Arctic LNG cluster: new opportunities or new treats?

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Abstract. Construction and further operation of the “Nord Stream”, “Nord Stream 2” and “Power of Siberia” gas pipelines are a crucial element in the development of cooperation between Russia, the EU and China in the gas sector. Nevertheless, the Russian Federation considers not only gas exports via pipelines but also the supply of liquefied natural gas (further-LNG) as a priority area in the regional markets. Nowadays, the LNG market is a derivative of the traditional gas market and has certain competitive advantages over pipeline gas supplies. Many countries, including the Russian Federation, are trying to consolidate their positions in the relatively new and growing LNG market. In the Paper, the Authors consider the main Russian LNG project’s strength and weaknesses. At the same time, there are several of specific problems that need to be taken into account in the development of Arctic hydrocarbon reserves. The creation of an LNG cluster with an annual capacity of up to 140 million tons on the territory of the Yamal-Nenets Autonomous district is associated with significant risks. Among the most crucial risks are: competition for the LNG market share in the EU and Asia-Pacific countries started between the US and Russia, as well as Australian, Indonesian and Middle Eastern companies; significant volatility in energy prices on the World markets, and in particular in the EU and Asia-Pacific markets; high cost of Russian LNG projects and their limited funding under sanctions restrictions.

1. LNG World market: rules are changed.

The crucial factor determining the volume of LNG production is demand from an international market. Its forecast is based on a scenario of the LNG market gradual globalization, based on the following underlying assumptions:

- equilibrium in the oil markets keeps energy prices at a consistently high level;
- developing countries, especially India and China, are beginning to actively limit emissions of harmful substances by using natural gas and LNG more than coal and oil in their fuel and energy balances;
- in the process of generating electricity in comparison with other types of fuel, gas begins to make up an increasing share. LNG is a perspective energy source, providing greater economic and environmental efficiency in comparison with other fuels.

LNG, as a fuel, has several advantages. First of all, it is methane, which is lighter than air, and in the event of an emergency spill, it quickly evaporates, unlike dense propane, which accumulates in
natural and artificial depressions and creates a risk of explosion [1]. This type of fuel is not toxic, thus, it does not cause corrosion of metals. At the same time, LNG is cheaper than any oil fuel, including diesel, while surpassing the latter in calories. This product is obtained from natural gas in the process of cooling it to a condensation temperature of minus 161.50 °C. The liquefaction process reduces the volume of gas by 600 times, while the specific weight of the finished product is twice as light as water [1–4].

Because currently, LNG production technologies remain quite expensive, only a few of the leading multinational oil and gas companies have their gas liquefaction technologies. The most well-known technologies include Air Products AP-C3MR and Shell [10]. However, the cost of LNG production is significantly reduced every year. This situation is facilitated by the expansion of the tanker fleet and the increase in the deadweight of tankers, the appearance of floating gas liquefaction plants and receiving regasification terminals. Since the 2000s, the volume of LNG consumption in countries has been growing continuously. In addition to the traditional use of LNG in industry and households as an energy resource, the use of LNG as a motor fuel for marine, aviation, rail and road transport is being actively considered. Understandably, that exporting countries that have time to conclude agreements on long-term LNG supplies as part of the construction of new capacities will gain undeniable economic advantages on a global scale in the future.

In 2010–2014, investors interest in LNG increased significantly due to the formation of a significant price premium in Asian markets, which on an average monthly basis reached $ 7 per MBTE relative to European quotations (one million British thermal units (MBTE) is equivalent to 0.028021135208008 thousand m³ of gas). As a result, the construction of LNG facilities with a total capacity of 93 million tons per year was initiated. However, after the fall in gas prices in 2015, petroleum companies began to actively reduce their investment programs. For example, 20 LNG projects in Canada, the United States and Australia with a capacity of 184 million tons were canceled [5].

Nowadays, the global LNG market is undergoing a profound transformation. Soon, LNG will be sold on the market in the same way as iron ore or crude oil. The LNG market is becoming more flexible, and changes are being made to LNG supply contracts in four directions at once: reducing the duration and volume of contracts, lifting the ban on reselling LNG in other markets, and switching from oil–based pricing to gas-to-gas mixed pricing. Thus, the previous model, in which LNG buyers were utterly dependent on producers and had to enter into long-term contracts in order to recoup the manufacturer's investment costs and get a market for their products for 20–30 years ahead, is a thing of the past [6, 7].

