas of the Barents Sea. Since September 2013, Vitino has not loaded anything, and Talagi has been the only terminal in the White Sea shipping petroleum cargo for export.

Now, most of crude oil produced by RN-Severnaya Neft is piped to Primorsk terminal in the Baltic Sea. Talagi terminal handles light petroleum products and gas condensate delivered from refineries and processing plants of Rosneft and other petroleum companies by railway. In Talagi, petroleum cargo is shipped to sea-going tankers and delivered to West European ports directly.

The oil loading station Privodino of the Northern railway was built in 1974. The station is in the south of the Arkhangelsk Region, 40 kilometres from Kotlas and 790 kilometres from Arkhangelsk by railway. In 2003, Rosneft started building a rail oil terminal in Privodino station with offloading capacity of 4.5 million tonnes of oil per year. The first line of the terminal in Privodino was put in operation in 2004, and in 2006, the terminal was completed. During reconstruction, there were built 2 new rail lines; 3 oil tanks for 20 000 cubic metres each; developed operational and security infrastructure. The terminal could fill in 5 rail tank-car trains per day loading crude oil from the pipeline directly or from the oil storage.

Since 2003, the RN-Arkhangelsknefteprodukt has been conducting modernisation of the export terminal in Talagi located on the bank of the Kuznechikha armlet of the Northern Dvina River delta. After the first phase of the reconstruction completed in 2003, Talagi export terminal could handle gas condensate deliveries from RN-Purneftegaz in the Western Siberia and also petroleum cargoes from other companies. The annual export terminal capacity was about 2.5

Figure 4.67 Petroleum cargo is delivered to Rosneft's oil depot and terminal in Talagi in the White Sea by railway, there it is offloaded to sea-going tankers. Photo: 29 000 tonnes deadweight tanker *Maersk Bristol* in Talagi.

million tonnes in 2003. The next step was completed in 2005. Then, terminal could unload simultaneously: 54 tank-cars with crude oil; 30 tank-cars with light oil products; and 15 tank-cars with fuel oil. The offloading speed was 800 cubic metres per hour for crude oil (400 in winter time) and 1000 cubic metres per hour for light oil products. 4 railroad side tracks could receive trains with 67-85 tank-cars each. The oil storage of the export terminal had a capacity of 190 000 tonnes. Two piers of the terminal, 150 metres long each, with the depth of 10.5 metres could receive tankers of 22 000 tonnes deadweight. In 2005, the capacity of the oil terminal in Talagi was 4.5 million tonnes per year, including 3 million tonnes of crude oil.

In 2006, Rosneft launched another phase of the Talagi export terminal reconstruction with the focus on railroad side tracks. The reconstruction was completed in the fall of the same year, and the terminal's capacity totalled 6 million tonnes of oil and products per year, including 4.2 million tonnes of crude oil.

The bottleneck of the terminal real capacity is the route out to the sea. The 46 kilometres way from the Talagi terminal to the receiving buoy of the Arkhangelsk seaport by Kuznechikha armlet of the Northern Dvina River allows maximum 9.2 metres draft of the vessels and works one-way when loaded tanker goes out. That limits the maximum deadweight and load of the shuttle tankers serving the terminal.

During winter navigation, tankers receive icebreaking assistance provided by the Arkhangelsk branch of Rosmorport in the port water area, and by Atomflot on the way through ice-covered waters of the White Sea.

Crude oil offloaded to shuttle tankers in Talagi was delivered to FSO *Belokamenka* in the Kola Bay for transhipment. Now, 30 000 tonnes deadweight tankers deliver petroleum cargo from Talagi all the way to the ports in the Western Europe.

In 2006, Rosneft ordered three 30 000 tonnes deadweight double-hull ice-reinforced tankers to be built at Factorias Vulkano Shipyards in Spain. The first tanker RN *Arkhangelsk* was delivered to Rosneft in 2008. The second and third tankers RN *Murmansk* and RN *Privodino* came in 2009. All have been registered in Cyprus.

In 2002, the RN-Arkhangelsknefteprodukt terminal in Talagi shipped 1.9 million tonnes of crude oil and oil products for export; in 2003 the

Figure 4.68 During winter navigation, vessels are receiving icebreaking assistance to pass through ice-covered waters of the White Sea. Photo: *50 Let Pobedy* piloting bulker *Zapolyarye* and tanker *Weichselstern* on their way from Arkhangelsk to open waters of the Barents Sea.

volume was 1.5 million tonnes; in 2005, these volumes reached 4.4 million tonnes (so far, the annual maximum turnover) and started to decline, as crude oil shipping volumes were decreasing. In 2010, RN-Arkhangelsknefteprodukt offloaded 1.2 million tonnes of oil and products for export. The year after, shipment volumes grew to 1.5 million tonnes; and in 2013, reached 2.7 million tonnes. In 2014, Talagi terminal shipped 2.2 million tonnes of export petroleum cargo, mostly gasoil and naphtha.

In addition to three Rosneft's tankers, 22 000 deadweight tonnes *Rhonestern*, *Themsestern*, *Weichselstern*, *Wolgastern*; 29 000 deadweight tonnes *Maersk Bristol*, *Maersk Borneo* and others shuttled between Talagi and West European ports in 2014.

Figure 4.69 Export petroleum cargoes are delivered by 30 000 deadweight tonnes tankers from Talagi in the White Sea to the West European ports directly. Photo: RN *Privodino* in the port of Rotterdam.

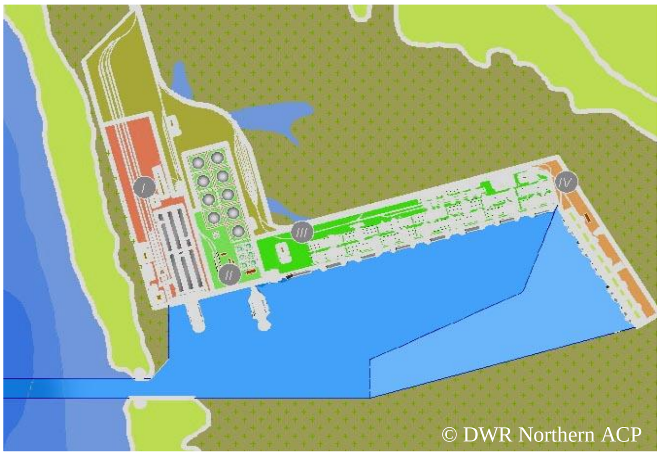


Figure 4.70 A scheme of the proposed deep-water region Northern in the Arkhangelsk commercial port ending the Belkomur railway.

New deep-sea port in Arkhangelsk

Administration of the Arkhangelsk region initiated a project on building up a new deep-sea port of Arkhangelsk in the Sukhoye More Bay of the Dvina Gulf of the White Sea. Construction of the new facilities in the Severny (Northern) deap-sea part of the Arkhangelsk port is planned in connection with building the Belkomur railway that should connect the Perm Region, the Republic of Komi and the Arkhangelsk Region. Container, coal, oil and universal terminals are to be built in the port with a total capacity of 28 million tonnes per year, and to receive vessels of up to 75 000 tonnes deadweight. The first phase can be launched in the fall of the second year of construction, and the project can be completed in 5 years after start up.

Figure 4.71 The Belkomur project of industrial and infrastructure development of Perm, Komi, Arkhangelsk and Murmansk regions has been included into the Strategy of Railway Transport Development of Russia through 2030.

Severodvinsk

Severodvinsk, the second largest city in the Arkhangelsk Region, was built in 1936. The city is located 30 kilometres to the west of Arkhangelsk. Severodvinsk is the centre of submarine shipbuilding, and the main enterprises of the city are machine-building factories Sevmash and Zvyozdochka.

Today, Severodvinsk is also an important industrial and production base for the development of the hydrocarbon resources of the Russian Arctic continental shelf. Zvyozdochka and Sevmash factories have constructed *Arkticheskaya* submersible exploration drilling rig for Gazflot, and Prirazlomnaya oil production and offloading platform for Gazprom Neft Shelf.

Figure 4.72 The town of Severodvinsk on the White Sea coast with Sevmash and Zvyozdochka factories is an important industrial base for the Russian Arctic continental shelf resources development. It was also discussed as possible location for construction of an oil terminal.

Severodvinsk may seem as a suitable location for construction of the oil terminal on the White Sea coast. The navigation channel to Zvyozdochka factory has strong water currents, and it was built for the large size submarines. The sea depths in the area allow receiving 40 000 tonnes deadweight tankers.

Back in 2003, Tatneft and ARM-Nefteservice companies stated their intentions of building an export oil terminal in Severodvinsk with the capacity up to 5 million tonnes. Later both companies changed their plans and went to other locations. Tatneft went to Kaliningrad Region on the Baltic Sea, and ARM-Nefteservis looked at the Onega Bay of the White Sea.

The Onega Bay

The Onega Bay of the White Sea was used for export oil transhipment operations during the summer navigation of 2003 only. The terminal and an oil spill story was presented more in details in the report 'Oil transport from the Russian part of the Barents Region' published in 2005. It demonstrated some possibilities and challenges of ship-to-ship transfer operations in remote areas.

Volgotanker Company started implementation of the project called "The White Sea" in 2003. The original plan was to anchor an 80 000 tonnes deadweight tanker in the vicinity of Osinki islands with sea depths about 18 metres, use it as FSO, and tranship up to 1.5 million tonnes of heavy fuel oil per year. FSO was not put on place. The heavy fuel oil was delivered to Osinki STS terminal by 2700 tonnes deadweight *Nefterudovoz* river tankers shuttling through the White Sea–Baltic canal. The *Nefterudovoz* tankers went through 19 water-locks of the canal to the Onega Bay and shipped fuel oil to 28 000 tonnes deadweight carrier tankers *Zoja-I* and *Zoja-II* of the Latvian Shipping Company that delivered cargoes to the port of Rotterdam. In 2003, Volgatanker transhipped 220 000 tonnes of heavy fuel oil in the Onega Bay. Apart from that, 100 000 tonnes of crude oil were carried from Vitino port and shipped to 127 000 deadweight tanker *Trader*.

Morskaya Liga Company based in Kronstadt on the Baltic Sea coast was to provide oil spill prevention and response services at the terminal.

In September 2003, *Nefterudovoz-57M* while moored to the *Zoja-I*, collided with the sea tanker, was dented and spilled heavy fuel oil into the sea. A number of lawsuits followed the oil spill case, and finally, the court ruled that Volgotanker was to pay the Onega municipality about 12.5 million roubles as compensation for the environmental damage caused by an oil pollution. In 2004, Volgotanker applied for but did not get the permit to resume the oil transhipment operations at the Osinki terminal in the Onega Bay.

In 2008, after a number of taxation claims and lawsuits, Volgotanker, being one of the largest river shipping companies in Europe with 353 ships of the total deadweight over 1.2 million tonnes, was officially declared a bankrupt.

In 2004, the year after Volgotanker's operations in the Onega Bay, ARM-Nefteservis Company proposed to construct the sea oil transhipment terminal near the town of Onega building onshore facilities in Shendunets railway station on the White Sea coast and offshore unit in the vicinity of the Osinki islands. The oil terminal project included construction of two rail racks; oil storage for 180 000 cubic metres; 40 kilometres pipeline (including 30 kilometres sub-sea); the offshore caisson type mooring installation; and 100 000 tonnes deadweight FSO. The plan was to deliver oil by Northern railway to Shendunets station and offload cargo to tankers via onshore oil storage and FSO. The terminal capacity was estimated to 5 million tonnes per year with all-year-round operations. The project has been frozen since 2004, as ARM-Nefteservis did not secure oil deliveries.

Figure 4.72 After summer navigation of 2003, there have not been oil transhipment operations in the Onega Bay. The plans of ARM-Nefteservis to build an oil terminal in the Onega Bay with the annual capacity of 5 million tons have not been realised.

Figure 4.73 The oil pollution marks (photo) have been found on the Osinki islands several years after the fuel oil spill happened in 2003.

Vitino

The seaport of Vitino is the first private seaport in Russia. For almost twenty years, Vitino was the major contributor to oil exports through the Barents Sea. Since the fall of 2013, Vitino has not offloaded any petroleum cargo.

The oil terminal in Vitino was constructed using the capacities of the Belomorskaya Neftebaza (the White Sea oil depot) located on the southwest coast of the Kandalaksha Bay of the White Sea. Belomorskaya Neftebaza was built in 1970s as a main storage facility for distribution of oil products throughout the Murmansk Region. With the private investors came in 1993, the port was modernised and rebuilt to offload crude oil from rail tank-cars to sea tankers. Back in 1995, Vitino carried out the first export oil operation shipping crude to 31 000 tonnes tanker *Probitas* under the Maltese flag. That year, the port loaded 9 tankers with 250 000 tonnes of oil in total. Every year from 1996 to 1999, Vitino sent between 0.5 and 1 million tonnes of oil for export although operating during summer navigations only.

Modernisation of the oil terminal was continued in and 2000s. In 2002, the port started to operate all-year-round. During winter navigation, petroleum cargo was shipped to 20 000 tonnes deadweight ice-class tankers that received assistance of icebreakers of the Murmansk Shipping Company, Rosmorport or Atomflot.

In 2004, the port of Vitino could load tankers with 60 000 tonnes deadweight. The 18 nautical miles (33 kilometres) fairway was dredged to the depth of 12.5 metres. Four mooring lines could serve one sea tanker and two river tankers simultaneously. The capacity of pumping facilities reached the level of 3000 cubic metres per hour (versus 500 cubic metres per hour in 1996). The oil storage of the Belomorskaya Neftebaza had a capacity of 230 000 cubic metres. The terminal had two rail trestles to offload 82 tank-cars simultaneously. The terminal capacity was about 8 million tonnes a year.

Figure 4.75 In 2002, the port of Vitino started year-round operations. During winter navigation, oil was offloaded to 20 000 tonnes ice-reinforced tankers, and shipment operations were assisted by icebreakers.

Figure 4.74 Vitino port can receive tankers of up to 80 000 tonnes deadweight. The terminal annual capacity is estimated to over 10 million tonnes. Since the fall of 2013, the oil terminal has not been in operation. Photo: 73 800 tonnes deadweight *Perseverance*, now *River Shiner*, in Vitino in 2008.

In 2004, Yukos crude oil flow went by rail to the port of Murmansk, and Vitino terminal was focused on increasing the capacity for shipping other products and improving the logistic system. In 2005, the capacity of the oil terminal was increased to 11 million tonnes. The fairway was dredged and piers modernised to receive 80 000 tonnes deadweight tankers. Four rail trestles had the capacity to offload 168 tank-cars (with crude oil, fuel oil, gas condensate and diesel fuel) simultaneously. The railroad side tracks could receive up to 7 trains. Vitino seaport was capable to ship 900 000 tonnes of cargo per month.

In 2005, NOVATEK together with Belomorskaya Neftebaza expanded the gas condensate capacities in the port of Vitino. NOVATEK built their own storage tanks and condensate shipping facilities.

The same year, Ros-Oil Company, subsidiary of OBL Nefteprodukt, started building an oil terminal in Baklanka, the Northern railway station in the Vologda Region. Crude oil transported by Transneft's Ukhta-Yaroslavl trunk pipeline to the oil storage of Baklanka terminal, could be loaded to rail tank-cars and carried by Northern and Oktober railways to the port of Vitino. The construction of the oil terminal with the capacity of 3.8 million tonnes was completed in 2008, and the same year Baklanka loaded its first 1500 tonnes of oil from the oil depot to rail tank-cars.

