Change in the Architecture of Energy Markets in North-East Asia

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***Abstract* — The paper aims to identify promising areas of energy cooperation between Russia and the countries of East Asia. A review of the main groups of factors (technological and techno-economic, energy security, geopolitical, and economic), which influence the change in the existing architecture of energy markets, is made. Assumptions are made about the directions for the development of the transport and institutional infrastructure for energy export from Russia. The findings indicate the need for accelerated development of hydrogen technologies and emphasize the importance of energy cooperation institutions. The paper proposes creating a new regional market, i.e., the market for green certificates for hydrogen.**

Index Terms: **North-East Asia, regional energy markets, energy infrastructure, energy policy, international energy cooperation, hydrogen technology.**

I. Introduction

At the beginning of the 21st century, "The world is on the verge of global changes in energy," as the title of the paper by A.M. Mastepanov emphasizes [1]. The external conditions for these changes are created by close interrelation and interweaving of the circumstances such as the limited and depleted hydrocarbon resources most accessible technically and economically; the high rates of scientific and technological progress, and the commercialization of renewable energy technologies; the growing human welfare and the increasing political significance of social and environmental factors; as well as a deep systemic crisis of the globalization process.

The totality of these circumstances regarding the object at issue, i.e., energy markets in the region of North-East Asia (NEA), indicates a rapid increase in the influence of the geopolitical factor on these markets. It clearly manifested itself in February 2022, after the start of a special military operation by Russia against the Nazification and militarization of Ukraine.

This event became a catalyst for the creation of new coalitions to build a multipolar world, the process that had already started by that moment. The political engagement of such an "ideal" political occasion is seen in the official statements made by the leaders of the "Western" institutes for economic and energy cooperation. F. Birol, director of the IEA OECD, pointed out in the preface to the forecast for the world energy development until 2050: "When people misleadingly blame climate and clean energy for today's [energy] crisis, what they are doing – whether they mean to or not – is shifting attention away from the real cause: Russia's invasion of Ukraine" [2]. Confirmation of the seriousness and long-term intentions of the coalition of "Western" countries (including such organizations as the G-7, AUKUS, etc.) in relation to Russia can be found in an analytical article on the new mechanism for regulating oil markets, prepared by T.A. Mitrova, Research Fellow at Columbia University's Center for Global Energy Policy. A document published in mid-December 2022 by the Carnegie Endowment states that "… in a decade, Russia's status as an energy superpower, which it claimed, will be a thing of the past" [3].

On the other hand, it must be underscored that the depletion of non-renewable energy resources (NRER – coal, hydrocarbon raw materials, uranium), the extraction of which is economically justified, is objective and inevitable. Thus, the energy transition (Energy transition is a long-term change in the energy consumption structure affected by resource, techno-economic, environmental, and geopolitical factors) process is currently beginning to take on the features of a struggle for appropriation of part of the natural resource rent of NRER between Russia and non-"Western" countries exporting hydrocarbon raw materials, and some energy importing countries.

Next, we will consider the main factors influencing the transformation of the architecture of energy markets in the NEA region.

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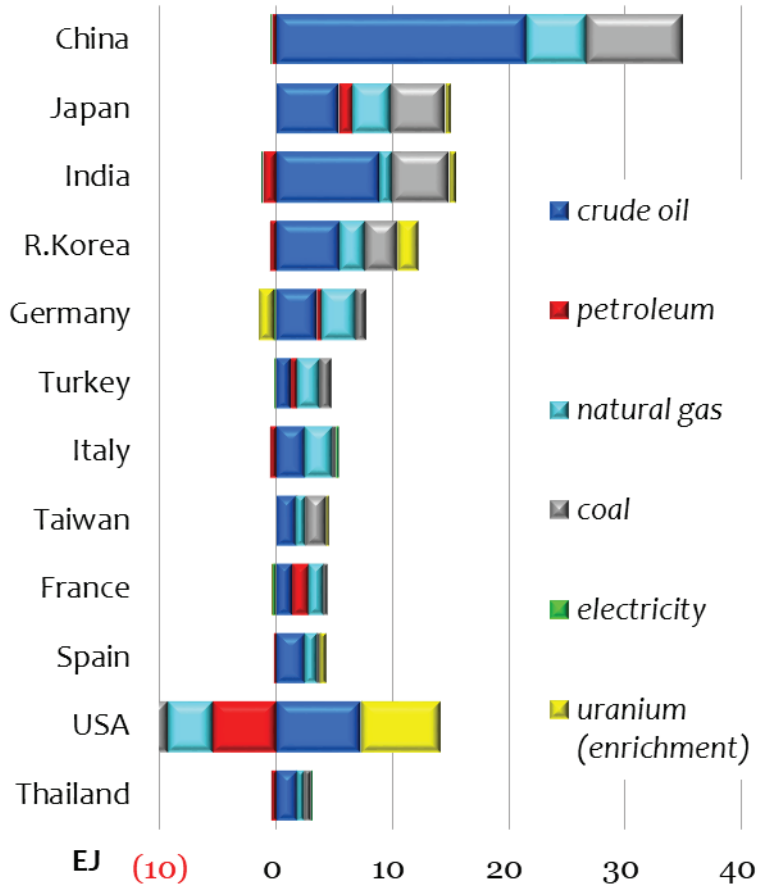