In the spring of 2018, the Chinese state oil and gas company PetroChina announced that it plans to replace all long-term LNG contracts that are linked to oil prices with shorter and more flexible agreements [6]. The exception will be transactions with Qatargas, Yamal and Gorgon. These are contracts that expire between 2025 and 2038. According to S&P Global Platts Analytics, the total volume of contracted LNG is 14 million tons per year. At the end of 2017, China became the world's second largest importer of LNG (5 billion cubic feet per day), behind only Japan (11 billion cubic feet per day). In the long run, S&P Global Platts Analytics forecast that China's share of global LNG demand will equal the Japan’ amounts. It can be expected that Chinese importers would have a significant impact on the global LNG market prices. Most Chinese and international experts believe that by the end of the next decade, China's gas consumption would at least double to a record half a trillion cubic meters per year. It should be noted, that China currently has 17 liquefied gas import terminals at 14 ports along its entire coastline with a total regasification capacity of 7.4 billion cubic feet per day [6].

The Asia-Pacific LNG market is currently quite volatile. For example, in 2012–2014, the cost of LNG was $ 15, for MBTE, after which it was reduced to $ 5, for MBTE in 2016-2017, and then doubled again in 2018. It is due to the stagnation of global demand for LNG in 2012-2016, which was replaced in 2017 by an 11 % increase in the background of expectations of a nearly 50 % increase in global liquefaction capacity in the period from 2015 to 2020 [7]. Only China in 2017 demonstrated a
46% increase in LNG demand. Since that time, China began to implement a transition of the city heating system from coal to gas.

Besides, new LNG importers have appeared on the Pakistan, Bangladesh, Thailand, Kuwait, UAE, Indonesia, Egypt, Jordan, and other markets. Only at the expense of new consumers in 2017 were initiated higher rates of LNG process growth that was more than the 2011 price growth, which was held as a reaction to the accident at the Fukushima nuclear power plant [7]. The structure of demand for LNG also varies from developed to developing countries. It is predicted that by 2022, the total volume of LNG imports by Asia-Pacific countries, mainly due to China and India, will outstrip consumption from Europe, Japan, Korea, and other developed countries [7].

2. Using gas from the Nadym-PUR-Taz region as a raw material for Arctic LNG

Until recently, LNG processing capacity in the Russian Federation was limited to supplies from the Sakhalin-2 plant, which is why the share of the Russian Federation in the liquefied natural gas (LNG) market in 2016-2018 was only 4.0-5.8 %, mainly in the direction of the Asia-Pacific region (APR) [8, 9, 10]. In recent years, Russia has sought to significantly increase its LNG production capacity and expand the geography of LNG supplies on the world market, including the regional market of the Asia-Pacific region. Several projects were announced, including Yamal LNG, Vladivostok LNG, far Eastern LNG, Pechora LNG, Baltic LNG, Portovaya LNG and Cryogaz-Vysotsk LNG [11-13]. However, the competition of LNG suppliers in foreign markets, low energy prices, sanctions imposed on domestic companies by Western countries, and some other problems have complicated the implementation of this task. Not all projects were able to withstand the sanctions [10]. For example, in the Leningrad region in April 2019. the first line of "LNG Cryogaz-Vysotsk" (PJSC "NOVATEK") was launched, although initially several medium-tonnage gas liquefaction plants were announced in the Baltic [10]. One of the few successful projects in the Russian Arctic was Yamal LNG (PJSC NOVATEK), the first stage of which was launched in December 2017, and the second and third in August and November 2018 [14,15].

In Russia at the moment, there are certain competitive advantages in the implementation of LNG projects in the Yamal-Nenets Autonomous District (YANAO). First, these are shorter transportation routes to the primary market of the Asia-Pacific countries. Secondly, during the winter period, when the demand for energy in the Northern hemisphere reaches its maximum, the level of costs for liquefied natural gas in the Yamal-Nenets Autonomous area will be 10-15% lower than, for example, in Qatar. It is also very encouraging that Russia has set a zero export duty for LNG supplies, designed to encourage the implementation of projects for the construction of LNG plants.