Vitino received crude oil, refined products and gas condensate by rail. Crude oil was transported from the terminals in Yaroslavl and Moscow regions where it arrived by trunk pipelines of Transneft. Light oil products came from refineries in Yaroslavl, Nizhny Novgorod, Ukhta, Antipinsk. Gas condensate was delivered by railway from Purovsky processing plant of NOVATEK in Yamalo-Nenets Autonomous District and Omsk plant of Gazprom Neft. In Vitino, petroleum cargoes were shipped to sea tankers then delivered to the western ports directly or via offshore transhipment terminals in the Barents Sea.

Figure 4.76 Four rail trestles in Vitino port can offload 168 tank-cars with crude and petroleum products simultaneously. The railroad side tracks could receive up to 7 trains.

In 2002-2004, tankers of 20 000 deadweight shuttled between Vitino and the Kola Bay; and in 2005-2011, offshore transhipment operations were carried out in Bøkfjord and Sarnesfjord in the Northern Norway.

From 2010 to 2013, gas condensate of NOVATEK offloaded in Vitino was delivered eastbound via the Northern Sea Route (NSR) to Asian markets. In August 2010, NOVATEK sent its first load of gas condensate to China via the NSR. In 2011, there were nine deliveries of gas condensate eastbound via the NSR for a total of 600 000 tonnes; in 2012 – seven for 425 000 tonnes; and in 2013 – two for 120 000 tonnes.

Figure 4.77 In 2011, gas condensate of NOVATEK was loaded to sea tankers in Vitino and delivered to Asian markets through the Northern Sea Route. Some cargoes were transhipped at STS terminal in Honningsvåg near the North Cape in the Barents Sea Photo: *Perseverance* with 60 000 tonnes of gas condensate on her way to Singapore in June 2011.

In 2002, Vitino offloaded 2.9 million tonnes of oil for export; and in 2003 reached its highest annual oil shipment level of 5.7 million tonnes, mainly crude oil; the volumes dropped to 1.6 million tonnes in 2005, and then started to grow with increase of gas condensate shipments. In 2006, Vitino offloaded more than 4.7 million tonnes with about 50% share of gas condensate. In the period from 2007 to 2012, Vitino shipped between 3.7 and 4.4 million tonnes of gas condensate and light oil products annually.

For eight months of 2013, Vitino offloaded 2.3 million tonnes of export petroleum, and stopped operations as NOVATEK diverted gas condensate to its own terminal in Ust-Luga in the Baltic Sea.

The specialised seaport of Vitino is owned by Management Company Vitino registered in Russia that received all seaport shares from a Cypriot Usarel Company in 2015.

Figure 4.78 Since September 2013, the port of Vitino has not offloaded petroleum cargo.

4.2.5 THE BARENTS SEA, RUSSIA

Shtokman and Teriberka

Liquefied natural gas (LNG), liquefied petroleum gases (LPG) and gas condensate produced in northern regions of Russia and Norway have been shipped for export through the Barents Sea in both western and eastern directions. Until 2007, it was gas condensate produced outside the Barents region.

The first gas production on the Barents Sea shelf came from the Norwegian field Snøhvit that started to ship condensate, LNG and LPG from facilities on Melkøya. On the Russian part of the Barents Sea, Shtokman was to be the first offshore gas field to be put in commercial production and export LNG and gas condensate.

Zavalishina Bay near Teriberka, a small settlement on the Barents Sea coast 120 kilometres east of Murmansk, has been chosen as a location for routing gas pipeline from Shtokman field to Volkhov, building an LNG plant and an export harbour.

The proven reserves of the Shtokman field make up 3.9 trillion cubic metres of natural gas and 56 million tonnes of gas condensate. Shtokman Development AG, 100% owned by Gazprom, was established in 2008, initially, as a joint venture of Gazprom, Total and Statoil for developing the first phase of the project. The annual gas production during the phase 1 of the project should be on the level of 23.7 billion cubic metres of natural gas that can be split for producing 7.5 million tonnes of LNG in Teriberka, and pumping 11 billion cubic metres by Shtokman-Teriberka-Volkhov pipeline to the Nord Stream. The start-up of the project was postponed several times.

The same year 2008, Gazprom Dobycha Shelf, subsidiary of Gazprom, was established was established to develop phases II and III of the Shtokman project. In 2014, Gazprom Dobycha Shelf was relocated to Sakhalin and renamed to Gazprom Dobycha Shelf Yuzhno-Sakhalinsk. Gazprom announced that the new subsidiary, called Gazprom Dobycha Shelf Murmansk, will be established for operations in the Barents Sea, including phases II and III of Shtokman project.

When all three phases of the Shtokman project are completed, the field will produce over 70 billion cubic metres of natural gas and 0.6 million tonnes of gas condensate annually.

Figure 4.79 The scheme-view on the facilities to be built in Zavalishina Bay near Teriberka within three phases of the Shtokman project with the overall annual production capacity of about 23 million tonnes of liquefied gas.

Murmansk and the Kola Bay

The port of Murmansk in the Kola Bay, is the only ice-free seaport in the Russian Arctic. The Murmansk seaport was constructed during the First World War in 1915, and in the 20th century became one of the largest seaports in Russia and the World's largest seaport above the Polar Circle.

The Murmansk seaport integrates motor, rail and sea transportation of the region. The fairway depths of the mooring lines in the port of Murmansk allow shipping vessels with 15.5 metres draught. The annual freight turnover of the Murmansk seaport amounted to 10 million tonnes in 2002; and in 2014, port operators handled more than 20 million tonnes of cargo. Murmansk seaport is developed as the multi-modal transportation complex with construction of new facilities and terminals both on the eastern and western coasts of the Kola Bay.

According to the general scheme of the Murmansk Port Transportation Junction development, the annual freight turnover can be increased up to 80 million tonnes when port facilities are built on both eastern and western coasts of the Kola Bay.

In 2003 and 2004, two coastal terminals for offloading oil from rail to sea were put in operation in Murmansk. Tangra Oil developed the facilities of the Murmansk Fishing Sea Port for shipping export crude oil and refined products, and set in operation an oil terminal at the Shipyard # 35 for the same

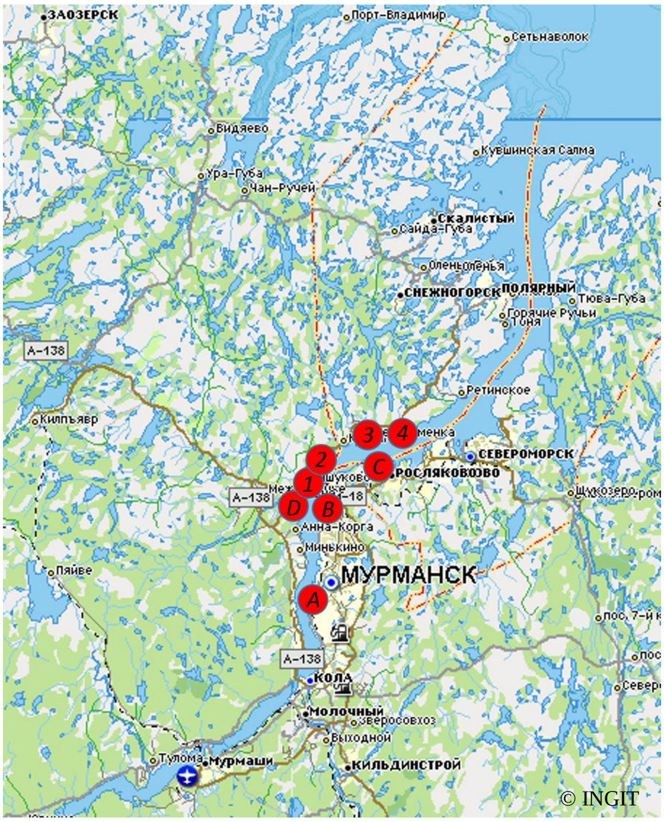


Figure 4.80 The Kola Bay with oil terminal locations. Coastal terminals: (A) The First Murmansk Terminal at Murmansk Fishing Sea Port, (B) Polar Terminal at Shipyard # 35, (C) Commandit Service terminal at Mokhnatkina Pakhta, and (D) Lavna.
Offshore terminals: (1) RPK-1 of Murmansk Shipping Company, (2) RPK-2 of Kola Oil Terminal, (3) RPK-3 Belokamenka, and (4) RPK Nord of Gazprom Neft.

purpose. In 2005, Commandit Service put on stream an oil terminal in the Cape Mokhnatkina Pakhta north of Murmansk. Polar Terminal at the Shipyard # 35 stopped operations in 2008. The First Murmansk Terminal, that leased a tank-farm of the fishing port in 2005, offloads light and heavy products; and Commandit Service ships heavy fuel oil via FSO *Kola Bay* moored at the pier.

From 2002 to 2004, three offshore oil transhipment terminals (hereafter RPK) were installed on roads of the Kola Bay – RPK-1 of the Murmansk Shipping Company, RPK-2 of the White Sea Service Company, and RPK-3 with FSO *Belokamenka* of Rosnefteflot and Bergesen companies. A new RPK-Nord with FSO *Umba* of Gazprom Neft should be put in operation in 2016. RPK-3 has not loaded any oil after 2013. Murmansk Shipping Company used *Nataly* as FSO at RPK-1 for petroleum cargo transhipment; and the Kola Oil Terminal ran a few STS operations at RPK-2.

Coastal oil terminals

The first oil export terminal on the coast of the Kola Bay was set in operation on the facilities of the oil depot of the Murmansk Fishing Sea Port.

Construction of the fishing port in Murmansk started back in 1925, and the first section was ready in 1927. Murmansk Fishing Sea Port was built as an up-to-date automated enterprise of the Murmansk Region specialised on handling fishing fleet. The total extent of mooring front of the sea fishing port now exceeds 4 kilometres. The port has its own storage tanks for oil products. In the end of 1990s, the oil depot handled about 500 000 tonnes of oil products annually. The operations on shipping oil from rail tank-cars to sea tankers for export were started in Murmansk Sea Fishing Port in 2003.

In 2003, the port terminal handled 1.6 million tonnes of petroleum products (all kinds of operations), and in 2004 – 2 million tonnes, including 1 million tonnes of crude oil for export. The export oil was shipped from rail tank-cars to 15 000 tonnes deadweight tankers of the Murmansk Shipping Company that shuttled between the sea fishing port and the first offshore transhipment terminal (RPK-1) in the Kola Bay.

In 2004, the fishing port initiated a full-scale reconstruction of oil loading facilities. The reconstruction mostly included the fairway dredging to 8.5 metres to enable mooring tankers of up to 30 000 tonnes deadweight. The capacity of the oil depot was extended to store about 175 000 tonnes of products, including 140 000 tonnes of light ones. The outdated offloading equipment was replaced. After the reconstruction, the capacity of the oil loading terminal was expected to reach 2.5 million tonnes per year. The full-scale reconstruction was not completed, and in 2005 the export oil shipment operations were stopped.

Figure 4.81 The First Murmansk Terminal has been operating the tank-farm of the Murmansk Fishing Sea Port in the Kola Bay since 2005.

At the end of 2005, the tank-farm of the Murmansk Fishing Sea Port was leased by the First Murmansk Terminal Company. The terminal is specialised on offloading light and heavy (clean and dirty) petroleum products both for export and domestic supplies.

In 2006, the First Murmansk Terminal shipped 300 000 tonnes of refined products for export, and tripled the volumes in 2007 exporting 900 000 tonnes. In 2008, the annual export volumes decreased to 340 000 tonnes, but started growing the next year. In the period from 2010 to 2012, the First Murmansk Terminal offloaded between 0.9 and 1.2 million tonnes of light products for export. In 2013, annual export cargo volumes dropped to 700 000 tonnes, and in 2014 – to less than 300 000 tonnes, the lowest result since 2006. In addition to export shipments, the First Murmansk Terminal offloaded 150 000 tonnes of petroleum cargo for domestic supplies, most of all, for Russian northern regions along the Northern Sea Route.


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Figure 4.82 In 2005, 126 000 tonnes deadweight *Trader* was berthed at the Polar Terminal at the Shipyard #35 and worked there as FSO until 2008.

The second export oil terminal in Murmansk was constructed at the Shipyard # 35, former Sevmorput. The Sevmorput factory was founded in 1932 as a maintenance factory for the merchant fleet. The factory building began in 1936 and was completed in 1938. In 1943, the factory was a part of the Northern Navy Fleet of the USSR. In 2003, Sevmorput changed the owner and was renamed into the Federal State Unitary Enterprise Shipyard #35 of the Ministry of Defence of Russia. Now, the enterprise is a part of the state founded Russian United Shipbuilding Corporation.

In 2003, Tangra Oil in cooperation with the Shipyard # 35 constructed an oil terminal on the territory of the factory. The 10-kilometres long


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Figure 4.83 16 000 tonnes deadweight tankers *Varzuga*, former *Uikku*, and *Indiga*, former *Lunni*, loaded with diesel fuel at RPK-1 FSO *Nataly* are piloted through the Northern Sea Route to Chukotka in July 2013.

pipeline from the rail trestle leading to the mooring line was constructed. Oil from rail tank-cars was shipped by a pipeline straight to shuttle tankers *Cheguevara* (45 500) and *Severomorsk* (40 000) of Severnaya Stividorskaya Company, a subsidiary of Tangra Oil, that carried oil to 126 000 deadweight FSO *Trader*, former *Polytrader* (built in 1978), moored at RPK-1 in the Kola Bay. The first section of the terminal with the capacity of 3.5 million tonnes per year was commissioned in 2004. The oil loading facilities at the Shipyard # 35 were operated by the Polar Terminal Company.

Modernisation of the terminal at Shipyard # 35 was continued the following years. In 2004, new rail trestle was constructed and the terminal could offload 74 rail tank-cars with crude and oil products simultaneously. The modernisation also included dredging works; building new T-type pier stretching 280 metres out from the coastline; construction of oil storage reservoirs for 135 000 cubic metres onshore. The terminal capacity after reconstruction was estimated to 7.5 million tonnes.


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Figure 4.84 The last cargo of export fuel oil was shipped at Polar Terminal in February 2008, after that *Trader* left the Kola Bay and was decommissioned.

In 2005, *Trader* was moved from RPK-1 and berthed at the Polar Terminal as FSO. Crude and oil products were shipped from rail tank-cars to FSO *Trader* then to 100 000 tonnes carrier tankers that delivered export cargo to the ports in the Western Europe. In 2006, the terminal was reoriented from crude to heavy fuel oil. Polar Terminal shipped 1.2 million tonnes of fuel oil for export that year. In 2007, the volumes dropped to 320 000 tonnes. The oil export terminal at Shipyard # 35 shipped 60 000 tonnes of fuel oil in the beginning of 2008 and has not been in operation since February that year.

Rosneft bought the oil loading facilities at the Shipyard # 35 from the United Shipbuilding Corporation in 2012.

Figure 4.86 Since 2008, 61 000 tonnes deadweight *Kola Bay* has been operating as FSO at the Commandit Service terminal in Mokhnatkina Pakhta.

The third terminal on the eastern coast of the Kola Bay was constructed north of Murmansk on the Mokhnatkina Pakhta Cape near Severomorsk.

The terminal for shipping heavy fuel oil was built on the basis of the Northern Navy fuel storage. The facilities of the Northern Navy on Mokhnatkina Pakhta were used for shipping export oil before. LUKOIL reconstructed one of the piers and transhipped crude from Kolguyev Island. Back in 1999, LUKOIL proposed to build an oil refinery and a terminal with the capacity of 7 million tonnes per year on the Mokhnatkina Pakhta Cape, but this proposal was not adopted by the Northern Navy. Rosneft and Tatneft also had plans upon this site, those plans were not realised.

