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Comparative Analysis of Liquefied Natural Gas with Renewable Energy Sources

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ABSTRACT
This work is to determine the leading position of liquefied natural gas by comparative analysis with renewable energy sources as competing energy industries with a development perspective until 2035. Hypothesizing an unknown energy source capable of replacing traditional energy.

Keywords: *World energy, International energy agency, International space station, Ministry of energy of the Russian Federation, Renewable energy sources, Liquefied natural gas, Gas transmission system, Newest Energy.*

1. INTRODUCTION

"In recent years, we have seen renewable energy sources steadily overtaking conventional energy sources. Every year, hundreds of gigawatts of renewables are built around the world. For five years in a row, green generation has surpassed coal, gas and nuclear in the volume of inputs, and global investments in RES annually exceed $300 billion" [1].

In connection with active growth of renewable energy popularity the question arises: "Will this energy replace traditional one? How long will it take? Are RES really more environmentally friendly and cost-effective than LNG?" These questions indicate that the topic is relevant in today's realities.

As a result of the study it is planned to structure the main positions of the research subjects: LNG and RES.

2. METHODS

Criteria such as the possibility of energy storage, environmentally friendly production, the use and disposal of items under study, government support and investment in renewable energy sources and in LNG were selected as the main study items. Overview of companies working in the field of RES and LNG implementation. Identification of a strategy for the LNG industry in the "giant country" of the gas reserve. Considering outer space as a potential source of "cutting-edge energy", with an overview of international space exploration programs for 2021.

3. RESULTS AND DISCUSSION

As you know, non-renewable energy sources include (oil, gas, coal), and renewable energy sources (RES) – solar energy, wind energy, water flow energy, the potential energy of waves, geothermal energy of the earth, bioenergy and biofuels.

According to the International Energy Agency (IEA), the demand for gas from the power generation sector is facing difficult conditions in 2020. Gas consumption for power generation, despite favorable fuel switching dynamics in North America and Europe, was the hardest hit segment, accounting for an estimated 45 % of the total annual decline. Electricity demand is expected to be limited in 2021 due to strong competition from increased renewable capacity and lower competitiveness relative to coal as natural gas prices recover from the lows of 2020. Thus, this forecast assumes a 1.2 % increase in natural gas use for electricity generation in 2021, not enough to offset a projected 2.1 % decline from 2020.

To date, we have seen the natural gas market move rapidly from regional integration to embedding into more globalized, interconnected markets. As the International Energy Agency reports, it is liquefied natural gas that provides this global supply of natural gas, plays an adaptive role in the event of a drop in global demand due to recent pandemic conditions.

However, there are likely consequences associated with the danger of supply exceeding demand on the natural gas market. Despite these ambiguous problems, the agency's experts predict a decline in the leadership of fossil fuels. For example, coal will surrender its position by 2025, they predict.

"Renewable generation will grow by nearly 50 percent over the next five years, its share of electricity generation will reach one-third. This will end the fifty-year role of coal as the main source of electricity," broadcasts Fatih Birol, executive director of the IEA.

State support affects the introduction of RES. Governments in different regions have special programs for companies that use energy from renewable sources. Such programs include grants, preferential taxation for responsible companies.

In addition to the above, it is important to note that the use of energy, including renewable energy sources, involves the need to accumulate and store energy reserves. This is for cases of sudden stoppage of generation (natural disasters, man-made problems, etc.) and for access to globalized markets. For these tasks it is necessary to create equipment (accumulators, storages) – i.e. infrastructure for accumulation and storage of electric power, or to "back up" with the help of reserve capacities of traditional power generation.

Nevertheless, there are problems of RES utilization. This is especially true for solar panels, wind turbines, and storage units, which must be disposed of after their lifetime. Thus, the real cost of renewable energy sources should include the cost of recycling and disposal of waste equipment. It is worth noting that this usually turns out to be more resource-consuming than the extraction and manufacture of these materials. This problem must be taken into account when analyzing the real cost.

Let's consider briefly the ecotoxicity of seemingly environmentally sparing RES mining. Not only steel, concrete and other industrial materials, but also toxic neodymium and dysprosium are used in the manufacturing process of turbines. Solar panels contain lead, cadmium, chromium and other toxic metals that are released when the panels are broken during transportation or disposal. Fauna also suffers: wind turbines and the extreme temperatures of GSP stations near bird habitats kill large numbers of birds.

An analysis of legislative support plays an important role in considering the prospects of this or that IE. Thus, according to the Government Decree No. 449 dated May 28, 2013, the following RES will be supported by the state in the wholesale market: SES (solar power plants), WES (wind power plants) and SHPP (small hydroelectric power plants). In addition, supported capacity ranges have been determined: solar and wind power plants not less than 5 MW, and small hydro power plants within the range of 5 to 25 MW.

All this has been developed and approved by the long-term program for the development of LNG production (Order No.640-p of March 16, 2021). I considered the prospects of LNG development using the example of Russia as the most significant gas supplier in the world. Our competitors are only the "big three" consisting of Qatar, Australia and the United States.