Fig. 1. Top net energy importers in 2021 (EJ).

II. Factors of Changing the Architecture of Energy Markets

The last decade was characterized by the growing role of the geopolitical factor in the development of energy infrastructure and the formation of a situation in the energy market. European market saw energy consumption stagnation accompanied by the statements about the need to diversify supplies and cut down the dependence on Russian imports, later supplemented by binding targets to reduce greenhouse gas emissions by eliminating the use of fossil fuels. At the same time, the high rates of economic growth and the increase in the well-being of the population in some of Asian countries, and in particular in East Asia, contributed to the growth in demand for energy carriers, primarily for oil and natural gas. On the supply side, the shale revolution in the United States allowed this country, after 50 years, to enter the global hydrocarbon market, which significantly diminished the possibilities of the regulatory mechanism within the OPEC.

Analyzing the current state of the world energy markets, we will take as an initial premise the statement that "any geopolitical changes are based mainly on the parameters of the capital redistribution, namely, competition for resources and access to them, for commodity flows, for redistribution of existing markets and capture of new ones, increase in the profits, for a wider area of application of their currency, etc." [4]. Without pretending to comprehensively consider the impact of the "energy transition" on the world trade in energy resources, we will focus on the groups of factors, which determine the changes in the architecture of the energy markets in the countries of East Asia (EA). These are technological and techno-economic factors, energy security, struggle of industrial and financial capital for world markets for energy carriers and energy technologies, and geopolitics.

Technological and techno-economic factors of the global energy transformation

The growth in the cost of conventional energy resources (another name for NRER) and their limitations at the end of the second decade of the 20th century led the world to adopt a new energy development paradigm based on the concept of "energy transition." It is based on the rejection of the use of fuel energy resources (coal and hydrocarbons), and the transition to "carbon-free" energy. In the strict sense of this term, "carbon-free" energy refers to renewable energy sources (RES) only, including hydropower and biomass, but excludes nuclear energy. However, recently, there has been more support to the view that nuclear energy should also be classified as "carbon-free" or "green" energy (with

the criterion of environmental efficiency identified as the criterion of CO_2 emissions).

The rapid (by historical standards) depletion of economically viable NRER reserves (not resources!) had become one of the main factors in the growth of the political narrative for globalization and the adoption of sustainable development goals by the UN before signing the 2015 Paris Agreement on "combating climate change."

The requirements for the enhancement of the energy efficiency stem from the increasing cost of energy carriers and reflect the finiteness of the NRER. For a long time after the first world oil crisis in 1973, Japan acted as an example of the development and implementation of a national energy saving strategy. Such a policy, in the context of the rapidly developing economy of the country, was used both as a mechanism to reduce the need for energy imports and as a driving force for the growth of exports of energy-efficient goods and technologies.

The commercialization of wind and solar power generation technologies at the beginning of the 21st century is based on a sharp decrease in specific investment in wind generators and photovoltaics. At the same time, the high rates of improvement in these technologies led to the fact that already at the beginning of the third decade of the 20th century, there were signals that the lower limits of the unit cost of such generation had been reached.

The current stage of advancement in battery technology, which began at the end of the last century with the development of lithium-ion batteries for portable electronic equipment, two decades later enabled a large-scale transition of passenger vehicles to electric cars. The successful commercialization of next generation batteries has already led to the displacement of traditional motor fuels in Europe and East Asia based on the energy policy mechanisms that indicate the temporal stages of a ban on the production of non-electrified road transport [5, 7].

