Perspective Approaches of Stranded Gas Fields Monetization in the Russian Arctic

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Abstract. The future growth and development potential of the Russian oil and gas industry is concentrated in the Arctic. Most of Russia’s gas reserves - about 70% [1] - are in the Arctic regions of the Russian Federation - the Yamalo-Nenets Autonomous District and the Krasnoyarsk Territory. One of the key issues in the monetization of gas is the logistics problem of delivering gas from the field to a consumer with high profitability. The work identified three key areas of natural gas delivery: pipeline transport, LNG production and Gas-to-liquids (GTL) technology. The paper is provided analysis of these methods of developing gas fields. As a result, recommendations for the use of each of them is evaluated.

1. Introduction
The development of the Russian gas industry is associated with the development of stranded gas fields in the Arctic region: the Yamalo-Nenets Autonomous District and the Krasnoyarsk Territory. The key assets of large Russian gas companies are located there [2].

There are deposits located directly on the continental shelf, as well as those that are remote from the coast into the sea. Their development is impossible without choosing the optimal gas transportation method. The following possible directions of natural gas monetization are highlighted:

- pipeline transportation of gas;
- LNG production;
- GTL production.

The use of each of these methods depends on the conditions of the field location, proximity to the existing infrastructure: the presence of a port or railway. Weather and ice conditions should be considered. The transformation of gas reserves into a consumer-demanded product is very important.

2. Pipeline transport of natural gas
The main way of the natural gas delivery is pipeline. It is considered the simplest mode of transport - there is no need to build complex technological complexes for gas processing, while providing continuous fuel delivery to the consumer. At the same time, the added value of the product is lower than if it was converted into liquid products. Zero flexibility in gas supply, the passage of an export gas pipeline through the territory of other states has risks for the producing company.

According to experts, the cost of laying a pipeline from the Arctic shelf to Europe is over $ 10.1 billion [3]. Moreover, the cost of 1000 m³ of natural gas with its passage of 1000 km increases on
average by $14. It should be noted that the cost of one kilometer of the Bovanenkovo-Ukhta gas pipeline is $37.55 million [4].

Pipeline transportation of natural gas over more than 5000 km is considered economically unprofitable [5], therefore, to monetize natural gas from remote Arctic fields, other options should be considered - LNG or GTL.

3. LNG production
According to forecasts [6], by 2040 the volume of LNG will exceed the volume of pipeline gas. This is due to the potential growth in gas consumption in the world and mainly due to consumers in the Asia-Pacific region. Among them, China stands out, which is predicted to have the largest volume of imports [7], followed by Japan and South Korea, which are currently the leaders in LNG consumption [8]. According to IGU forecasts [9], a 40% drop in gas production in Europe will lead to an increase in its dependence on imported gas to about ¾ by 2040.

LNG production is more flexible than pipeline and allows it to be delivered almost anywhere in the world. Moreover, the location of production facilities in the Arctic shelf allows it to be delivered both to Europe and Asia using the northern sea route.

Domestic companies have ambitious plans to expand gas production in the Arctic. These are mainly the projects Arctic LNG-1,2 and 3 and Obskiy LNG [10].

The distance of Arctic LNG from the APR market increases shipping costs. One possible solution would be to use reloading terminals. Novatek plans to build an LNG terminal in Kamchatka and one more in Murmansk.

4. GTL production
Transportation of liquid products of natural gas is 10 times cheaper pipeline [11]. One of the perspectives liquid gas product is methanol. Conversion of NG into methanol increases its added value by 4-6 times, which favorably distinguishes the chemical conversion of natural gas into liquid products from its cryogenic liquefaction to produce LNG [12].

Estimates show that even for traditional gas when transported over long distances with the already existing level of gas chemical technologies, its preliminary chemical conversion into liquid products can be much more profitable than pipeline transportation or transportation in the form of liquefied gas (LNG) [13]. For marginal and unconventional sources, this is practically the only economically acceptable solution.

In these gas chemical processes, the first and most expensive stage is the conversion of natural gas into synthesis gas, which accounts for up to 60–70% of all costs for obtaining final products [7, 8]. One of the solutions to the problem of creating a technology for the use of low-rate sources of gas raw materials, such as low-resource and low-pressure fields, associated petroleum gas, shale gas, and others can be the use of cheaper synthesis gas obtained by partial oxidation of natural gas with atmospheric air.

Experts note the growth of the methanol market by an average of 5.5% per year and its main consumers will be concentrated in China and Southeast Asia. Although China also has its own methanol production capacity, it is insufficient to meet domestic demand.

Novatek has its own experience in methanol production with a total capacity of 52.5 million tons/year at the Yurkharovskoye field directly at the gas production site (a pilot plant with a capacity of 12,500 tons per year and another unit of 40,000 tons per year. These installations allow meeting the domestic demand for methanol - combating gas hydrates [14].