In 2003, Commandit Service Company, subsidiary of Progetra Group and Sudkomgrupp started construction of the terminal for shipping heavy fuel oil using the facilities of the Northern Navy on Mokhnatkina Pakhta. In 2004 and 2005, the first stage of the project was implemented including dredging works, reconstruction of oil reservoirs, rail side tracks and infrastructure, building rail trestle for 23 rail tank-cars; construction of floating dock structure, building 1-kilometre long pipeline (two lines of 426 mm diameter) from the rail trestle to floating dock structure. 68 000 tonnes deadweight tanker *Marshal Vasilevskiy* was moored as FSO. The oil terminal with the annual capacity of 2.5 million tonnes was put in operation in the fall of 2005. In 2008, 61 000 tonnes deadweight tanker *Kola Bay*, former *Bright Sprout*, replaced *Marshal Vasilevsky* as FSO.

Figure 4.85 51 700 tonnes deadweight CPO *China* receives heavy fuel oil from FSO *Kola Bay* at the terminal in Mokhnatkina Pakhta, March 2013.

Heavy fuel oil is transported by rail to a Mokhnatkina Pakhta station and a terminal, piped to FSO, and shipped to up to 60 000 tonnes deadweight tankers that carry oil to the western customers. In 2006, Commandit Service shipped 730 000 tonnes of heavy fuel oil for export, and in 2007 – 980 000 tonnes. In 2008, the terminal was not in operation from April to November, and volumes dropped to 440 000 tonnes. In 2009, annual export volumes started to grow, and in 2011, they almost reached 1.5 million tonnes. In 2012 and 2013, about 1 million tonnes of heave fuel oil was shipped from Mokhnatkina Pakhta annually; and in 2014, there was a decline to 660 000 tonnes.

Progetra Group intended to upgrade the facilities in Mokhnatkina Pakhta for crude oil transhipment operations, and increase the terminal capacity to 5 million tonnes per year. There were also plans to build another oil terminal in the Kola Bay in Safonovo settlement near Severomorsk with the capacity of 15 million tonnes per year, but those plans have not been realised.

Offshore oil terminals in the Kola Bay

The first offshore oil transhipment terminal (RPK-1) in the Kola Bay was constructed by the Murmansk Shipping Company nearby the Cape Mishukovo. In October 2002, RPK-1 transhipped its first crude oil, then 106 500 tonnes deadweight tanker *Moscow River* of Novoship (now, part of Sovcomflot Group) was loaded with crude delivered from the port of Vitino by 54 500 tonnes deadweight *Burgas* and 55 800 – *Geroi Sevastopolya*.

The terminal had eight anchorage-mooring systems (anchors, bridles, flanks) capable to serve sea tankers of up to 150 000 tonnes deadweight in heavy weather conditions with a wind of up to 20 metres per second. From 15 000 to 60 000 tonnes deadweight shuttle tankers were moored directly to line tankers for offloading oil. The terminal operated all-year-round. The designed capacity of RPK-1 was 5.4 million tonnes of oil per year.

Figure 4.87 The first export oil ship-to-ship transfer was carried out in the Kola Bay in October 2002.

From 2002 to 2004, RPK-1 was operating as a ship-to-ship transfer (STS) terminal. In 2004, the 126 000 tonnes deadweight *Trader*, former *Polytrader* (now decommissioned), was anchored at the RPK-1. For one year, *Trader* was used as floating storage and offloading vessel (FSO) at RPK-1. In 2005, *Trader* was moved to Shipyard # 35 export oil terminal and RPK-1 stopped regular transhipments. Until 2012, RPK-1 was used for STS operations. In 2006, Murmansk Shipping Company modernised 140 000 tonnes deadweight tanker *Nataly*, former *Velez Blanco*, at Cxengxi Shipyard in China, and in 2012, installed her at RPK-1 as FSO. In 2012-2014, RPK-1 with FSO *Nataly* transhipped petroleum cargoes to be delivered for export and domestic supplies.

Figure 4.88 In 2004, 126 000 tonnes deadweight *Trader* was anchored at RPK-1 and used for one year as FSO. That year, RPK-1 transhipped more than 4 million tonnes of export oil. In 2005, *Trader* moved to Polar Terminal at Shipyard # 35.

Oil has been delivered to RPK-1 from terminals in Dudinka, Kolguyev, Varandey, Vitino, Murmansk Fishing Sea Port and Shipyard # 35 by shuttle tankers. Further, oil was shipped for export to line tankers about 100 000 tonnes deadweight.

In 2003, RPK-1 transhipped 3.7 million tonnes of crude oil for export; in 2004 – 4.3 million tonnes; and in 2005 – 3.4 million tonnes. In the period of 2008-2011, RPK-1 handled few STS operations transhipping crude oil, gas condensate and petroleum products for export on the levels from 50 000 to 100 000 tonnes annually. From 2012, FSO *Nataly* received exports gas condensate from Dudinka and light products from the First Murmansk Terminal. In 2014, RPK-1 offloaded 25 000 tonnes of gas condensate for export.

Figure 4.89 140 000 tonnes deadweight FSO *Nataly* was installed at RPK-1 in 2012 and transhipped petroleum cargoes for export and domestic supplies. Photo: FSO *Nataly* at RPK-1 and Heavy Load Carrier *Transshelf* on the way to Murmansk port.

Figure 4.90 106 000 tonnes deadweight *Kuban* at RPK-1 and 126 000 tonnes *Trader* at RPK-2, December 2003.

The second offshore oil transhipment terminal (RPK-2) in the Kola Bay was built by the White Sea Service Company, and put in operation in December 2003. Then, terminal worked for 3 months only as a STS facility transhipping crude oil delivered from Vitino. In 2007, Kola Oil Terminal bought RPK-2 from White Sea Service. Since then, Kola Oil Terminal has been running irregular STS operations at RPK-2.

The third and the largest terminal in the Kola Bay – RPK-3 Belokamenka was set in operation in 2004. The terminal with FSO *Belokamenka* on road in the Kola Bay was in operation for 10 years being a key unit in the northern oil export channel developed by Rosneft, and transhipping crude oil delivered from Varandey terminal.

RPK-3 terminal is based on a 360 000 tonnes deadweight oil storage tanker *Belokamenka*. The tanker is 340 metres long and 65 metres wide. *Belokamenka*, former *Berge Pioneer* (built in 1980), was chartered by Rosneft from the Norwegian company Bergesen. The tanker came in the Kola Bay and was moored near Belokamenka settlement. The operator, Oil Terminal Belokamenka Company, was founded in 2004 as a joint venture of Bergesen and Rosnefteflot. In 2007, Rosneft and Sovcomflot companies reached an agreement on the formation of a joint company on the basis of Rosnefteflot. In 2015, Rosneft got the right to consolidate Rosnefteflot.

After FSO *Belokamenka* was installed in the Kola Bay, Rosneft put on stream a new oil delivery route "from the oil well to the consumer". Oil produced by Rosneft subsidiaries in Timan-Pechora oil-and-gas province was delivered to the terminal in Talagi on the White Sea coast, further carried by shuttle tankers to the storage tanker in the Kola Bay, from where it was delivered to West European ports by line tankers with up to 150 000 tonnes deadweight.

The operational capacity of RPK-3 Belokamenka was estimated for about 10 million tonnes per year.

In February 2004, FSO *Belokamenka* received its first crude oil delivered from Talagi by shuttle tankers *Volgograd* (16 000), *Rundale* (17 000) and *Samburga* (17 100). In March, RPK-3 offloaded the first oil for export into the line tanker *Moscow River* (106 000). In August the same year, throughput of *Belokamenka* reached one million tonnes.

FSO *Belokamenka* received crude oil delivered to the Kola Bay by shuttle tankers from the terminals in the Ob Bay, Varandey and Talagi. In 2009-2013, *Belokamenka* was mostly occupied transhipping export crude oil from Varandey.

Figure 4.91 In February 2004, FSO *Belokamenka* received its first cargo of oil. It was in operation for 10 years loading Russian Arctic crude oil for export.

Figure 4.92 In December 2013, FSO *Belokamenka* offloaded its last cargo of oil and stopped transhipment operations.

In 2004, RPK-3 *Belokamenka* transhipped 2.5 million tonnes of crude oil for export, in 2005 – 3.3 million tonnes, in 2006 – 4 million tonnes, in 2007 – 3.3 million tonnes, and in 2008 – 3.7 million tonnes.

In 2009, *Belokamenka* transhipped 7.9 million tonnes of oil; and in 2010 – 7.5 million tonnes of crude was delivered, including 7.3 million tonnes from Varandey.

In 2011, annual crude oil export volumes of RPK-3 decreased to 3.2 million tonnes, and in 2012 – to 1.5 million tonnes following decline of shipments from Varandey accordingly. In 2013, FSO *Belokamenka* offloaded 4.5 million tonnes of crude oil for export, as Varandey increased its output with new fields connected to the terminal.

In December 2013, RPK-3 Belokamenka shipped its last load of 62 000 tonnes of crude oil to 106 500 tonnes deadweight *Afra Willow* that delivered cargo to Rotterdam.

Since January 2014, crude oil from Varandey is delivered to Northern Norway for transshipment.

A new offshore oil transhipment terminal in the Kola Bay, RPK Nord with FSO *Umba*, will be put in operation in 2016. 360 000 tonnes deadweight *Belokamenka*, former *Berge Pioneer*, should leave the Kola Bay by the end of 2015 and be returned to the Norwegian owner. 300 000 tonnes deadweight *Umba*, former *Berge Kyoto*, should arrive Murmansk and be installed east of Belokamenka in the beginning of 2016.

RPK Nord, subsidiary of Gazprom Neft, bought *Sarah Glory*, former Berge Kyoto (built in 2001) in 2013 and named her *Umba*. The tanker was modernised at Huarun Dadong Dock Yard in China to be used as FSO at the terminal location in the Kola Bay near Krasnoschelye Cape. RPK Nord terminal with the estimated annual capacity of 12 million tonnes will be put in operation in 2016 and transship crude oil from Gazprom Neft's Arctic terminal in the Ob Bay of the Kara Sea and Prirazlomnaya platform in the Pechora Sea.

The oil spill prevention and response services at all offshore terminals in the Kola Bay are provide by the Northern Branch of the Marine Rescue Service of Romorrechflot, former Murmansk Basin Emergency and Salvage Department. The Northern Branch runs regular oil spill response trials. In 2015, Russian-Norwegian search-and-rescue and oil-spill response exercises were held in the Kola Bay.

Murmansk Multi-Modal Port Complex

The Murmansk port is to be developed as a multi-modal hub on both eastern and western sides of the Kola Bay.

According to the Master Growth Plan for the Murmansk Transportation Hub elaborated by LenmorNIIproekt, the Kola Bay's east coast should boast: the special terminals for bulked freight with the capacity of 8.3 million tonnes; the coal terminal; the terminal for mixed freight with 2 million tonnes capacity; the special oil products terminal at the Shipyard # 35 with the capacity of up to 10 million tonnes; and the terminal for oil products at the pier with up to 8 million tonnes capacity.

Petroleum products will be delivered to the terminals on the eastern coast by rail and loaded to sea tankers.

The Kola Bay's west coast in the area of Lavna and Kulonga rivers are to house new facilities consisting of: oil terminal with shipping capacity of 4.5 million tonnes, including 470 metres long pier to moor tankers from 120 000 to 300 000 tonnes deadweight, oil storage for 400 000 cubic metres, and rail trestles; coal transhipment terminal with 15 million tonnes capacity; mixed freight and containers transhipment terminal with capacity of up to 3 million tonnes per year; supply depot and an oil terminal at the mouth of the Lavna River with the capacity of up to 25 million tonnes of crude oil and one million tonnes of other cargo.

In addition to that, the new dockyard will be built on the western coast for construction of super-large marine facilities with the annual output capacity of more than 300 thousand tonnes.

Figure 4.93 300 000 tonnes deadweight *Umba*, former *Sarah Glory* and *Berge Kyoto*, will be moored at RPK Nord terminal in the Kola Bay in 2016 and tranship export Arctic crude oil of Gazprom Neft delivered from Prirazlomnaya and Novy Port.

Figure 4.94 Ministry of Transport of Russia and the Administration of the Murmansk Region proposed to build up the Murmansk multi-modal port complex using both eastern and western coasts of the Kola Bay. The scheme shows the planned oil terminal near Lavna on the western side of the Kola Bay.

The construction of the port base in Lavna started in 1980s but stopped with the collapse of the Soviet Union. According to the development plan, oil should be delivered to Lavna terminal by new railway from Murmashi-II station to be constructed, and shipped to line tankers of up to 250 000 tonnes deadweight. The annual capacity of the oil terminal in Lavna should reach 25 million tonnes when completed.

In 2015, NOVATEK joined the project of the Murmansk Transportation Hub Development. The gas producer launched a project on establishing a centre for construction of super-large marine facilities on the western coast of the Kola Bay. The new Kola Shipyard, subsidiary of NOVATEK, will be located near Belokamenka village. According to the plan, the first line of the shipyard will be commissioned in 2017. By 2020, NOVATEK's intends to build three floating LNG plants with the annual capacity of 6.5 million tonnes of LNG each for its Arctic projects.

Figure 4.95 NOVATEK is building a centre for construction of super-large marine facilities on the western coast of the Kola Bay. The new Kola Shipyard (scheme) will construct floating LNG plants for NOVATEK's Arctic projects.

Rosneft plans to develop port infrastructure on both sides of the Kola Bay. In addition to facilities of Shipyards # 82, where the company should build the Arctic supply base, and an oil terminal at the Shipyard # 35 on eastern coast, RN-Active, a subsidiary of Rosneft, buys an oil terminal in Lavna from Sintez Petroleum.

It was estimated by three different scenarios that the Murmansk port freight turnover could be on the levels between 52 and 144 million tonnes per year in 2025.

The project of the Murmansk Transportation Hub Development has been included into the Federal programme 'Development of the Transport System of Russia'.

In October 2010, the Government of the Russian Federation established a Special Economic Zone for development of the Murmansk Transportation Hub.

Pechenga Sea Port

In 2006, Scientific Corporation Sevneft proposed to construct a Severniy (Northern) Port – Oil Complex and Dry-cargo Northern Sea Port in the Pechenga Bay of the Barents Sea, an ice-free area close to the border with Norway.

The planned total freight turnover was set as 65 million tonnes per year, with the perspective to increase the capacity up to 200 million tonnes. According to the technical project description, the port could consist of four shipping regions – oil and oil processing terminal; coal terminal; wood terminal; and general and container cargo terminal. The oil terminal should have shipping capacity of 30 million tonnes of oil and oil products per year, include an oil storage for 450 000 cubic metres; three double side rail trestles to handle 120 rail tank cars; and piers to ship four tankers of 150 000 tonnes deadweight. Oil should be transported to the port by rail, loaded to the oil storages and further shipped to tankers. Sevneft planned to start the construction in 2008, so the port could start operating in full scale in 2015. In 2008, the company International Sea Port Pechenga was established. However, construction of new international sea port facilities has not started yet.