The formation of prerequisites to the commercialization of hydrogen technologies for the production of synthetic fuels based on hydrogen produced by electrolysis of water (e-fuels – such as "green" hydrogen, ammonia and methanol; biofuels, etc.) is even a more serious factor in the displacement of traditional motor fuel from transport sector. In addition, these technologies open a new stage in the development of interseasonal electric power storage systems in power systems characterized by a significant share of intermittent renewable generation.

A significant factor in the transformation of energy markets is the "revival" of nuclear technology after decades of stagnation caused by three well-known disasters – Three Mile island, Chernobyl, and Fukushima. Against the backdrop of the aggravation of global nuclear energy issues, including the need to dismantle aging and closing nuclear power plants, the organization of a nuclear fuel cycle and non-proliferation of weapons of mass destruction, improved nuclear technologies (safer low-power reactors) were developed and the stage of their commercialization started. The importance of nuclear energy is currently recognized even in the EU [8].

Thus, the development of electrical (RES), hydrogen and nuclear technologies is becoming one of the central factors in the transformation of energy systems, the driving force behind the creation of new markets for carbon-free energy carriers, energy technologies and equipment, and energy supply services.

Energy security

The structure and size of the major energy trade balances for the world's largest net energy importers as of 2021 is shown in Fig. 1. Four of the six East Asian (EA) economies ranked first, second, fourth and eighth respectively in this list. The desire to improve their energy security in the face of insufficient NRER reserves (in the case of China) or almost their complete absence (Japan, R. Korea, Taiwan) is expressed in the following components of their national energy strategies: firstly, increasing energy efficiency in all sectors of energy consumption; secondly, diversifying the structure and sources of energy imports; thirdly, developing the technologies using synthetic fuels based on renewable energy sources (e-fuels).

Enhancement of energy efficiency and change in the structure of the economy in favor of the service sector and less energy-intensive industries was reflected in the decline in energy consumption in Japan and in the stagnation of final energy consumption in R. Korea and Taiwan. In contrast, energy consumption in China continues to grow, despite the adoption of some measures to increase energy efficiency. The greatest potential for further growth in primary energy consumption however is represented by RES (generation of electricity based on the country's solar and wind energy resources), as well as the gas market – due to the replacement of coal with gas in the power industry, and conversion of buildings and transport to gas.

On the supply side, the security of supplies and their economic efficiency is ensured by the participation of companies from East Asia (mainly state vertically integrated companies and owners of energy infrastructure in the national domestic markets of their countries) in energy projects abroad, and the organization of imports based on these projects under long-term contracts. Such mechanisms to some extent determine the predictability of the structure of energy supplies and ensure the stability of Russia's trade and economic relations with the partners from East Asia. Against the backdrop of the sanctions imposed in 2014, Japan and R. Korea began to be wary of new gas projects in Russia. However, even with the situation worsened in 2022, these countries do not plan to withdraw from existing joint ventures, and China has become the largest foreign investor in the Russian LNG industry [9].

The struggle of capital for world energy markets

The emergence of new shale oil producers and the creation of the possibility for exporting LNG from the

United States after the shale revolution led to increased competition in the global oil and natural gas markets. The American energy business found support in the face of the US government, which, through intergovernmental negotiations, is trying to increase the supply of these energy carriers to foreign markets. However, due to relatively high costs, in the context of falling oil prices in 2014 because of an excess oil supply (OPEC + could not change the situation on account of the inconsistency of positions both within the cartel and between the cartel and oil exporters not included in it), and against the background of a decrease in the consumption of petroleum products caused by the global COVID-19 pandemic in 2020, US companies could not strengthen their positions in the oil market.

The lack of economic prerequisites for the growth in the share of US energy exports of hydrocarbons in world markets led to attempts to position these homogeneous goods (light oil and LNG) as those having some additional value according to non-market criteria – for example, as more "reliable," more "environmentally friendly," and so on. Accordingly, the increase in energy exports from the United States to European countries that have abandoned Russian energy resources can be viewed, on the one hand, as the result of the use of political influence tools, and, on the other hand, as protectionism in the formation of sales markets for "their" companies.