One of the unique promising Russian methanol projects in the Arctic region is FlotMethanol [15]. This project is a fleet of floating methanol plants. Figure 1 shows basic units of such vessel.
The vessels combining production and transshipment terminals on their board will be based on the Northern Sea Route, in the Yamal Peninsula, where gas production platforms are located. The gas will be immediately gone for processing and produced methanol will immediately be poured into tankers for export [16]. Estimated volumes of commercial methanol production - 10 million tons per year. In addition, mobile plants can serve as bunkering stations for new types of commercial cargo ships, which can be powered by methanol.

In general, GTL production is promising for the sale of gas assets in the Arctic. The accumulated experience makes it possible to implement the project both to meet own needs for the field, as well as for export to the Asia-Pacific countries.

5. Conclusions

The choice of the way to sell gas reserves should be made in an integrated manner, considering the infrastructure of the area where the field is located, the distance to the sales market and the volume of gas produced. In the coming decade, natural gas will be mainly exported in liquid form. This trend allows us to make the sale of gas reserves more flexible, which makes it possible to monetize gas reserves in the Arctic.

The dependence of the gas transport method on production volumes and distance to consumers is shown in Figure 2. It can be concluded that the sale of remote Arctic assets is possible in two ways - LNG production or GTL.

The supply of LNG becomes economically viable only at very long distances, exceeding 4–5 thousand km [17]. And at distances exceeding 8-10 thousand km, the preliminary conversion of gas into GTL already becomes preferable.

Figure 1. Mobile plant "FlotMethanol" [15].

Figure 2. Comparison of NG transportation methods depending on the volume of produced gas and the distance to the consumer [18].

Figure 3. Natural gas transportation costs.
GTL are significantly more valuable and expensive than natural gas from LNG regasification [19, 20]. In addition, the innovative project of the FlotMethanol mobile plant opens a new side of the methanol producers’ market and in the next decade will find its niche in the gas market.

6. References
[1] Bogoyavlensky V I 2020 Improvement of state policy and development of a strategy for developing hydrocarbon resources in the Russian Arctic Scientific works of Free economic society of Russia 224 pp 59-85
[2] Buslaeva M A, Kholopov K V 2020 Export logistics of Russian liquified natural gas under sanctions New realities of the global economy: sanctions and trade wars 72 pp 30-40
[3] Arutyunov V S, Strekova L N, Lapidus A L, Zhagfarov F G 2015 Gaschemistry at the present stage of development (Moscow: National University of Oil and Gas "Gubkin University" (Gubkin University)) p 172
[4] Voyko D V, Berg A G 2020 Valuation of investment attractiveness of the project for the production methanol in Russia Vestnik universiteta 6 pp. 129–135
[5] Eliseev O L, Kryuchkov M V, Lapidus A L 2019 Prospects for conversion of hydrocarbon gases into liquid products based on nitrogen-containing synthesis gas (review) Petrochemistry 59 pp 246-255
[6] Shell LNG Outlook 2019 p 34
[7] BP Energy Outlook: 2019 edition p 142
[8] Arutyunov V S, Lapidus A L 2003 Gas Chemistry as a key direction of development of energy chemical technologies of the XXI century Russian chemical journal 47 pp 23-32
[9] World LNG Report 2020 (International Gas Union) p 68
[10] Novatek Company URL: http://www.novatek.ru/
[11] Levinbuk M I, Kotov V N 2013 Change in the structure of consumption of basic energy carriers in the United States–one of the challenges to Russia's energy security World of petroleum products 9 pp 3-14
[12] Lapidus A L, Golubeva I A, Jafarov F G 2013 Gas Chemistry (Moscow: CentrLitNeftegaz) p 450
[13] Nastin A N 2018 Analysis of technologies for producing liquefied natural gas in the Arctic climate Actual problems of development of the Russian oil and gas complex p 272
[14] Dolinsk S E 2009 Installations for the production of methanol in the Arctic circle integration and compactness guarantee the highest efficiency Gas chemistry 8 pp 14-26
[15] FlotMethanol Company URL: http://flotmethanol.ru/
[16] Nikitin A V, Sokolov V V, Isayeva N N Ustrojstvo dlya polucheniy metanola vysokoj koncentracii [Device for producing high-concentration methanol] Patent RF 2 724 085 2020
[17] Gulkov A N, Lapshin V D, Morozov A A, Vlasenko V S and Alembaev A N 2016 Improvement of Natural Gas Liquefaction Process by Application of Carbon Dioxide Boiling in Triple Point 26th Int. Ocean and Polar Engineering Conf. Int. Society of Offshore and Polar Engineers pp 1023-26
[18] Mokhatab S, Mak J Y, Valappil J V, Wood D A 2013 Handbook of liquefied natural gas Gulf Professional Publishing p 591
[19] Gimaeva A R, Khasanov I I, Bakhtizina A R 2017 Factory ships for processing of natural and associated petroleum gas in the Arctic Transport and storage of petroleum products and hydrocarbons 5 pp 37-41
[20] Protasova S K 2020 Analysis of the liquefied natural gas industry and its problems (on the example of Yamal-LNG) Actual problems of accounting, analysis and audit 2 pp 134-141