As far as the support for LNG facilities is concerned, Russia's tactics is also aimed at the most powerful growth, which is inherent in the long-term (up to 2035) program of LNG production development. The volume of LNG production will increase and the use of Russian technologies will expand:

- equipment for gas liquefaction and purification,
- special compressors,
- cryogenic units,
- autonomous LNG power complexes,
- integrated control systems.

The RF Government Decree No. 1523-r, dated June 9, 2020, Moscow, approving the RF energy strategy for the period up to 2035 [2] states:

The set of key measures ensuring the solution of the problem of development of production and consumption of liquefied natural gas, entering of the Russian Federation in the medium term among the world leaders in its production and export includes the provision of legislative and regulatory conditions, including measures of tax and customs-tariff incentives, economically effective and balanced development of production, transportation, storage, sale and use of liquefied natural gas in the general development of the gas industry. Work is currently underway to design large production facilities in the Arctic zone of the Russian Federation on the Yamal Peninsula and the Gydan Peninsula. The Arctic projects will be implemented using gravity type platforms manufactured at the Murmansk shipyard. Outside the Arctic zone of the Russian Federation it is planned to implement major projects under production sharing agreements – construction of the third technological line of the large-capacity liquefied natural gas production plant on Sakhalin Island and "Far Eastern LNG", as well as an investment project of the natural gas processing and liquefaction complex near the settlement of Ust-Luga.

It is also planned to unlock the resource potential not only of Yamal, Gydan, Vladivostok and the north of Krasnoyarsk Krai, but also the Arctic shelf, which will attract new investors and increase Russian LNG exports.

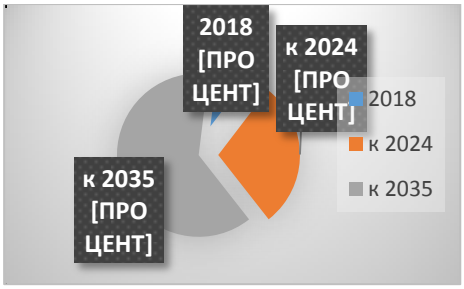

Diagram 1 Volume of liquefied natural gas production in Russia, million tons.

An indicator of our ability to respond flexibly to the dynamics of the global gas market is our position as one of the top three global producers and exporters of liquefied natural gas:

2018 – 18.9 million tons;

By 2024 – 46–65 million tons;

By 2035 – 80–140 million tons.

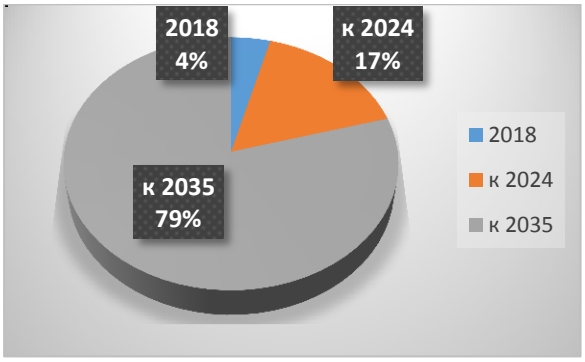

Diagram 2 Volume of methane consumption in transport, billion cubic meters.

These are the methane consumption figures for transport:

2018 – 0.68 billion cubic metres;

2.7 billion cubic metres by 2024;

10 to 13 billion cubic metres by 2035.

The Russian energy industry plans to increase the efficiency of the entire system, to increase LNG production to 80–140 million tons per year by 2035.

By 2040 more than 50 % of natural gas trade will be in liquefied form. Due to the particular attractiveness of the liquefied gas market, Russia intends to occupy a decent niche in it and claim the level of LNG production in these volumes, – says the Russian Minister of Energy Alexander Novak in the journal Energy Policy [3].

On April 20, 2021 the State Duma passed in the first reading the bill that allows the registration in the RMRS (Russian International Register of Ships) of floating storage tanks of LNG (Figure 1). It is also proposed to make changes in the Merchant Shipping Code of the Russian Federation: tax benefits and preferences for ships registered in this register.

Figure 1 Computer model of LNG carriers.

As of 2020, investment in renewable energy will be $281 million, second only to the oil and gas sector at $322 million. Moreover, investment in oil and gas will slow down much more than in renewable energy in 2020. Current projections suggest that green energy will become the largest energy sector in terms of investment as early as 2025 to 2030 (Figure 2).

Figure 2 Windmills and solar panels.

Let's take a look at several notable Russian and foreign companies involved in renewable energy.

1. RusHydro (HYDR). It is a large energy company, specializing in hydro power (80 % of its assets). Hydro power plants provide the most part of generating capacities (30,8 GW). The total number of capacities is 38 GW. RusHydro has a fairly reliable investment portfolio. For example, the analytical indicator has grown 1.34 times since 2015, dividends have more than doubled, and the company's solvency has grown from 1.48 to 2.4.