Therefore, it is expected that the issue of creating an LNG cluster with a capacity of up to 140 million tons per year in Yamal and Gydan is being actively discussed at the state level. The initiators of the project are the St. Petersburg mining University and PJSC "NOVATEK". The Ministry of energy supported the proposal of the rector of the St. Petersburg mining University to give the status of a national project for the development of Arctic territories. In October 2019, the Ministry of regional development introduced a bill to the government, according to which it is proposed to provide all oil and gas companies to work on the coast and shelf of the Arctic ocean with a set of benefits offered to the Yamal LNG project [16]. It is noted that PJSC Gazprom has an excellent raw material base in this region, the fields of which are located just 50 km North of the location of Yamal LNG. These are Malyginskoe, Taseska, Severo-Tambeyyskoye and Zapadno-Tambeyskoye gas condensate fields [17]. The logistics for the central part of Gazprom's hydrocar on reserves and resources in this region has already been built – the Bovanenko-Ukhta and Urengoy-Pomary-Uzhgorod pipelines. It is evident that Gazprom's participation in the LNG cluster in this region if there are existing main pipelines, is at least impractical since the existing raw material base of the fields is considered primarily as a prospect for filling the current ESG transport capacities. Therefore, PJSC "NOVATEK" it is necessary to discuss cooperation with other major vertically integrated oil companies in the region, for example, PJSC "Rosneft".
However, according to the authors, low-pressure gas from large fields in Western Siberia, which are at the final stage of development, can eventually be considered from the standpoint of raw materials for the future cluster. As natural gas reserves are extracted, the gas pressure would be decreased, after that low-pressure gas (i.e. gas with low reservoir pressure) would have remained. Then gas must be compressed to 7.5 MPa for subsequent transport to the final consumer [18]. However, for economic and technical reasons, this process is not appropriate. Further production of low-pressure gas production, preparation and transport are problematic, because it is associated with high additional investment and operational costs (including costs for mobile compressor installations at wellheads, gas compression in the field, as well as in the process of field and main transport). Besides, the remoteness of these fields from sales markets also negatively affects their cost, making further development of these fields unprofitable. It should be noted that we are talking about vast volumes of gas reserves with low reservoir pressure. Experts estimate the forecast of the recoverable reserves volume of low-pressure gas in the Nadym-PUR-Taz region by 2030 at 3 trillion m$^3$ [18]. The "old" gas fields are being developed by subsidiaries of “Gazprom Dobycha Nadym”, “Gazprom Dobycha Noyabesk”, and “Gazprom Dobycha Urengoy”. The main volume of LNG production may be associated with the Urengoy field. If we assume that the low-pressure gas from the" old " fields will be in demand for LNG production, then the port of Yamburg can be considered as a site for the construction of the plant. According to experts, the annual capacity of the plant would be about 90 billion m$^3$. For supplying gas produced at the Urengoy field to the port of Yamburg, it is necessary to build a gas distribution pipeline Urengoy-Yamburg, with a length of at least 150 km.

Nowadays, Gazprom considers Novatek's Arctic LNG as main competitor in the EU market. Indeed, initially, Novatek, together with other partners within the Yamal LNG project, promised to supply LNG to the Asia – Pacific and EU markets, and at the latter-to those countries that do not supply domestic CNG, such as Spain, Portugal or the South of France [10]. By the end of 2019, two Russian energy suppliers – Gazprom and Novatek-are actively competing in the EU market. And this is despite the absence of competition in the Russian market at all.

Gazprom experts emphasize that for the natural gas pipeline export the Russian budget receives 14.3 USD tax concerning extraction of mineral resources, 63 USD customs duty and 12 USD income tax for every thousand cubic meters. Besides, this can include 7 USD dividends, thus, the total amount of Russian Federation income could be for about 96.3 USD. There are no budget revenues from the Yamal LNG project in these areas [16].

The authors agree that the increase in foreign exchange earnings from the sale of gas to the Federal budget of the Russian Federation should be considered as a factor that stabilizes the economic situation of the country [19]. Gazprom experts note that currently Novatek is included in the scheme for dumping gas prices on the EU market. The cost of Arctic LNG for the entire cycle-from production in Yamal to delivery of regasified gas at EU terminals-should be $ 239.8/1000 m$^3$. Selling gas for $ 112/1000 m$^3$, the company would have received losses in the amount of the difference between the cost of production and the dumping price.

Therefore, according to Gazprom, the programs of YANAO resources accelerated sale at low prices within the proposed Arctic cluster, with huge financial support from the state, represent excessive waste. However, according to former Russian Finance Minister Anton Siluanov, investments in Yamal LNG "provide excellent servicing of invested funds and have a high return" [20]. VYGON consulting experts note that the break-even price of the Russian "Arctic LNG-2" with the declared capital investments may be at the level of $ 3.8. for MBTE, while the cost of LNG, including delivery to the Asia-Pacific countries, will be $ 6.7. for MBTE [5]. Figure 1 shows the dynamics of EU and APR (Japan and Korea) market LNG average prices. At the end of 2018, the average price of gas supplies to the EU countries was $ 240.7/ thousand m$^3$, while for Asia – Pacific countries such as Japan and Korea, the price of LNG is significantly higher-311.28 USD / thousand m$^3$. 
Representatives of Gazprom noted that for the development of the LNG cluster, the construction of LNG plants on gravitational bases (with unproven technology) is proposed [21]. The cost of the Arctic LNG-2 project is estimated at 10 bln. USD, which 17 bln. USD less than the cost of the Yamal LNG project. A significant reduction in the cost of the plant is expected to be carried out due to gravity platforms, on which a modular gas liquefaction plant is supposed to be placed. Thus, "in Russia would be carried out localization of innovative technologies for the liquefaction of gas (Air Products AP-C3MR and Linde), Russian companies could gain the necessary experience and competence, as well as get almost the full range of technologies for the construction of LNG plants" [10].