The latter circumstance takes on particular weight in the context of chronic underinvestment in oil and gas projects in other countries, which has been observed over the past decade (see the next section). High energy prices in the face of an artificially created shortage of supply allow US business actors not burdened with long-term contracts to receive additional profits not only due to increased sales, but also due to higher prices. In other words, long-term planning and successful implementation of the US geopolitical course to squeeze Russia out of the European hydrocarbon markets created favorable opportunities (based on the most efficient use of financial instruments) for the development of the shale industry and related sectors of the economy of this country.

Additional business interests associated with the production and use of shale oil and gas include positive effects for the local and national economy. These are the development and operation of fields, the transportation of oil and gas condensate by rail and road, the re-equipment of previously built terminals for receiving LNG into LNG export plants, the development of an industry for the production of equipment for building LNG infrastructure. Huge investments were made in the financial, consulting and political sectors of the US economy to prepare and create international institutions for LNG trading, primarily pricing mechanisms.

The international financial and industrial capital plans to carry out activities similar in scope and scale when implementing the policy of "energy transition" at the global level. At least since the G-20 summit in Osaka (2019), political consolidation has been carried out to maximize the coverage of nation states subordinate to transnational corporations and financial capital in order to transition to a "new technological order of the economy" based on hydrogen technologies. A directive accelerated introduction of "carbon-free" energy technologies (renewable energy and hydrogen energy, transport electrification, small modular nuclear reactors) is expected for this community, with the help of the institutions of the "energy transition" and the "fourth technological revolution." Thus, international capital organizes channels for large-scale investments: "Industries helping the world shift to net-zero emissions could be worth $10.3 trillion to the global economy by 2050, sustainable development consultancy Arup and economics advisory firm Oxford Economics said in a report" [10].

Geopolitical factors in the transformation of world energy

The main geopolitical factor associated with the challenges of energy infrastructure development is the current relative inaccessibility of hydrocarbon resources and critical materials. The latter are particularly acute for the technologies of "green" "carbon-free" energy. Relative inaccessibility refers to the ratio of reserves and resources that can be disposed of by national/private and transnational mining companies. In essence, this is the problem of the distribution of natural resource rent among world economic and geopolitical actors.

The growth in specific energy consumption by developing economies (such as India, China, the countries of Southeast Asia, Africa) indicates the importance of the problems of energy inequality and energy inaccessibility, which are necessary to solve for the socio-economic development of these countries.

The statements and unilateral measures of some governments in the field of carbon-free energy development, which is promoted as the basis for achieving climate goals, are becoming an instrument of political influence on international energy markets. A vivid manifestation of the surge in the political narrative on "fighting climate change" was the emotional speech of 16-year-old Greta Thunberg at the UN Climate Change Action Summit in 2019, within the framework of the UN General Assembly. This activist announced the beginning of an environmental catastrophe due to the inaction of politicians who do not take decisive measures to reduce greenhouse gas emissions from the rostrum of the highest international body.

An important issue of international energy cooperation remains the adequacy of investments and the existing capacity of the infrastructure for transporting energy carriers, both universal and specialized (pipelines, power lines, tankers). Solving this problem is significantly influenced by the uncertainty and ambiguity of the processes of formation of new geopolitical coalitions and institutions of energy cooperation. The latter include

consideration of such factors as the provision of transit goods flows (including shipping through the sea straits), the level of energy security (including the problem of maritime terrorism / piracy), pricing (spot and long-term contracts), which together affect the viability and efficiency of investment projects in the energy sector.

The desire to avoid a situation of monopsony in the gas market in the segment of pipeline supplies is a factor pushing Russia to look for mechanisms to maintain its presence in the European market (the creation of a gas hub in Turkey, swap supplies, and others are being discussed). The strategic objective of Russia in the field of cooperation with China and Mongolia, which do not refuse to import Russian energy resources, is to deepen it in the context of technological and investment partnership. This direction will allow Russia to act in the reformatted energy markets in developing countries not only as an exporter of energy resources with low added value, but also as an investor, contractor and supplier of equipment and services for end energy consumers.

As the role of renewable energy in providing primary energy increases and the "energy transition" deepens, the concept of energy imports, and, accordingly, the definition of the energy security of the economy, is going to be significantly transformed. "The concept of *an energy superpower* will change its content. This will not be a "custodian" and "producer" of large volumes of fossil fuels, but a manufacturer and developer of equipment and technologies for a new [carbon-free] energy industry" [11].