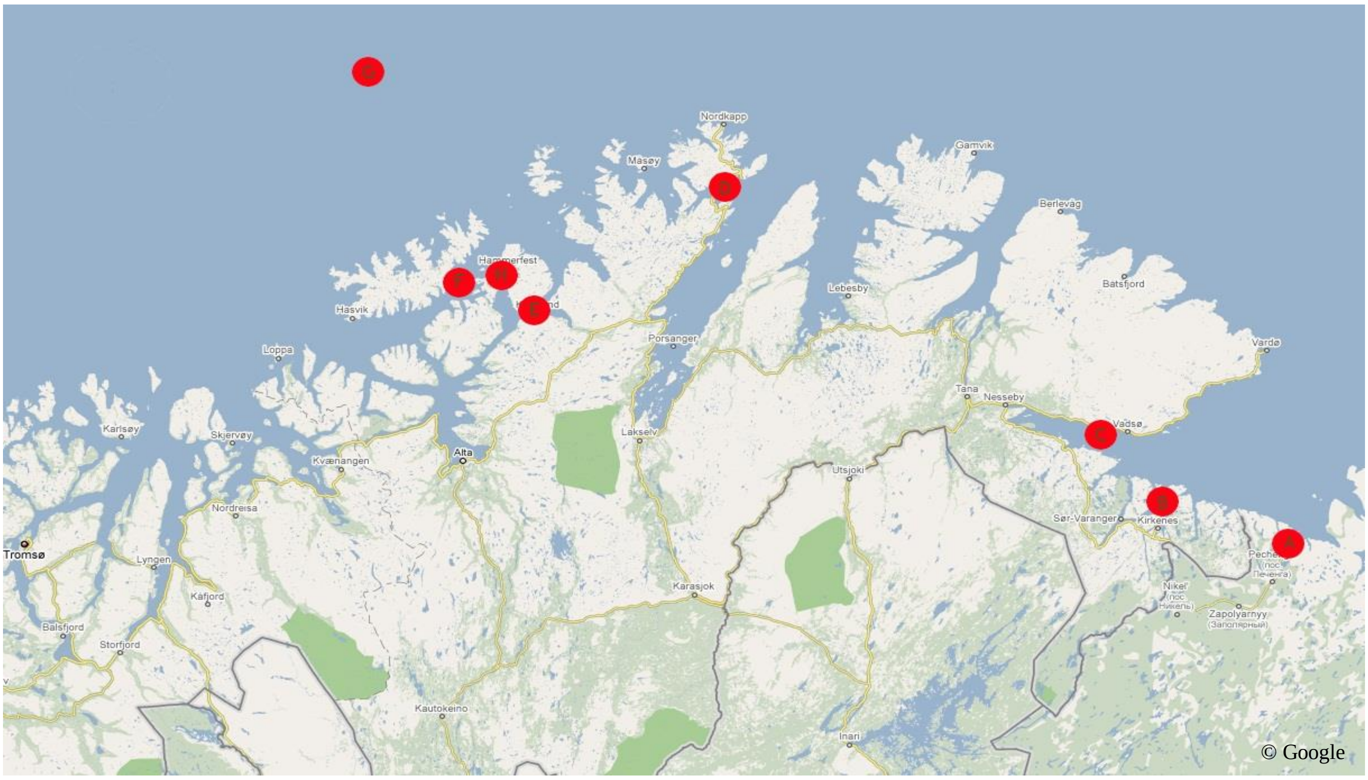

Figure 4.96 The Western Barents Sea coast with existing and planned terminals: (A) Pechenga Bay in Russia. (B) Bøkfjord and Kirkenes, (C) Paddeby near Vadsø, (D) Sarnesfjord and Honningsvåg near the North Cape, (E) Kvalsund, (F) Slettnes on Sørøya (G) Goliat platform in the Barents Sea, and (H) Melkøya LNG in Norway.

4.2.6 THE BARENTS SEA, NORWAY

Since the oil cargo flows from the Russian Barents Region started growing in 2002, several projects for establishment of transhipment terminals for Russian oil in the Northern Norway have been initiated. There have been different kinds of proposals to build offshore and onshore terminals in small and big fjords along the Norwegian coast from Kirkenes in the east to Tromsø in the west.

The formal requests for getting permits to build oil transhipment terminals in the Northern Norway were sent by Bergesen, ShipCargo Kirkenes (now, Norterminal Floating Storage), Kirkenes Transit (now, Tschudi Arctic Transit). The work to obtain the necessary permissions for the projected terminals went on from 2002 to 2015.

The ship owner Bergesen planned to anchor *Berge Enterprise* super tanker and use it as a Floating Storage and Offloading vessel (FSO) oil transfer terminal. This was a similar solution that Bergesen Company had with *Belokamenka*, former *Berge Pioneer*, in the Kola Bay near Murmansk. An anchored storage ship in Bøkfjord was considered as a permanent installation. The prospects to establish a terminal were based on the possible increase of oil cargo volumes to be shipped from Russia, and estimations of lack of oil transhipment capacities on the Russian side. These plans were not realised and 360 000 tonnes deadweight *Berge Enterprise* was converted to the floating production storage and offloading unit (FPSO), the world's largest converted FPSO, named *Yùum K'ak'Náab* and put in operation in the Gulf of Mexico.

In May 2002, there was the first oil transhipment in Bøkfjord operated by ShipCargo Kirkenes. Three ice-class tankers of LUKOIL Arctic Tanker offloaded ship-to-ship (STS) 15 000 tonnes of crude oil each into a 46 500 tonnes deadweight Greek tanker *Shinoussa* (now, *Omega*). This operation started the entire process of petroleum cargo transhipments in the Northern Norway. In 2005, ShipCargo received a permit for STS from the Norwegian Coastal Administration, and in 2007 got necessary permissions from other governmental institutions to carry out operations. In 2013, ShipCargo Kirkenes changed the owner and was reorganised to Norterminal Floating Storage, subsidiary of Norterminal, which started oil transhipments in Bøkfjord in 2014.

Figure 4.97 In winter 2005-2006, nine STS transfer operations of gas condensate were managed by Kirkenes Transit, now Tschudi Arctic Transit, in Bøkfjord. The cargo came from Vitino in the White Sea and after transhipment went to ports in the USA and Western Europe.

In 2005, a temporary permission for operations in Bøkfjord was given to Kirkenes Transit, now Tschudi Arctic Transit, and was annulled in 2006 when the authorities banned oil shipping activities in a salmon protected area. Kirkenes Transit got a permit to carry out oil shipments in Sarnesfjord, Honningsvåg close to the North Cape. The company accomplished nine operations in the winter of 2005-2006 in Bøkfjord, transhipping 55 000 tonnes of gas condensate each.

Terminals in Bøkfjord and Sarnesfjord were the first ones established in the Northern Norway for offloading petroleum cargoes from Russia, and both were involved in transhipping crude oil delivered from the Varandey terminal in the Pechora Sea in 2014.

In 2005-2011, terminals in the Norwegian part of the Barents Sea transhipped gas condensate delivered from Vitino. In 2012 and 2013, Russian petroleum cargoes were not handled in North Norwegian terminals. Operations with Russian oil were resumed in 2014, when crude oil from Varandey was sent for transhipment to STS terminals in Sarnesfjord and Bøkfjord instead of FSO *Belokamenka* in the Kola Bay.

The first petroleum production on the Barents Sea shelf came from the Norwegian gas field Snøhvit in 2007. The Goliat oil field should get on stream soon. We pay attention to status and plans for oil and gas production and transportation from these two fields in the Barents Sea.

There have also been announced plans to build terminals in other North Norwegian ports for handling oil and gas from Russia and Norway.

Bøkfjord and Korsfjord

In 2005, ShipCargo and Kirkenes Transit companies obtained official permission to carry out ship-to-ship (STS) oil transfer operations in Bøkfjord near Kirkenes. Kirkenes Transit of Tschudi Group ran operations with gas condensate that was offloaded from an inbound ship into tankers of up to 75 000 tonnes deadweight anchored near Reinøy in the Bøkfjord. Gas condensate was transported by rail from Western Siberia to Vitino port in the White Sea, from where it was transported further by tankers to Kirkenes.

In a statement by Norwegian authorities, it was pointed out that the chosen oil shipping sites were situated in the national salmon protected areas of Neiden, the Korsfjord and the Bøkfjord, where an activity that represented a risk of pollution that could damage salmon was forbidden.

In 2005, there were two STS operations offloading 104 000 tonnes of condensate and in 2006 – nine STS operations shipping 480 000 tonnes to the markets in Europe and the USA. Those operations were carried out during winter.

Both companies, ShipCargo and Kirkenes Transit, applied for permission to run STS and FSO operations in Bøkfjord and Korsfjord in Sør-Varanger municipality in 2007-2009. They both received permits including strong regulations to do maximum 40 transhipments per season with FSO established.

High nature values of the fjord and strong regulations made Kirkenes Transit to move their operations to Sarnesfjord in Honningsvåg port close to the North Cape.

Transhipment operations with Russian export oil were resumed in Bøkfjord in 2014.

Figure 4.98 Norterminal started oil transhipment operations in Bøkfjord in October 2014 using 165 000 tonnes deadweight *Triathlon* to transfer oil between shuttle and export tankers. Photo: *Timofey Guzhenko* delivers first cargo of crude oil to *Triathlon*.

Norterminal, a joint venture of S-N Terminal and Stolthaven Norterminal of Stolt-Nielsen, was established in 2012 and launched the process of developing an oil transhipment terminal with storage facilities on shore at Gamneset on the eastern cost of Korsfjord north of the Kirkenes airport.

Construction is planned to start in 2016, with operations to be launched in 2018-2019. The first construction phase should provide storing capacity for 400 000 cubic metres of oil in on shore tank farm; the second – for another 800 000 cubic metres; and the third one – for 600 000 cubic metres in caverns. An import quay will be built to receive tankers of 16 000 – 70 000 tonnes deadweight, and an export quay is planned for handling tankers up to 300 000 tonnes deadweight. When completed, the terminal can handle 150-300 tankers per year and has an oil transhipment capacity for 10-20 million tonnes.

In 2013, Norterminal signed a contract with Litasco of LUKOIL for handling crude oil offloaded at the Varandey terminal in the Pechora Sea for the European markets. While awaiting the completion of its oil terminal on shore, Norterminal has obtained permission for floating operations at four positions in Bøkfjorden and Korsfjorden, north and north-west of Kirkenes, through its subsidiary Norterminal Floating Storage, former ShipCargo Kirkenes.

On basis of the contract with LUKOIL, and while the company was awaiting approval to conduct oil transhipments in Bøkfjord, Norterminal was running STS operations in Sarnesfjorden at Honningsvåg from January to October 2014. Transhipment were carried out by Tschudi Arctic Transit, former Kirkenes Transit, while Arctic Protection provided oil-spill response services.

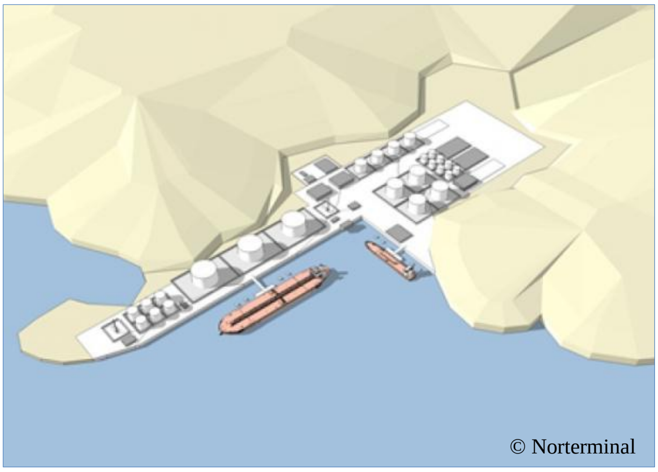

Figure 4.100 Norterminal has launched a project for construction of the oil terminal at Gamneset on the eastern coast of Korsfjord with the overall storage facilities for 1.8 million tonnes and transhipment capacity for 10-20 million tonnes of oil per year.

Figure 4.99 For two months of oil transfer operations in Bøkfjord in 2014, Norterminal handled 1.1 million tonnes of crude oil from Varandey that was transhipped from shuttle to export tankers and carried to ports in the Great Britain and the Netherlands.

In October 2014, the operations were moved to Kirkenes, with STS conducted at a position south of Reinøya. To optimise operations, Norterminal used 165 000 tonnes deadweight MT *Triathlon* of Greek Tsakos Columbia Shipmanagement to handle oil cargo between 73 000 tonnes deadweight shuttle tankers *Vasiliy Dinkov*, *Kapitan Gotskiy* and *Timofey Guzhenko* of Sovcomflot and export tankers up to 120 000 tonnes deadweight, like *Delta Captain* or *Proteas*, that delivered crude oil to Fawley in Great Britain or Rotterdam in the Netherlands.

Oil spill response and preparedness services at the terminal are provided by Norterminal Response, a subsidiary of Norterminal established in September 2014. The new company has more than 20 certified employees, disposes two 27-30 feet Jemar response vessels, one icebreaker, and specialised response equipment.

By the end of 2014, Norterminal handled 1.1 million tons of crude oil delivered with 19 voyages of shuttle tankers from Varandey to Kirkenes roads; and for the whole year of 2014, almost 5.7 million tonnes of Russian export crude oil were transhipped at terminals in Sarnesfjord and Bøkfjord in the Northern Norway.

In January 2015, the Norwegian Environment Agency made an inspection of Norterminal's STS operations in Bøkfjord and claimed that conditions for the permission were violated as the Reinøya position – unlike three other locations - was not approved for FSO. According to the agency's statement, *Triathlon* had to be defined as FSO, as it temporarily stored oil on-board between arrivals of export tankers. Further operations at the Reinøya position have been conducted in compliance with the agency's definition – STS transfer carried out directly from shuttle to export tankers.

Export tankers loaded in Bøkfjord are partially 100 000 tonnes deadweight Aframax and 140 000 tonnes deadweight Suezmax.

Due to weather conditions and appearance of ice slush during part of the winter in Bøkfjord and Korsfjord, Norterminal applied to the Environment Agency in March 2015 for a permission to use a new position in Korsfjord for STS and FSO during winter season. The overall transhipment capacity can be increased by operating simultaneously at two locations, if required. The present STS location in Bøkfjord is approved for 3.5 million tonnes annually, while the new position in Korsfjord could provide the capacity for transhipping 10-11 million tonnes per year – sufficient to handle all planned oil output from the Varandey terminal by 2020.

Transhipment operations with FSO in Korsfjord require construction of shore based anchoring of the vessel. Norterminal considers using a 140 000 tonnes deadweight Suezmax as FSO on a short term, and installing a 280 000 tonnes deadweight VLCC in the future.

Vadsø

In 2004 and 2005, there were plans of establishing an oil terminal near Vadsø on the northern side of the Varanger fjord. The consideration about the terminal was to get a location for transhipment of Russian oil. The plan was to transport oil to be delivered to Vadsø by shuttle tankers from terminals in the Northwest Russia.

The Canadian company Scannex Incorporation was a project initiator that intended to establish a land-based oil terminal in Paddeby near Vadsø. The plan was to build capacities for storing 500 000 tonnes of oil either in underground tanks or in reservoirs on the ground. The pier was to be constructed in the fjord to moor 300 000 tonnes deadweight VLCC as FSO on one side and to receive export tankers of 100 000 tonnes deadweight and smaller tankers shuttling between the port in the White Sea and Paddeby – on the another side of the pier.

There has not been taken any further steps with this project during recent ten years.

Figure 4.101 Norterminal carries out oil transhipment operations in Bøkfjord with STS transfer directly from shuttle to export tankers (photo), following requirements of the Norwegian Environment Agency after their inspection in January 2015. In March 2015, Norterminal applied for a permission to install FSO at a new location in Korsfjord.

Sarnesfjord

The oil transhipment in Sarnesfjord near the North Cape in the water area of the port of Honningsvåg was a continuation of the activities carried out in Bøkfjord on Kirkenes roads after authorities did not allow any further operations there. In 2006, the Norwegian Pollution Control Authority (SFT) granted Kirkenes Transit, now Tschudi Arctic Transit, a permit to tranship oil. In the 2007 oil transport report, we published excerpts from the permits that SFT issued for terminals in Bøkfjord and Sarnesfjord giving an example of environmental requirements for carrying out oil transfer operations in northern Norwegian fjords.