2. Enel Russia (ENRU). After selling Reftenskaya GRES (3.8 GW) in 2019, the company is building wind farms with a total capacity of 362 MW. Today the construction of Azovskaya Wind Power Plant, which intends to provide “green energy” to Rostov Region, is nearing completion. By the end of 2021 Enel Russia plans to complete construction of the largest wind farm, the Kola Wind Farm (201 MW) above the Arctic Circle. And by 2022 the company plans to have at least 40 % of all renewable energy sources.

3. 10 years ago Lukoil (LKOH) decided to start investing into renewable energy sources, namely – into hydro power plants in the Republic of Adygea, in Krasnodar region with total capacity of 297 MW. In 2013 the Company purchased wind farms in Romania and Bulgaria (208 MW).

4. Gazprom Neft (SIBN) invested in wind farms and geothermal systems in Serbia.

5. Tatneft (TATN) and Rosneft (ROSN) also have similar projects.

6. Shell (RDS A) is one of the leaders actively investing in environmental projects. Among them: the energy storage company Sonnen (Germany), the American solar power producer Silicon Ranch and several wind power projects in Europe and the USA.

7. British Petroleum (BP) is a renewable energy investor. Established with Bunge a company called BP Bunge Bioenergia. The company is engaged in bioenergy and production of ethanol from sugar cane. The company has a stake in wind power generation in seven U.S. states, including Hawaii. British Petroleum has increased its stake in Lightsource BP to 50 %. They are involved in "solar" projects and plan to deploy 10 GW of capacity by 2023.

8. Total (TOT). The French giant plans to increase its RES capacity to 25 GW by 2025 and significantly expand its share of its portfolio by 2035. Through its subsidiaries Total Solar, Total Eren, Total Quadran and SunPower, Total is developing photovoltaic solar, wind, bio, hydro power.

9. Chevron (CVX). This U.S. company has already acquired 65 MW of wind power capacity in West Texas and 29 MW of solar power in Southern California. It is partnering with Pacific Ethanol, Waste Management and CalBio on renewable transportation fuels.

10. As you can see, the oil and gas giants are turning into major energy companies with a huge share of renewables in their assets. These are significant players in the green energy market.

The year 2021 marked the beginning of active exploration of deep space. This spring, one after another, spacecraft from the UAE, China and the United States reached Mars. April 19, 2021 Ingenuity drone helicopter of the same NASA (Figure 3), made history by making the first flight to Mars.

And on April 20, 2021, NASA's Perseverance planetary rover managed to pick up a sample of the Martian atmosphere for the first time, from which it was able to isolate oxygen. "Devices like this may one day provide astronauts with breathable air," experts said. Mars interested astronauts for a reason. In July 2020, Earth and Mars converged, an event that happens about once every 26 months. Depending on the initial flight speed, its duration varies from 260 to 150 days, which was used by scientists.

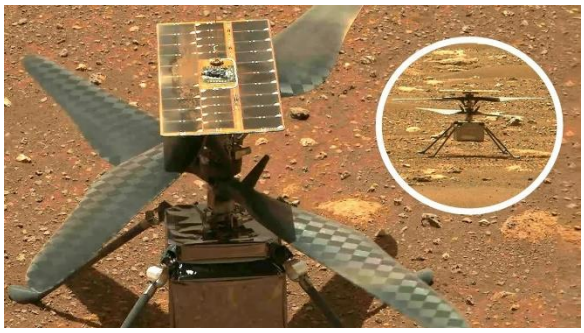

Figure 3 NASA Ingenuity drone helicopter.

In 2021, Russia resumes lunar exploration. It is planned to create a vehicle simulating human movements to collect soil samples. Ahead, we will get acquainted with new chemical substances, and, as a consequence, the "Table of cosmic elements". Probably, a kind of energy with unexpected properties, units and parameters will be discovered there. One more suggestion. Possibly some "Energy traps" will be invented with which earthlings will be able to transport this resource to their planet. These conclusions suggest that the energy of the future is not on Earth (Figure 4).

Figure 4 The newest energy.

4. CONCLUSION

Despite the fact that interested countries are actively financing the development and implementation of renewable energy sources, they have a number of problems: production, operation, storage and environmental friendliness of disposal. In turn, the increasing share of LNG development in the world market could compete significantly with renewables over the next 15 years.

Studies have shown that LNG is an effective solution to the problem of choosing a reserve fuel. LNG is particularly relevant for enterprises where natural gas is the main fuel, which will avoid stopping work processes during repairs and commissioning. With such qualities as environmental friendliness, safety, reliability and high

energy efficiency of the fuel, it should be noted that storage is also highly economical and compact.

Thus, in the medium term, LNG is undoubtedly the most realistic to hold the leading position. Nevertheless, in the long term, RES can be a serious competitor to LNG.

It is too early to put an end to the priority of this or that type of energy. We should not forget that new cosmic spaces are being explored, robotic expeditions to the surface of the Moon, Mars, asteroids are underway. And it is possible that scientists will find a new element unknown to us, a potential source of "Newest Energy", which will take its long vacant place in the Mendeleev's chemical table, becoming the absolute leader in this field.

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