In addition to the reasons outlined above, Gazprom’s lack of interest in the LNG cluster in YANAO can also be explained by its focus on creating its cluster in the Ust-Luga area. The implementation of the Baltic LNG project with cost 2.5 trillion rubles, or approximately 40 bln. USD is twice as expensive as the Arctic LNG-2 project. The annual capacity of the LNG plant could reach 10 million tons. However, the Baltic cluster is also expected to create a gas-chemical complex, which could cost 13 bln USD [20]. Even though, Shell has already shown its interest in this project. It is assumed that Gazprombank, VEB and the national welfare Fund would be act as investors. At the same time, it is clear that the primary market for Baltic LNG is again the EU market. In this case, no one objects to a zero export duty.

3. Conclusion

After all, Russian LNG plants under construction are launched – the fourth Yamal LNG processing line, Cryogas-Vysotsk, and Portovaya CS-Russia would take the sixth place in the World LNG exports. If the Arctic LNG-2 project is launched on time, Russia would be in the fourth place concerning LNG production. Besides, Novatek is already announcing the construction of the Arctic

![Figure 1. Dynamics of liquefied gas prices in the EU and Asia-Pacific regional markets](image-url)
LNG-1 plant with a capacity of 20 million tons per year. The resource base for the new plant would be the Soletsko-Hanaveysky gas field reserves located in the North of the Yamal Peninsula [22]. The Authors compiled Yamal-Nenets Autonomous District LNG production SWOT analysis. The strengths, weaknesses, opportunities, and threats for expanding the LNG industry in the Arctic region are presented below.

Arctic LNG production’ strength:
- The volume of LNG produced is one six-hundredth of the volume of the gaseous phase, which makes it much more economical when transported by sea over long distances.
- LNG does not harmfully affect the environment. In the case of LNG leak, it is implausible that ignition or explosion would be occur.
- The liquefaction process also has a significant advantage in that it removes oxygen, carbon dioxide, sulfur, and water from natural gas, resulting in LNG being almost pure methane.
- Convenient geographical location (ports of Sabetta, Yamburg), which is associated with the task of optimizing the cost of preparing the site for construction and the possibility of further expansion of liquefied natural gas production with minimal subsequent investment and subsequent transport to the Asia-Pacific or EU countries.

Arctic LNG production’ weaknesses
- Independent examination of the cost of construction of the Arctic LNG-2 plant;
- Severe climatic conditions (low ambient temperature; large seasonal variations in air temperature (the difference between summer and winter temperatures can reach 40-600 C);
- Few experience in setting up LNG plants in cold climates (four LNG plants operate in cold environment: Kenai (Alaska, 1969), Snovit (Norway, 2007), Sakhalin (Russia, 2008) Yamal-LNG (Russia, 2018), while hundreds of LNG plants have been built for warm environment projects);
- In Russia, only a few number of LNG tankers have sufficient year-round ice penetration for cold conditions.

Opportunities
- Creating a gas OPEC with the subsequent delegation of the organization's functions to regulate the volume of gas production and sales by leading producers;
- The lack of dependence through transit countries;
- Does not fall under the requirements of the third EU energy package for pipeline supplies;
- The perspectives to entering new markets;
- Ability to sell to final customers without the transit through another country;
- There is a zero export duty for LNG exports.

Threats
- Growth in shale gas production in the United States, against natural gas dumping prices;
- Active actions of LNG suppliers (increased construction of liquefied gas plants)
- The scale of LNG projects is associated with significant amounts of investment from domestic producers and carries substantial financial risks against the background of sanctions imposed by the US and EU countries;

Simultaneously, Novatek projects serve as reference points for creating a military-strategic system in the Arctic. The location of the Russian military bases near LNG storage facilities may harm the infrastructure of these projects.

In conclusion, even in the current difficult situation of sanctions restrictions and technological
wars, further development of LNG projects in Russia is possible. At the same time, it should not reduce the efficiency of existing and under construction pipeline capacities. A comprehensive approach to the increasing of the LNG production should be include the sufficient mechanism for supplying LNG to new regional markets, where the construction of main pipelines is economically unprofitable or simply impossible due to their geographical location. The development of the Arctic territories should help to effectively develop Russia's hydrocarbon reserves, correctly locate the necessary infrastructure facilities, stimulate nearby regions’ sustainable growth, and develop a well-thought-out logistics chain for LNG supplies.

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