The operations in Sarnesfjord in 2007-2009 were conducted by 75 000 tonnes deadweight tankers. Each vessel had a capacity of carrying about 55 000 tonnes of gas condensate. The plan was to handle 2.2 million tonnes of gas condensate per season. In cooperation with Honningsvåg port authorities, Kirkenes Transit chose three locations to be used for STS operations – two in Sarnesfjord; and the third one in Kåfjord. STS transfers were carried out between anchored shuttle and export tankers.

Kirkenes Transit started their operations for transhipping Russian petroleum cargo in Bøkfjord, Sør-Varanger, but moved operations to Sarnesfjord, Nordkap municipality when environmental authorities first closed Bøkfjord for oil transfer operations, and then gave a permit with requirements difficult to follow.

All the cargo transhipped in Sarnesfjord in 2007-2009 and in 2011 was gas condensate of the Russian

Figure 4.102 In August 2011, *Stena Poseidon* and *Tamar* transhipped 60 000 tonnes of gas condensate each to 162 000 tonnes deadweight *Vladimir Tikhonov* at STS terminal in Sarnesfjord operated by Tschudi Arctic Transit. *Vladimir Tikhonov* delivered cargo eastbound to Thailand being the largest tanker piloted through the Northern Sea Route.

gas producer NOVATEK delivered from Vitino port in the White Sea. In 2007, there were eight STS operations with 425 000 tonnes of condensate, and in 2008 – nine with 500 000 tonnes, and in 2009 – nine with 526 000 tonnes of gas condensate. In 2010, there was no transhipment activity in Sarnesfjord.

In 2010, Kirkenes Transit was reorganised to Tschudi Arctic Transit, a subsidiary of the Tschudi Group. The same year, the company got a permit from Norwegian environmental authorities to tranship crude oil in Sarnesfjord in addition to gas condensate and clean products.

In 2011, Tschudi Arctic Transit was involved in a historic voyage of a Suezmax tanker through the Northern Sea Route. In August 2011, 75 000 tonnes deadweight *Stena Poseidon* (now, *Espada Desgagnes*) and 70 000 tonnes deadweight *Tamar* (now, *Muskie*) delivered 60 000 tonnes of NOVATEK's gas condensate each from Vitino in the White Sea to Sarnesfjord in the Barents Sea and transhipped cargo to 162 000 tonnes deadweight *Vladimir Tikhonov* of Sovcomflot. STS transfer operation was conducted by Tschudi Arctic Transit. *Vladimir Tikhonov* delivered gas condensate to the port of Map Ta Phut in Thailand via the NSR and became the largest tanker that passed the NSR in transit under pilotage of nuclear-powered icebreakers of Atomflot.

In 2012 and 2013, Tschudi Arctic Transit has not carried out transhipment operations in Sarnesfjord.

From January to October 2014, Norterminal involved Tschudi Arctic Transit in running STS transfer operations at the terminal in Sarnesfjord with crude oil from LUKOIL's Varandey terminal. 73 000 tonnes deadweight ice-class tankers *Vasiliy Dinkov*, *Kapitan Gotskiy* and *Timofey Guzhenko* shuttled between Varandey and Sarnesfjord terminals and transhipped crude oil to Aframax or Suezmax tankers, like 104 000 tonnes deadweight *Tulip* or 158 000 tonnes deadweight *Mare Picenum*, that delivered export cargoes to ports in the Western Europe.

During nine months of 2014, three shuttle tankers made 84 calls to Honningsvåg bringing 4.5 million tonnes of crude oil from Varandey in the Pechora Sea to Sarnesfjord in the Norwegian part of the Barents Sea for transhipment.

In October 2014, Norterminal moved STS oil transfer operations from Sarnesfjord to Bøkfjord.

Figure 4.103 Tschudi Arctic Transit, former Kirkenes Transit, carried out STS transfer operations in Sarnesfjord with gas condensate of NOVATEK delivered from Vitino port in the White Sea; and with crude oil carried from LUKOIL's Varandey terminal in the Pechora Sea.

Kvalsund

Kvalsund municipality in the West Finnmark together with Kvalsund Næringspark, Polar Gjenvinning and Arctic Terminal Operating Company (ATOC) proposed to establish a terminal for oil offloading operations and a service port for the oil-and-gas industry.

Kvalsund municipality allocated an area of 45 hectares for commercial use. The municipality was motivated to have an oil terminal, which could serve petroleum projects in both Norwegian and Russian sectors of the Barents Sea. It was proposed to build rock caverns for oil storage, and a quay capable to receive VLCC super-tankers. Kvalsund municipality visualised a gradual development of offloading facilities: ship-to-ship in the Repparfjord; loading at the existing quay for smaller ship; construction of deep-water port for super-tankers at Markoppnes; transfer from smaller to larger vessels via rock caverns.

ATOC, a company under the foundation that consists of five companies including the biggest partner – FenderCare Marine, in 2006, applied to Norwegian authorities for a permission to carry out STS operations in Repparfjord, Kvalsund municipality. The application was sent at a time when Norwegian environmental authorities temporarily banned oil transfer operations in Bøkfjord. The plan was to have gas condensate or crude oil delivered from Russia to Repparfjord by shuttle tankers between 20 000 and 100 000 tonnes deadweight and transfer cargo to export tankers of up to 165 000 tonnes deadweight.

There has not been any development with this project after 2006.

Sørøya

Nordoil Caverns Company was established in 2006 by Baroil, Hammerfest Harbour and Hasvik Municipality and developed a proposal for building an oil terminal in one of two alternate locations at Sørøya – in Slettnes, Hammerfest municipality or in Dønnesfjord, Hasvik municipality. Nordoil proposed to build storage for crude oil and oil products in rock caverns and a terminal for transhipping oil from Goliat field in the Barents Sea and from the Russian Barents Region.

When the decision was made that the crude oil from Goliat would be offloaded to export tankers from the offshore platform directly, the project with Nordoil caverns was stopped.

Sørøysundet

Hammerfest Harbour owned by Hammerfest municipality during 2007-2010 investigated the possibilities of establishing STS-operations in Sørøysundet within the borders of Hammerfest municipality. The FenderCare Barents Company has applied to the Norwegian environmental authorities for a permit in 2010. The goal was to do up to 140 STS operations per year for a total of 8.4 million tonnes of petroleum cargo, and bunker operations of ships too large to enter the bunker services inside the port of Hammerfest. Ships between 50 000 and 60 000 tonnes deadweight were to deliver petroleum cargoes - gas condensate, refined products and crude oil, to tankers of up to 300 000 tonnes deadweight.

In 2011, the municipality council of Hammerfest decided that there shall not be STS operations in Sørøysundet.

Snøhvit and Melkøya

Snøhvit operated by Statoil is the first offshore development in the Barents Sea. Subsea installations produce and transport natural gas to land for liquefaction and export from the first plant of its kind in Europe and the world's northernmost liquefied natural gas (LNG) facility. Snøhvit is the first big project on the Norwegian continental shelf with no surface installations at sea.

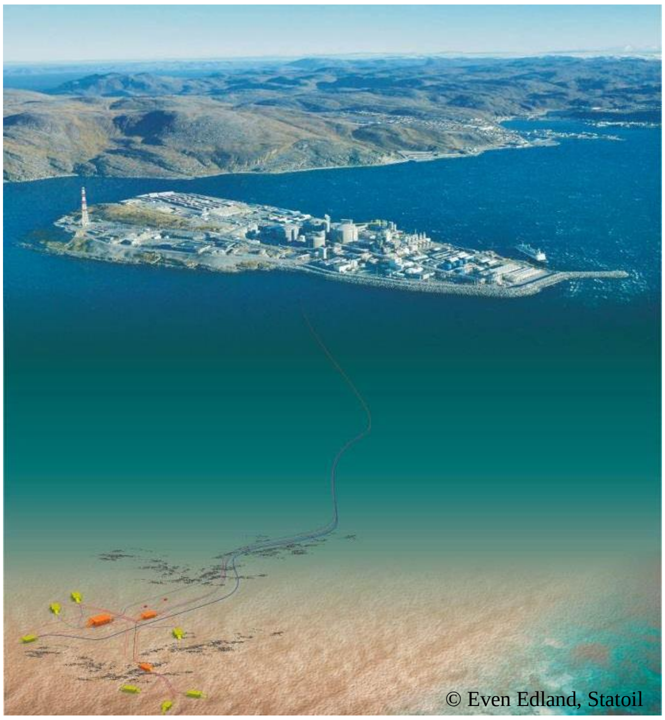

Figure 4.104 Snøhvit subsea installations connected by a 143-kilometre long pipeline with LNG at Melkøya.

Figure 4.106 In November 2012, *Ob River* was loaded with 75 000 tonnes of LNG at Melkøya (photo) and delivered cargo to Tobata in Japan via the Northern Sea Route (NSR). In 2013, Snøhvit LNG was delivered to Japan by *Arctic Aurora*. When sailing along the NSR LNG carriers were escorted by Atomflot icebreakers.

The subsea production facilities stand on the seabed, in water depths of 250-345 metres. A total of 20 wells produce gas from the Snøhvit, Askeladd and Albatross fields. This output is transported to land through a 143-kilometre pipeline. The Snøhvit and Albatross wells came on stream in 2007. The Askeladd part of the development is not due to come on stream until 2014-15. The production period is estimated for 2007-2035. Reserves are estimated to 193 billion cubic metres of natural gas and 15 million tonnes of condensate.

The sub-sea facility transport gas to Melkøya, Hammerfest from where the liquefied products are exported to the markets in Europe, North and South America and Asia.

Production at Snøhvit started in 2007. That year, there were produced 145 million cubic metres of natural gas, 14 000 cubic metres of natural gas liquids (NGL) and 111 000 cubic metres of gas condensate. There were exported 67 000 tonnes of condensate on two ships and 294 000 cubic metres of LNG (or 155 000 tonnes) on 4 vessels from Melkøya.

The annual production at Snøhvit was growing three following years and reached almost 5 billion cubic metres of natural gas in 2010. In 2011-2013, annual natural gas production was on the levels between 4.2 and 4.7 billion cubic metres; and in 2014, rose to a 5.2 billion cubic metres – the highest level since the production start at Snøhvit. In addition to dry natural gas, there were produced almost 480 000 cubic metres of NGL and 800 000 cubic metres of gas condensate in 2014.

7.6 million cubic metres (or 3.2 million tonnes) of export LNG was offloaded at Melkøya to 54 carriers in 2012; 6.9 million cubic metres (2.9 million tonnes) to 49 vessels in 2013; and 8.5 million cubic metres (3.6 million tonnes) to 60 carriers in 2014. In addition to LNG, Melkøya shipped 545 000 tonnes of gas condensate to 15 tankers and 238 000 tonnes of liquid petroleum gases (LPG) in 2012; 511 000 tonnes of condensate and 209 000 tonnes of LPG to 14 and 10 tankers in 2013; and 590 000 tonnes of condensate and 250 000 tonnes of LPG to 16 and 13 tankers respectively in 2014. LPG was delivered to both domestic and international markets.

LNG from Melkøya is exported mostly to Western Europe. In 2012 and 2013, Snøhvit LNG was also delivered to Asia via the Northern Sea Route (NSR). In November 2012, LNG carrier *Ob River*, former *Clean Power*, of Dynagas chartered by Gazprom was loaded with 75 000 tonnes of LNG at Melkøya and delivered cargo to Tobata in Japan In 2013, *Arctic Aurora* carried 67 000 tonnes of LNG from Melkøya to Japanese port of Chiba via the NSR. LNG carriers were piloted through the NSR by nuclear-powered icebreakers of Atomflot.

Figure 4.105 In 2014, 8.5 million cubic metres of LNG was offloaded at Melkøya to 60 carriers, 590 000 tonnes of gas condensate to 16 tankers, and 250 000 tonnes of LPG to 13 tankers. Most of petroleum cargo was exported.

Goliat

The Goliat field is located in the Barents Sea between Snøhvit and Hammerfest. It will be the first oil field put in production in the Norwegian part of the Barents Sea. The production licence for the area was awarded to Eni Norge (65%) and Statoil Petroleum (35%) in 1997, and the discovery was made with the first exploration well in 2000.

Recoverable oil reserves at the Goliat field are estimated for 28.5 million cubic metres, and recoverable natural gas reserves – for 8 billion cubic metres.

Annual production of oil should reach a top of about 5 million tonnes the first year of production and then will decline to about 1.5 million tonnes, followed by a further reduction to 0.4 million tonnes. Gas produced at Goliat will be re-injected into the Kobbe reservoir or transported to Melkøya. Maximum annual gas production on the level of about 1.1 billion cubic metres can be reached two years after the production start. The Goliat field will be in production for at least 15 years. Its lifetime may be extended if new discoveries are made.

Operator Eni Norge planned the first gas and oil to be produced from the field in 2013, but the production start has been postponed. The installation period at Goliat was completed in 2015, and the first shipment of oil from a Floating, Production, Storage and Offloading (FPSO) facility is expected in 2016.

Eni Norge and Statoil has chosen Sevan FPSO 1000 concept for development of the Goliat field. The world's largest cylindrical FPSO, 59 400 tonnes heavy, 75 metres high, 112 metres long (bilge box), 90 metres in waterline diameter, 210 000 tonnes displacement at 30.5 metres draft, has been designed by a Norwegian company Sevan Marine and built at the Hyundai Heavy Industries in South Korea. The platform has an oil production capacity of about 14 000 tonnes per day, a gas reinjection capacity of 4 million cubic metres per day and an oil storage capacity of 150 000 cubic metres. Goliat FPSO started its voyage from South Korea to Norway in February 2015 on board 116 000 tonnes deadweight *Dockwise Vanguard* heavy lift vessel and arrived Hammerfest in April 2015. The platform, installed at its location in the Barents Sea at water depth of 400 metres 85 kilometres northwest of Hammerfest, should start producing and offloading oil in the beginning of 2016.

Figure 4.107 Floating, Production, Storage and Offloading unit (FPSO) built for Goliat started its voyage from South Korea to Norway in February and arrived Hammerfest in April 2015. Goliat FPSO should eb put on stream and offload oil in 2016. Photo: Goliat FPSO floated off *Dockwise Vanguard* semi-submersible heavy lift vessel in the Barents Sea.

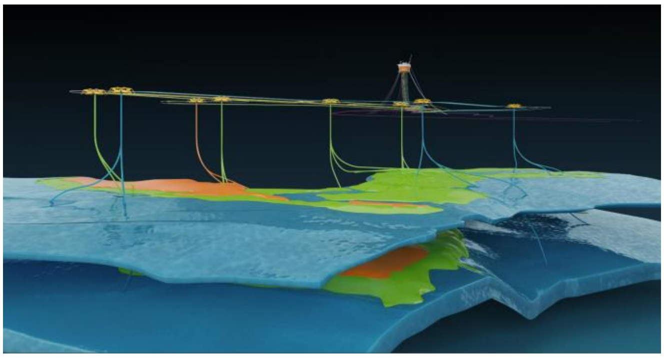

Figure 4.106 Recoverable hydrocarbon reserves at Goliat field are estimated for 28.5 cubic metres of oil and 8 billion cubic metres of gas. Goliat will be the first oil field put in production in the Norwegian part of the Barents Sea.

Eni Norge and Statoil together with the Norwegian Clean Seas Association (NOFO) have taken an initiative to implement new oil spill preparedness principles at Goliat. Oil spill protection plan is based on four barrier principle: on the field (risk reduction measures); in the open ocean (NOFO barriers 1 and 2); along the coast; and on land. For the first time, the local coastal fishing fleet is included in the oil spill preparedness and response plans. Goliat operations will be supported by new and modern oil spill contingency vessels – *Esvagt Aurora* and *Stril Barents*. Remote monitoring of possible oil spills will be operated from aircrafts, helicopters, satellites and ships and should not depend of weather conditions. New storages of equipment to combat an oil spill are located in Hasvik and Måsøy municipalities.

5 Environmental Safety

In the previous reports issued in 2005, 2007, 2009 and 2011, we published articles about environmental national policies in Russia and Norway; examples of environmental policy documents of Russian and Norwegian oil companies; brief description of oil pollution prevention systems in both countries. We wrote about the vessel traffic monitoring and control system developed in Norway since 2002. We gave examples of the Norwegian pollution control authority requirements for oil transhipment in the Northern Norway, and wrote about bilateral Norwegian-Russian cooperation in oil pollution prevention. A brief status description of the vessel traffic monitoring and the Norwegian-Russian ship reporting system is given in this section. We also write about new salvage fleet built for Russia and Norwegian-Russian emergency response and bilateral cooperation.

We have paid attention to environmental problems caused by oil spills in the sea in Norway and Russia. In 2005 report, we wrote about accidents happened with *Rocknes* in Norway, *Nefterudovoz* and *Cristoforo Colombo* in Russia. The accident with *Server* and clean-up operations were described in the 2007 report. In the 2009 report, we provided some information about the big accident happened in the Kerch Strait between the Azov and the Black seas. In the report published in 2011, we paid attention to the world's biggest oil spill ever that happened in the Mexican Gulf; and wrote about ship accidents in Norway with *Full City* and with *Petrozavodsk* in 2009; and with *Godafoss* in 2011.

An article about the complexity in rehabilitation of oiled wildlife was included in the 2011 report. With the present report, we continue paying attention to the problem of wildlife protection from oil pollution. We give one example of a major seabird loss caused by a minor oil spill back in 1979, and present the Norwegian response system for treatment of oiled seabirds status and development. Finally, we give a brief presentation of the world's first unit for treating birds contaminated by oil spills that was opened in Finland in 2008.

5.1 VESSEL TRAFFIC MONITORING SYSTEM

The Norwegian coast emergency response system and the vessel traffic monitoring and control developed in Norway in 2002-2010 was described in the report published in 2011. In this chapter, we give a brief information about the vessel traffic services along the North-Norwegian coast, prepared by the Norwegian Oceanic Region Vessel Traffic Service (NOR VTS), and a new Norwegian-Russian ship reporting system established.

5.1.1 VESSEL TRAFFIC SERVICES IN NORTHERN NORWAY

Norway operates five Vessel Traffic Service Centres through the Norwegian Coastal Administration (NCA), the agency of the Norwegian Ministry of Transport and Communications. These cover ship traffic along the Norwegian coast.

Norwegian Oceanic Region Vessel Traffic Service (NOR VTS) is the northernmost centre, located in Vardø. It became operational on 1st of January 2007, and now covers traffic monitoring in the northern areas from the Barents Sea to Lofoten by means of radar monitoring, ship reporting and Automatic Identification System (AIS).

NOR VTS also administers the state tugboat emergency preparedness scheme in Northern Norway. From July 2008, NOR VTS became responsible for monitoring all tankers and other hazardous traffic along the entire coast and the sea area around Svalbard, with the exception of the areas of operation for the Norwegian Coastal Administration's other four VTS centres. It also provides statistics for ships that sail with petroleum cargoes through its area of coverage.

NOR VTS has the following primary tasks:

- monitor ship movements – record, identify and detect irregularities;
- prevent accidents by maintaining constant dialogue with vessel traffic;
- take action and alert when a situation requires it;

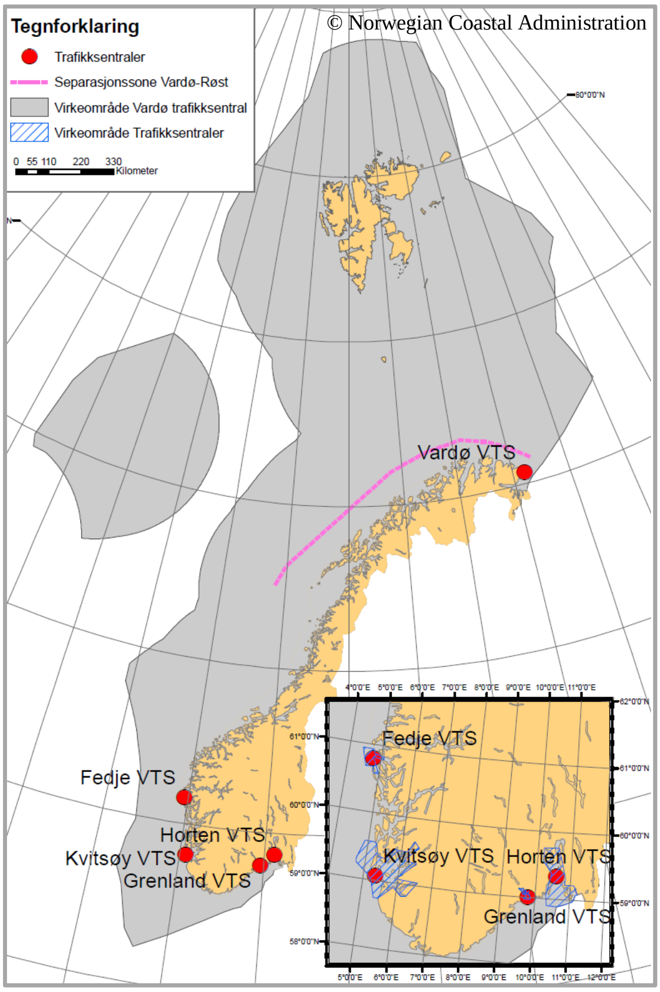

Figure 5.1 An area of NOR VTS responsibility with a vessel traffic separation scheme.

- manage tugboat preparedness Norway;
- monitor the coverage area in the Norwegian economic zone, Svalbard and Jan Mayen;
- NAVAREA XIX coordinator, issuing and sending of navigational warnings;
- assembly and provision of statistics;
- first line response of the NCA;
- contact in the agreement on international notification of acute pollution with Russia;
- information exchange with Iceland;
- national coordinator of Single Hull, reporting to HELCOM/EMSA.

To fulfil these responsibilities in a safe and effective manner, NOR VTS is equipped with the latest surveillance and communication technology, including its own receiving station for AIS-data from Norwegian Space Centre's Polar satellites AISSat-1 and AISSat-2. By the end of 2015, they will be complemented by AISSat-3, and in February 2016, the Norwegian Space Centre will start providing additional data through launch of Norsat-1.

Central to this are:

- AIS chain
- AIS satellites
- AIS data from Russia
- Telenor's coastal radio chain
- Long Range Identification and Tracking (LRIT)
- Armed Forces' coastal radar chain
- NCA's SafeSeaNet ship reporting system
- C-Scope map system
- Operating Support System (OSS)

The combination of these advanced technology systems enables the detection of irregularities in shipping. This alerts the VTS at an early stage and enables the preventive measures implementation to avoid adverse incidents. In such cases, the VTS works closely with the NCA's emergency forces and other agencies, including the Armed Forces and the Rescue Coordination Centres in Norway.

NOR VTS has participated in several exercises and incidents that have provided increased knowledge on the handling of incidents at sea and that have improved expertise on the traffic service's data and communications systems.

In 2015, NOR VTS expanded its activities to do in-depth analytical work on the maritime traffic in the North to be more efficient in revealing any irregular or illegal activities. The new analytical unit in Vardø consists of four experts, two of them reporting to the Directorate of Fisheries. They operate in close cooperation with national tax and customs authorities and the Norwegian National Authority for Investigation and Prosecution of Economic and Environmental Crime.

Figure 5.2 NOR VTS monitors all tankers and other hazardous traffic along the coast of Norway and around Svalbard. In 2015, a new analytical unit was put in operation at NOR VTS in Vardø.

5.1.2 BARENTS SHIP REPORTING SYSTEM

The Barents Ship Reporting System (SRS) came into force on 1st of June 2013. A new Norwegian-Russian ship reporting system has become the first fully electronic one in the world that was approved by the International Maritime Organisation (IMO).

Through the new mandatory reporting system, the Vessel Traffic Services in Murmansk, Russia and Vardø, Norway receive early notification of traffic that requires special attention. That includes vessels carrying petroleum cargo, radioactive materials and vessels under tow. All vessels above 5000 tonnes of gross tonnage are also obliged to report.

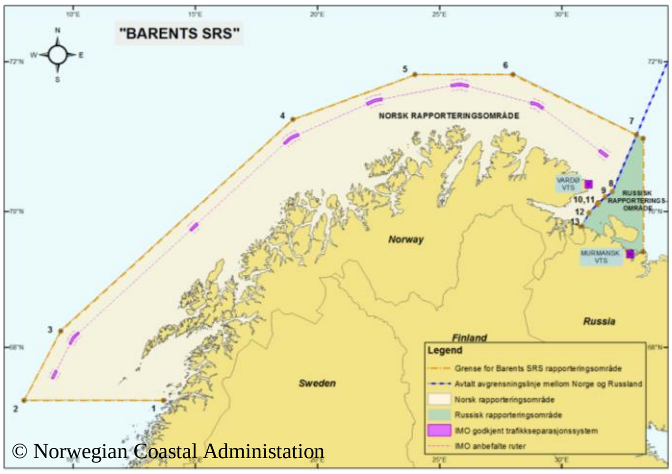

Figure 5.4 Barents SRS, a new Norwegian-Russian ship reporting system approved by IMO, came into force on in June 2013.

5.1.3 NEW SALVAGE FLEET FOR RUSSIA

Marine Rescue Service of Rosmorrechflot, an agency of the Ministry of Transport of Russia, is the state responsible institute for oil-spill response and search and rescue operations at sea. The area of responsibility of the Northern Branch of Marine Rescue Service with headquarters in Murmansk covers the Russian part of the Barents Sea, White, Pechora, Kara Seas and the western part of the Laptev Sea. Since 2002, Rosmorrechflot has ordered construction of 41 new rescue-salvage vessels within the implementation of federal programmes of the Russian transport system development for 2002-2010 and 2010-2015. In the period from 2010 to 2014, Marine Rescue Service received 24 vessels, including 7 MW multipurpose salvage icebreaking vessel *Baltika*, and three 4 MW ice-class multipurpose salvage vessels *Spasatel Karev*, *Spasatel Kavdeykin* and *Spasatel Zaborshchikov*. The fourth vessel in the series, *Spasatel Demidov*, should be delivered by the end of 2015.

The first in its kind oblique icebreaker *Baltika* was designed for oil spill response and rescue operations by Aker Arctic Technology and constructed in cooperation by Arctech Shipyard in Helsinki and Shipyard Yantar in Kaliningrad. *Baltika* was delivered to the Marine Rescue Service in 2014; and in 2015, she was on duty in the Kara Sea. The lead salvage icebreaker *Spasatel Petr Gruzinsky* is under construction at Amur Shipbuilding Plant since 2010.

In 2014, the third and fourth 7MW multipurpose salvage icebreaking vessels were launched at Nordic Yards Wismar in Germany. *Beringov Proliv* and *Murman* should be put in operation by the end of 2015. *Murman* will be assigned to the Northern branch of Marine Rescue Service of Rosmorrechflot.

Figure 5.3 The first oblique icebreaker *Baltika* was commissioned at Arctech Shipyard in Helsinki and delivered to Marine Rescue Service in 2014.

Figure 5.5 Salvage icebreaking vessels *Beringov Proliv* and *Murman* are built by Nordic Yards Wismar in Germany for Marine Rescue Service of Russia.

5.1.4 NORWEGIAN–RUSSIAN COOPERATION IN MARITIME SAFETY AND OIL SPILL RESPONSE

The cooperation in the field of protection against oil pollution between Russian and Norway has been going on for more than 20 years and focused on prevention of the Barents Sea environment from accidental oil spills.

This cooperation is built on the basis of the inter-governmental Agreement on Maritime Safety and Environmental Protection against Oil Pollution from 1994 with the Joint Norwegian-Russian Contingency Plan for the Combatment of Oil Pollution in the Barents Sea is its integral part. The agreement was based on the 1990 International Convention on Oil Pollution Preparadeness, Response and Cooperation (OPRC).

The bilateral cooperation has had the character of practical joint activities, in which the oil pollution protection authorities from two countries have obtained experience and have had joint exercises both in Norway and in Russia. Earlier, the joint exercises were organised every other year; in the recent years, the joint oil spill response trainings are held at least once a year and regularly combined with search-and-rescue drills in the Barents Sea.

The Norwegian Coastal Administration, the agency of the Ministry of Transport and Communications of Norway, and the Marine Rescue Service of Rosmorrechflot, the agency of the Ministry of Transport of Russia, represented by its Northern branch, have been the most important players in the joint work on oil pollution prevention. Environmental, fishery and emergency response authorities on national and regional levels, private oil spill response units and environmental NGOs have also been actively involved in workshops and trainings. The joint activities and oil-spill response exercises have been coordinated with bilateral search-and-rescue cooperation, organised within the Russian-Norwegian Agreement on Search of Missing People and Rescuing Persons in Distress in the Barents Sea signed in 1995 as continuation of the bilateral agreement dating back to 1956.

Figure 5.6 The 3rd joint Russian-Norwegian oil-spill response exercises in the Kola Bay were held in May 2014 and included oil pollution prevention and clean-up actions at sea and on shore.

Figure 5.7 The joint Norwegian-Russian exercises Barents are held in the Varanger fjord of the Barents Sea every year. Photo: *Beta* of the Norwegian Coastal Administration and *Kapitan Martyshkin* of the Northern branch of Marine Rescue Service of Russia at the Exercise Barents-2015.

In May 2014, the 3rd joint Russian-Norwegian oil-spill response exercises were arranged in the Kola Bay of the Barents Sea within the 1994 Agreement. The training included oil pollution clean-up actions at sea and on shore, and involved rescuers and equipment of state and private oil-spill response units from Murmansk and Øst-Finnmark, as well as volunteers of the WWF Barents Sea office.

The large-scale bilateral Exercise Barents are arranged in the Varanger fjord of the Barents Sea. The joint drills held in June 2014 were led by the Norwegian side, and the ones carried out in June 2015 – by the Russian partners. Both exercises carried out in 2014 and 2015 had multi tasks with search-and-rescue and oil-spill response elements, and involved personnel and facilities (vessels, airplanes, helicopters, specialised equipment) of rescue units of navy, coast guards, transport ministries, emergency and fishery departments from Russia and Norway.

5.2 OIL SPILL RESPONSE AND WILDLIFE PROTECTION

The chapter 'Oiled Wildlife Response' based on the article of Barbara Callahan from the International Bird Rescue Research Center (IBRRC) can be found in our 2011 report. We follow up the topic of wildlife protection in case of an oil spill in this report and write about a major seabird loss caused by a minor oil spill back in 1979; the Norwegian response system for treatment of oiled seabirds current status and development prospects; and the first in the world special mobile unit for treating birds contaminated by oil spills that was established in Finland in 2008.


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Figure 5.9 During the Varanger fjord oil spill in March 1979, the fjord was full of auks and other seabirds.

5.2.1 MINOR OIL SPILL – MAJOR SEABIRD KILL

In March 1979, a small oil spill in the Varanger fjord killed thousands of seabirds. How was that possible and can it happen again?

The Varanger peninsula makes a half of the Varanger fjord ecosystem located in the southwest of the Barents Sea – the northernmost part of Norway on the border with Russia. This area has always been an important region for fisheries and wildlife. In spring, the small fish Capelin migrates to these coasts to spawn. Capelin is an important food resource for bigger fish, seals, whales and seabirds. For hundreds of years, animals and people have come to Varanger in the spring to take part in this food festival.

On 23 of March 1979, people started to see seabirds along the coast that were covered with oil. Next day, more and more oiled seabirds where found. On a 100 km long coastline between Vardø and Vadsø, some 5000 oil contaminated birds were killed and collected in a week time. The estimation was that between 10 000 and 20 000 seabirds died due to the oil spill happened. Most of the birds killed were Brünnich's Guillemots, the rest were Common Guillemots, Puffins, Razorbills, Black Guillemots, Long-tailed Ducks, Common Eiders, King Eiders and Steller's Eiders.

When this many oiled birds are killed, usually, it is caused by a big oil spill. It was not the case of the Varanger fjord oil spill in 1979. The spill was so small that it was never discovered with an airplane search. The timing of the spill could not have been worse. It seems that we will never know what really happened. Probably a ship discharged some oil to the sea accidently or by purpose, and that was enough to kill thousands of seabirds. It was all


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Figure 5.8 Thousands of oiled seabirds were collected and analysed by specialists during the first week after the oil spill in the Varanger fjord in March 1979.


© Rob Barret

Figure 5.10 Steller's Eider male birds have natural brown color on the belly. During shooting of oiled birds, healthy birds might be mistaken and killed.

Figure 5.11 Winter population of Steller's Eider in Europe has declined 50% the recent 10 years. Now, there are a couple of thousand birds at the best in Varanger.

about the time. During the Capelin spawning season from February to April, there is always a lot of seabirds in Varanger area, and a relatively small spill may cause a big environmental damage.

Can it happen again? The answer is yes. The world has not changed that much since 1979. Many ships use the area – fishing vessels, local ships, international cargo carriers to and from Russia are sailing not far from this valuable and vulnerable area. The biggest change is that the seabird populations have declined since the last big oil spill. Locally, there is much more focus on the seabirds than before. One reason is that nature based tourism, partly the bird-watching tourism has developed. Tourists from Europe and some from America, Asia and South-Africa arrive to see rare Arctic birds.

Parts of the western population of the Steller's Eiders stay close to the coast of the Varanger fjord during winter. They arrive in December, most of them leave in April and some stay for summer without breeding. The Steller's Eiders breed along the northern coast of Siberia and Alaska, and have to go to ice free areas during winter. The Steller's Eider species has today a special status because of a big decline in world's population. The global population is estimated at between 110 000 and 125 000 individuals, while in the 1960s, there were about half a million birds. European wintering numbers are estimated between 10 000 and 15 000 birds, that show a 50% reduction within 10 years. During recent years, between 2000 and 3000 birds wintered in the Varanger fjord. This rapid population decrease has resulted in the Steller's Eider being listed as a 'Species of European Conservation Concern (SPEC)' in 1994.

5.2.2 NORWEGIAN SYSTEM FOR OILED BIRDS RESPONSE

A number of oil spills, that recently happened in Norway, are seen of importance for taking political decisions on improvement of an oil spill response system.

Oil spills and oiled birds

19 of January 2004, the bulk carrier *Rocknes* grounded close to Bergen on the west coast of Norway. 18 people died in the accident. 45 kilometres of coastline was polluted. The cleaning operation took 5 months, involved 90 people and 20 boats. Most environmental damage was on local bird populations. It was estimated that between 2000 and 3000 seabirds of 19 species died from the spill. National authorities gave a permission to volunteers to establish a cleaning unit for oiled birds. Some 130 birds were treated at the unit.

12 of January 2007, the bulk carrier *Server* grounded close to Hellisøy lighthouse at Fedje on the west coast of Norway. All personnel were rescued by helicopter in the storm. Later the same day, *Server* broke in two parts. Some 370 tons of oil leaked to the sea. Due to bad weather conditions, the spilled oil was spread to a huge area, also to Herdla – a bird sanctuary. Some 1000 seabirds died because of the accident, many of those birds were Long-tailed Ducks.

31 of July 2009, the bulk carrier *Full City* grounded close to Langesund in Telemark, Norway. *Full City* had an estimated 1000 tons of heavy fuel oil (IF 180) and approximately 120 tonnes of marine diesel on board and was in ballast when grounded. A considerable amount of oil spilled from the vessel, and pollution had been observed in the area from Stavern to Grimstad (about 150 kilometres). The Norwegian Coastal Administration deployed a total of about 20 kilometres of oil containment booms. The authorities involved environmental NGOs in oil spill response towards wildlife rescue, both Norwegian and international organisations were included. 56 million Norwegian crowns (NOK) were spent on rescue and clean-up operations.

January 2015, the Norwegian Nature Inspectorate personnel reported hundreds of oiled seabirds in Oslo fjord and along the coastline to Kristiansand in southern Norway. The spill itself and the source of the spill have not been found.

14 of March 2015, the Norwegian Nature Inspectorate reported many oiled seabirds on Jæren, west coast of Norway. 30 more or less polluted birds were seen on Håtangen a few days later. The source of the oil spill has not been found.

The Norwegian system to rescue oiled wildlife

Oil spills happen and impact wildlife. A response system proposed by Norwegian authorities and reflections on it from are presented below.

Diverse environmental NGOs have pushed for an active approach for oiled wildlife response and have built capacities and storages of equipment to be used in oil-spill clean-up actions. The national authorities have partly let the NGOs into clean-ups and given them the task to wash oiled birds. The authorities in general do not support washing of oiled wildlife. Their view is that washing of oiled wildlife has little value due several reasons. Some of the reasons are that it is hard to catch birds before they are too exhausted, washing of seabirds after a single oil spill do not really mean anything for the population of the bird species that are hit, and that from an animal welfare point of view, washing procedures put birds under a huge stress.

The political system has been challenged several times to create a national system for washing and cleaning birds and sea mammals that have got oiled during an oil spill, and has landed on a questioned choice. Two species have been singled out as worthy for rescue after being polluted by oil, the Steller's Eider and the Lesser White-fronted Goose. In Norway, these species can be found in Finnmark in small numbers.

The Steller's Eider stay for winter on the coast of Middle- and East-Finnmark. The Lesser White-fronted Goose can be seen in the Northern Norway during migration and breeding in a very small numbers. Both species are more common on the Russian side of the Barents Sea region, than on the Norwegian one. The Lesser White-fronted Geese in Finnmark will not have a high risk for being polluted by an oil spill, because they spend very little time on the sea and in the tidal zone. The Steller's Eiders are in the high risk zone all the time. They are seabirds, they move in flocks, they stay along the coast during the time of the year when the weather is bad, and there is so little daylight in November-February, that a rescue operation has to be conducted in darkness.

The Ministry of Climate and Environment has given the task to the Norwegian Environment Agency to create a structure that should take care of catching and washing of Steller's Eider and Lesser White-fronted Goose. The system is not on place yet, and it is indefinite when such structure will be established.

Petroleum companies operating intend to support cleaning of oiled wildlife, but the industry does not plan to take a separate initiative to establish a washing and rehabilitation unit in Norway. During an oil spill exercise in Finnmark in April 2015, the local leader of the Regional Oil Spill Prevention Unit, asked Norwegian Clean Seas Association for Operating Companies (NOFO) to include rescue of Steller's Eider in the exercise. That did not happen, and it is unclear how the NOFO's system of rescuing Steller's Eider work.

Proposals for building an oiled wildlife response system in Norway

Our impression is that the rescue system for oiled wildlife established in Finland (a brief presentation is given below) is in general good, and a similar system can be established in Norway. Here, we give some specific recommendations.

Figure 5.12 Fishing vessels were involved in oil spill-spill response exercises carried out in Sarnes fjord near the North Cape in May 2013.

Figure 5.13 Steller's Eider most of the time stay in flocks, on the sea or in the tidal zone.

1. General structure of the system
   The Norwegian Coastal Administration (NCA) will be in charge of the rescue and clean up during an oil spill cooperating with the Norwegian Environment Agency, the Norwegian Food Safety Authority, NOFO and two NGOs – WWF Norway and Birdlife Norway.
2. All species are to be rescued with special attention to rare and threatened species
   When there is an oil spill, to rescue two species only – Steller's Eider and Lesser White-fronted Goose, but not all birds, seems to be a political decision that cannot be implemented in a real case. If an oil spill happens, for example, in Varanger fjord when a flock of seabirds is present there, all species that are normally to be found in the area can oiled – Steller's Eider, King Eider, Common Eider, Long-tailed Duck and Red-breasted Merganser together with some Herring Gulls. Selecting oiled Steller's Eiders as the only birds to be brought for treatment can create a negative public impact both locally and internationally, and damage the reputation of the national oil-spill response system and the region that is attractive for bird-watching tourism.
3. Collecting of oil contaminated birds
   Oiled birds should be collected by specialists. The Norwegian Nature Inspectorate (SNO) has professional rangers with excellent equipment for sea operations and experts that know seabirds too. A national rescue unit for working with oiled wildlife should be established in SNO. Birdlife Norway has amateur ornithologists that can take part in collecting of birds. A national group of volunteers that have the needed skills should be established. Local people that know the polluted territory best can be involved in oiled wildlife search-and-rescue operation.
4. Scaring birds away from the polluted area
   Not-contaminated birds should be prevented from being polluted. Local people, who are familiar with areas where seabirds normally stay at different times of the year, together with specialists from SNO can do the job scaring birds away from oil-polluted areas.
5. The decision for life or death
   Veterinarians from the Norwegian Food Safety Authority will be in charge for making the priorities on who to be given treatment and who does not fit for that. The authority has to establish a unit of skilled veterinarians to be at an oil spill site from day one. These veterinarians should be regularly trained and work with experienced veterinarians during real oil spills worldwide.
6. Washing and rehabilitation of the rescued birds
   WWF Norway can be in charge of running the cleaning, treatment and first phase rehabilitation procedures. WWF Norway run annual trainings of volunteers and is supported by the Norwegian Coastal Administration with funding, experts and equipment.
7. Mobile field hospital for rescuing oiled wildlife
   The Norwegian Directorate for Civil Protection (DSB) can take a task of operating a mobile container based rescue unit for washing oiled wildlife. The mobile rescue unit can copied after the model from Finland and operated by a specific department for fire and rescue operations in Norway. This unit can be developed in cooperation with the authorities in Finland that already has the system in operation with experienced personnel.

8. Rehabilitation centres
   One or two rehabilitation centres should be established in Norway. One must be located in North-Norway to take care of internationally protected Steller's Eiders.
9. Training on live birds during oil spills
   Training must take place on the most common birds that are hit by oil spills, and not on endangered species only that are politically selected for rescuing. Training should be carried out regularly along the whole Norwegian coast.
10. International cooperation
   The need of carrying out a rescue operation for oiled wildlife has been on a relatively low level in respect to well-established oil-spill prevention system in Norway. Development of the oiled wildlife response system is resource demanding, therefore, step-by-step approach for establishment of the national system prior to the international one may delay the whole process. Joining forces with neighbouring countries – Finland, Denmark and Sweden, can help establishing an efficient and practically operative system. Further, developments can go for both, expanding cooperation to Russia and other Arctic countries, and developing national capabilities.

Figure 5.14 Norwegian observers attended the course for volunteers at the mobile unit for rescue of oiled birds in Finland. Veterinaries trained volunteers outside the container one (left); containers two (middle) and three were for washing and drying.

5.2.3 CLEANING AND TREATMENT UNIT FOR OIL-CONTAMINATED BIRDS IN FINLAND

Finnish Environment Institute (SYKE) is the national authority responsible for oil spill response at major ship accidents. It organises the treatment process of oil-contaminated birds and the use of the cleaning unit after the accident. The regional rescue unit is responsible for oil spill response measures within its own territory.

The new unit for treating birds contaminated by oil spills was opened on 5 of June 2008 by Finnish Minister of Environment making Finland a pioneer in the provision of such facilities.

The new unit, based in the town of Porvoo on the shore of the Gulf of Finland, is the first of its kind anywhere in the world. It improves prospects for the rapid treatment of oiled birds, as part of wide-ranging improvements in the international capacity for dealing with oil pollution in the Baltic Sea.

The unit is housed in three containers, which can be quickly transported by road or sea to the location of an oil spill to provide vital first aid for birds in distress. The unit has the capacity to treat up to 150 birds a day. It has been designed by a group of experts from SYKE, Eastern Uusimaa Rescue Services and WWF Finland, with the help of veterinary specialists and ornithologists. The washing, drying and treatment equipment have been fitted into the containers by the Finnish company Oy Morehouse.

The unit is based on the premises of Eastern Uusimaa Rescue Services, whose staff have been trained to ensure that the unit is permanently ready to be rapidly transported to nearest suitable base for coping with any oil spill. Training for volunteer workers on how birds should be handled, cleaned and dried has been provided by WWF Finland in collaboration with SYKE and Eastern Uusimaa Rescue Services. Listed volunteers will be called up to assist the authorities in cleaning up in case of any serious oil spill.

Figure 5.15 Two veterinarians go through the procedure for receiving oiled birds. Veterinarians are volunteers involved in operation by WWF Finland.

Figure 5.16 Tubing of a Mute swan at the course. Volunteers are trained to put a tube into a bird long enough to feed it and to not create an internal damage.

Facilities for washing, drying and medical care

One of three containers is fitted for veterinary care; the second has cleaning facilities; and the third one contains drying equipment. During emergencies, when many birds need treatment, birds are prioritised according to the rarity of their species as well as their condition. A veterinary specialist should examine birds in the initial treatment unit. Treatment is provided for as many birds as possible with a reasonable chance of survival. All oiled birds are to be brought from the accident scene to the treatment unit, but after a preliminary examination, some birds may be humanely killed to prevent unnecessary suffering.

Oil can dissolve the insulating fatty coating that protects water-birds' skin, often resulting in hypothermia and death. Birds are kept warm throughout treatment, and given water and food as necessary. Before being released they are transferred from the containers into an outdoor enclosure where their condition is assessed. Each bird may be treated for as long as two weeks.

Figure 5.17 A rescuer must follow a specific bird-washing manual developed for each species.

Speedy procedures

SYKE has overall responsibility for responses to significant oil spills in Finnish waters, including the treatment of oiled birds. The regional rescue services deal with minor spills in their respective areas. Whenever the new bird treatment unit is needed, Eastern Uusimaa Rescue Services will arrange its transportation and check its readiness for use. Volunteers registered with WWF Finland will be contacted by SYKE and asked to help look after any oiled birds for the duration of their treatment.

SYKE runs a round-the-clock alert service to deal with environmental emergencies. In the event of an oil spill at sea, SYKE's duty officer will call a bird expert to assist oil spill response personnel by initiating the necessary rescue work.

Figure 5.18 Training in washing a gull – one holding, one washing, and one learning by watching.

The new unit has total cost of about 150 000 euros. Most of these funds, 125 000 euros, have been provided by the national Oil Pollution Compensation Fund. This fund, which can also be used to support measures to combat pollution, is accumulated from fees paid for all shipments of oil or petrochemicals arriving in or passing through Finland. An additional sum of 7500 euros was provided for veterinary equipment from funds of the Ministry of the Environment.

International interest

During recent 15 years, there have been serious oil spills at sea near costs of France, Spain, Australia, South Africa and Britain. In the Baltic, birds have been affected by oil spills in Estonian and Swedish waters.

No specially designed units for treating oiled birds had existed until 2008. Facilities had to be improvised in buildings, such as schools or sport halls. Treating birds rapidly can often save their lives. The transportability of the new container units established in Finland guarantees the promptest possible response. They can also be quickly moved to assist with spills in Finland's neighbouring countries around the Baltic or even further afield. The new Finnish facilities have already attracted interest from several European countries, USA and Brazil.

Training session for clean-up of oiled birds

In May 2013, Norwegian observers were invited to take part in a regular training of WWF volunteers in Finland. The training took place at Eastern Uusimaa Rescue Services (fire brigade) in Porvoo, not far from Helsinki. The harbour master of Vadsø and a representative from Bioforsk (now, NIBIO) Svanhovd attended the course, both having an interest in taking care of possible oiled wildlife in the Varanger area in Norway.

The first day one of the course, the group had a practical training at the Porvoo Eastern Uusimaa Rescue Services. The fire brigade personnel mobilised three containers. WWF Finland brought in new volunteers for the training and two veterinaries were responsible for the hospital training.

A specially trained fireman gave the WWF volunteers dead birds and showed them how to handle the birds. Dead birds were used during the whole training. Next, the birds were delivered to veterinaries for inspection and classification whether they could be saved and threated or had to be put away. The inspection of oiled birds is essential for making an operation efficient, especially, in case of a big oil spill with hundreds of birds to be delivered to the unit. Feeding of the stressed birds is also important. One practical training task was on how to put a plastic tube into a bird for feeding. All volunteers were trained on swans and gulls.

The next task was on washing birds. Dead ducks and gulls were used as dummies for the training. First, trainees had to read the manual for the species they were to handle. Next, they tested the grade of pollution on a bird and made a suitable strong liquid to wash away the oil. Two people worked together. One held the oiled bird and another washed it. More of that hard work was required for a bigger bird.

After washing, the birds were placed in a drying container. After the birds got dry, they were inspected to decide whether they were in good enough condition to be released. If not, they had to stay at a rehabilitation centre until they could be released. There are a few of such bird rehabilitation centres in Finland.

The second day of the course, the group trained at Heinola Bird Centre. Volunteers were guided in catching of live birds by a specially trained fireman that had years of experience on rescuing wildlife. The birds used for training were birds that could not be released back to nature and were kept in the Centre for training purposes.

Conclusions from the Norwegian observers

Invited Norwegian observers were impressed by practical skills of the personnel of the Porvoo fire brigade. The personnel were dedicated and motivated, and looked for possible improvements for the containers. The fire brigade had an offensive approach and rescuers were eager to share their experiences with others. They also were positive to join exercises in Norway.

The veterinaries, which worked in the oil-spill unit on volunteer basis, proved to be skilled and good teachers. Veterinaries and trainees for the course were organised by WWF Finland.

SYKE has a trained ornithologist in its staff who organises rescue operation of oiled birds together with WWF Finland and Eastern Uusimaa Rescue Services in Porvoo.

Finland possesses a valuable experience that can be used for developing a system for rescue of oiled wildlife in Norway.

Figure 5.19 WWF Finland's volunteers and personnel with Norwegian observers at Heinola Bird Centre.

6 Conclusions

The purpose of this report is to present an overview of the level and extent of oil transportation system in the Russian part of the Barents Region, and petroleum cargo shipping from the Russian north along the Norwegian coast. We have also presented the visions about the northern oil shipment development perspective and environmental challenges connected to that. We hope that this can contribute to focus more on oil transportation safety, and in this last chapter, we give some recommendations in a seven-step, for us, logical order.

6.1 INTRODUCTION

Oil transportation represents a risk of oil pollution. It is complicated to remove oil discharged to land or water environments. Most of accidents with ships happened due to a "human factor" caused by violation of rules and procedures. Ship accidents recorded in the Barents Sea the last 15 years did not involve tankers, but other kind of vessels. Practices from response operations show that some 10-15% of the oil spilled at sea can be successfully recovered in Arctic conditions. From our point of view, this should lead to a strategy where the goal is a considerable reduction of oil spill risks. A central element in this oil pollution protection concerns overall oil transportation safety.

In this report, we have presented information related to a complete oil transportation line from the production field to big European harbours. Today, about a half amount of oil transported along the northern coast of Russia and Norway is comprised of crude oil produced in the Russian part of the Barents Region. Petroleum products are carried long distances, and transportation routes start in areas far away from the Barents Sea. Petroleum cargoes are delivered by pipelines, railroads and tankers on their way to markets in Europe, Asia and America.

During the recent years, oil transportation logistics in Russia were both improved and became more controlled by state companies.

Prior to continuation of our discussion about oil transportation safety and oil pollution prevention, we would like to underline some elements that influence the level of oil spill response preparedness standards:

1. Oil spills will happen – oil transportation will lead to increased risk of accidents, but the level of risk can be assessed.
2. Oil spills are in most cases detected too late and most of oil spilled is never recovered.
3. It is resource demanding and therefore expensive to clean up oil-polluted areas.
4. It is a political question how much oil pollution a society can tolerate – prevention expenses are to be evaluated against the costs of clean-up after the accident.
5. Improvement of regulations always takes place after accidents have already happened.

Figure 6.1 Since October 2014, all crude oil offloaded for export at Varandey terminal in the Pechora Sea is transhipped at Norterminal near Kirkenes in the Barents Sea (photo).

6.2 TARGET ISSUES FOR OIL POLLUTION PROTECTION

In the following articles, we have structured our reflections and comments in some selected categories, which we recognise as central in the oil-spill protection. We have divided the oil-spill protection issues in seven categories:

- laws and regulations;
- personnel;
- equipment;
- transport operators;
- traffic monitoring and control;
- towage capacity;
- oil-spill response system.

All these factors are essential in an oil-protection system and often work simultaneously, regardless of the fact that they are partially dependent on each other. In this respect, it is important to emphasise that oil-spill protection in a broad sense is both extensive and dynamic. It is extensive because it contains diverse elements both public and private in character. It is dynamic because conditions in each area are constantly changing. The best oil pollution protection action is to hinder an oil spill to happen.

6.2.1 LAWS AND REGULATIONS

Laws and regulations provide a framework for human behaviour and every land adjusts and improves their normative guidelines constantly. After extensive disasters, such as *Prestige* in Atlantic or *Deepwater Horizon* in the Mexican Gulf, authorities tend to make considerable progress in the development of the regulations.

Both in Russia and Norway, the legislation and regulations in transportation safety and oil protection are well developed. Based on practical knowledge and information from official reports and media, our experience is that there seem to be some differences in how the countries are managing their regulations. In Norway, the authorities have adequate resources and therefore the possibility to control every operation whenever they want to. In Russia, the reality may be the opposite, where the control authorities are lacking the capacity to check industrial operations or infrastructure. At the same time, industrial standards can be developed in parallel.

6.2.2 PERSONNEL

The human factor is always important in obtaining successful results. In transportation activities, crew with sufficient education and high working morale will substantially reduce the risk of accidents. One of the best measures for reducing the risk of oil spills is to ensure that the crew operating the oil transports is well educated and has good technical skills. If we add high professional morale to this, we will make a big step towards the efficient prevention of accidents. The knowledge must exist in combination with the practical experience. The theoretical knowledge about emergencies amd oil spills has a little value for a person who collects oil from the sea surface and does not have equipment or has never been trained in using it in practise. Responsibilities and priorities must be clarified before an emergency occurs. The participants must know what institutions and persons should be contacted, and the people in charge must have the necessary licenses in order. The personnel must be trained through emergency exercises both on paper and in the field. Exercises cost money, however, unprofessional emergency response and oil-spill recovery actions lead to both increased financial losses and environmental impacts.

6.2.3 EQUIPMENT

Reliable equipment in combination with well skilled workers helps to prevent disasters. Good equipment in combination with unskilled workers and low morale can increase the risk of accidents in addition to wasted financial resources. Bad equipment and workers with low education and

Figure 6.3 Testing of ice towing equipment for use in Arctic oil spill response (photo). Tests were performed by Viking Ice Consultancy, Norterminal and Egersund Group in Kirkenes area in June 2015.

low professional morale represent even a higher risk of accidents.

In Norway, it is not so easy for a transport operator to function with insufficient oil spill response equipment. The control from authorities with input from trade unions and environmental organisations may damage the company's reputation in case of poor conditions in the matter of prevention and. In Russia, in this field we could come across different realities and see two extremes. The level of the equipment standards was very much dependent of the company's policy and the way it did business. We have seen a positive trend in the recent years. The industry was motivated to lower the operational costs in the long term by investing into facilities reconstruction and building new safer infrastructure and logistic schemes. Arctic regions and environmental safety are getting more attention in the political and industrial dialogues of two countries.

6.2.4 TRANSPORT OPERATORS

It is important to use transport operators with good reputation. In international shipping industry, the vessels' control is recognised as a basic standard. National authorities and professional associations undertake frequent inspections, based on international regulations for shipping in international waters.

Russia, still having a fleet of smaller vessels built in the Soviet time, is improving its national standards to meet with the international ones. Most of the out-dated fleet operates on domestic routes – in large rivers, canals and coastal waters. The tankers that carry petroleum cargo from the Russian Arctic along the Norwegian coastline are of good technical standard. Russia is in the process of getting the tanker fleet of the Russian companies under the Russian flag and in the national register. The Sovcomflot Group, the state owned biggest shipping company in Russia with one of the world's youngest fleet, reached the agreements with Gazprom, Rosneft, LUKOIL and NOVATEK on serving their oil and gas projects. Sovcomflot has become a leader in shuttle transportation in the Arctic and ice navigation.

In Russia, the pipeline operator Transneft has a monopoly on trunk oil pipelines. Oil companies themselves can only own and operate local industrial pipelines. Large amounts of petroleum

Figure 6.3 70 000 deadweight tonnes double acting Arc6 ice-class tankers *Mikhail Ulyanov* and *Kirill Lavrov* were built at Admiralty Shipyards in St. Petersburg and delivered to Sovcomflot in 2010 for Prirazlomnoye project. In 2014, Prirazlomnaya platform started to offload Arctic crude oil for export.

cargo are also transported by rail. Russian Railways has a monopoly on the public railway network that has been under intensive modernisation and development the recent years. Oil and gas companies often invest in parts of the railway system they plan to use for serving their projects and transporting products. That helps to modernise a considerable amount of railway system and it is a positive factor for all the railroad customers.

It is important that the transport operators are continually inspected and controlled that everyone can have sufficient information to select the most reliable and safest ways. In case of oil transportation, it can reduce oil pollution risks.

6.2.5 VESSEL TRAFFIC CONTROL

Norway and Russia has established cooperation for monitoring and control of ship traffic in the Barents Sea. In 2013, a mandatory Barents Ship Reporting System was put in operation that improved safety at sea and strengthened cooperation between vessel traffic centres in Vardø and Murmansk.

In the modern society, the authorities must have full control over ship traffic all the time. This is a condition so that in case of difficulties, ships will be provided with adequate help, and it presupposes that the help can be provided before a disaster can strike.

The vessel traffic control functions are to:

- track all ship movements – register and identify ships;

- stay in constant dialogue with ships;
- respond and act as required by the situation.

It is desirable that traffic control centre also has dynamic biological data as a background for its activities. It mostly concerns spawning grounds, large concentrations of sea birds, fishes and marine mammals. The most efficient response technics (mechanical clean-up, dispersants application, in-situ burning, no action) should be chosen based on environmental risk assessment and net environmental benefit analyses (NEBA) tools. Procedures for carrying out these assessments and analyses should be harmonised between Norway and Russia for application in the Barents Sea.

6.2.6 TOWAGE CAPACIY

Every oil tanker can be considered to be a threat to the environment unless there is a sufficient towage capacity available. The traffic control system must have a possibility to summon tugs when the situation calls for it. The towage capacity both in size and number must meet the requirements at all time. When the oil traffic from Russia started in 2002, the tankers were mostly small. Today, we see the appearance of less numerous but far larger ships with a steadily growing total volume.

The optimal situation for oil traffic is when the authorities on both Norwegian and Russian sides have proper information exchange and arrange the available resources such as tug-boats and other ships available for towing in time and place. Without advanced preparations, there is too little time to have efficient use of the resources.

Figure 6.4 In January 2009, some 10 tonnes of heavy fuel oil were spilled to the sea due to a human mistake at the oil terminal in the Kola Bay. In March 2015, about half a tonne of oil was spilled into the sea at the same terminal. In both cases, oil was collected from the sea surface by hand and mechanical means.

Figure 6.2 Automatic Identification System (AIS) satellite receiving station in Vardø (photo) is a part of the vessel traffic control and monitoring system in Norway.

6.2.7 OIL SPILL RESPONSE SYSTEM

The oil spill response system is put in action when something has gone wrong and resources are needed to remove oil from a sea surface or clean-up coasts. A disaster can happen regardless of how well one is prepared. *Exxon Valdez*, *Prestige* and *Deepwater Horizon* are examples of serious accidents with significant impacts to people, environment and economy.

Oil-spill response system in Norway consists of personnel and equipment from authorities, petroleum and transportation companies. Response systems are well developed around large terminals such as, for example, Sture and Mongstad, and oil platforms. We assume that there is less equipment for oil pollution prevention in Russia than in Norway (per kilometre of coastline or square kilometres of sea surface). The oil-spill response systems are built and coordinated differently in two countries. Norway has relatively little traffic in ice covered areas, while in a major part of the Russian Arctic operations are carried out in ice-covered waters during six months of the year.

Oil spill emergency response units from Norway and Russia have a good practical cooperation. Russian emergency response units are to reach good standards in capacities, especially with new and modern fleet of ice-class salvage vessels built. Dialogue between Norway and Russia on all levels is the must for development of a sufficient oil-spill response system in the Barents Sea.

The focus in environmental protection has to be put on oil spill prevention. The challenge is to demonstrate results of prevention, although the costs when a disaster strikes will be enormous.

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8 Abbreviations

AIS - Automatic Identification System
AMNGR - Arktikmorneftegazraavedka
APA - Awards in Predefined Areas
ATOC - Arctic Terminal Operating Company
BP - British Petroleum
BPS - Baltic Pipeline System
CDC FEC - Central Dispatch Control of the Fuel-and-Energy Complex
CIS - Commonwealth of Independent States
CNIIMF - Central Marine Research and Design Institute
CNPC - China National Petroleum Corporation
COTU - Crude Oil Topping Unit
CPC - Caspian Pipeline Consortium
EC - European Commission
EIA - Environmental Impact Assessment
ESIMO - United State Information System about World Ocean conditions
ESPO - East Siberia–Pacific Ocean pipeline
ETV - Emergency towing vessel
FOIROT - Fixed Offshore Ice-resistant Offloading Terminal
FSO - Floating Storage and Offloading Vessel
GDP - Gross Domestic Product
IMO - International Maritime Organisation
LNG - Liquefied natural gas
LPG - Liquefied petroleum gases
MARPOL - International Convention on the Prevention of Pollution from Ships
MNR RF - Ministry of Nature Resources and Ecology of the Russian Federation
MSC - Murmansk Shipping Company
NAVAREA - Navigational Area
NCA - Norwegian Coastal Administration
NGL - Natural gas liquids
NGO - Non-governmental organisation
NIAC - Nenets Information Analytic Centre
NOFO - Norwegian Clean Seas Association for Operating Companies
NPD - Norwegian Petroleum Directorate
NSR - Northern Sea Route
OE - Oil equivalent
OSPAR - Convention for the Protection of the Marine Environment of the North-East Atlantic
PRMS - Petroleum Resources Management System
PSA - Production Sharing Agreement
RF - Russian Federation
RPK - Offshore oil transhipment complex
SRS - Ship Reporting System
STS - Ship-to-Ship Transfer
SYKE - Finnish Environment Institute
TOPP - Trunk oil products pipeline
UGSS - United Gas Supply System
UN - United Nations
USA - United States of America
USGS - United State Geological Survey
USSR - Union of the Soviet Socialist Republics
VLCC - Very large crude carrier
VTS - Vessel Traffic Services
WWF - World Wide Fund for nature

Conversion factors used in the report:

1 barrel = 159 litre
1 tonne = 1 metric tonne
1 tonne of oil = 7.3 barrels of oil
1 tonne of LNG = 1.9 cubic metres of LNG