East Asian energy security policy

Unlike the EU countries, since the beginning of the conflict in Ukraine, the EA countries have been pursuing a significantly more "cautious" policy in relation to the import of Russian energy resources, not yet supporting a complete rejection of it. Thus, Senior Research Fellow Assistant Director of the Institute of Energy Economics of Japan (IEEI) I. Kutani gives the following assessment of the current situation: "We should not ignore the fact that, for a large proportion, improving people's standards of living and developing industry are top priorities, and climate change measures are merely side issues. *European policy to end dependency on Russia have strengthened this view*… The outcome of the war between Russia and Ukraine is unclear. Given this unavoidable external factor, we should consider how best to increase future profits and competitiveness amid the given environment." [12].

The chairman and CEO of the IEEI Tatsuya Terazawa, speaking about the need for "de-Russianization" of the energy sector, gives the opinion of Japanese experts on the timing of achieving carbon neutrality: "the decarbonization process cannot be completed in the short nor even in the medium term" [13], which implicitly but firmly links together the problems of energy security, NRER trade, and geopolitical processes.

Although Japan and the Republic of Korea have stopped technical and scientific cooperation with some Russian companies and institutions, because of their connection with the defense industry of the Russian Federation, these countries currently do not completely refuse to import Russian energy resources and participate in existing joint ventures in the energy sector.

China has political disagreements with some Western countries and is likely to continue to strengthen its relations with Russia as a geopolitical partner, while ensuring an acceptable level of prices for its energy imports. Chinese Foreign Minister Wang Yi, speaking at a symposium on Chinese diplomacy in December 2022, noted the following: "Throughout the year, China and Russia have firmly supported each other in upholding fundamental interests; our political and strategic mutual trust has further strengthened … [Relations between China and Russia] are free from interference or attempts to sow discord between the two countries and are immune to changes in the international environment" [14].

Thus, the EA countries will continue cooperation with Russia in the energy sector, but its nature will change. Japan and R. Korea, at least in the medium term, will not look for places in the Russian energy sector to invest their capital [15, 16].

III. Example of the World Gas Market

The gas market is one of the most illustrative examples of the ongoing transformation of commodity and financial flows related to energy. This has many explanations. First, the global gas market is just emerging, as the three largest regional markets in the west and east of Eurasia are merging against the backdrop of the rapid pace of China's gasification. Secondly, the United States began to use the so-called "shale revolution" as a tool for solving its geopolitical and socio-economic problems.

The financial and political tandem of the United States and large companies of LNG importing countries creates opportunities for building a logistics infrastructure and related institutions (which will provide arbitrage LNG supplies and mechanisms for related services). In this case, both the Atlantic (western Eurasia, mainly the pipeline gas market with a large share of Russia on it) and the Pacific (the world's largest center of LNG consumption in the east of Eurasia, where China surpassed Japan in terms of imports, and where Russia started to supply pipeline gas as well) regional markets prove interrelated.

The desire of developed countries to diversify the structure of imports and reduce import dependence through the development of renewable energy, supported by the goals of "fighting climate change," became a key factor in underinvestment in the oil and gas, and coal industries. Thus, whereas by 2020 world oil consumption decreased by 5.6% compared to 2015, the investments in the oil industry declined by more than 40% (see Fig. 2); similarly in the coal industry, where consumption fell by 2.5% and investment by 16.2%. At the same time, investment

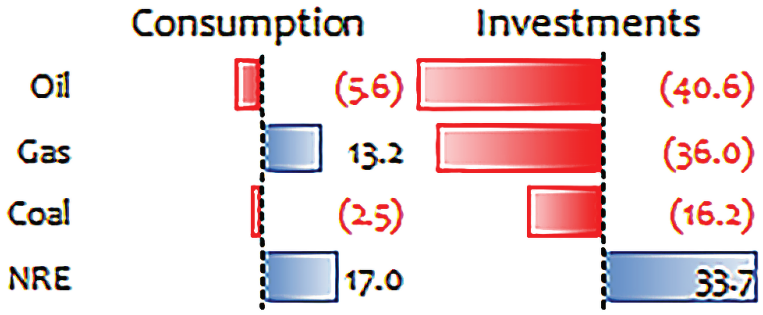

Fig. 2. Growth in energy consumption and investments in energy in the world in 2015-2020, %. Source: estimation based on [17].

in renewable energy grew at a faster rate than renewable energy consumption.

Paradoxically, even in the gas industry, where consumption grew by 13.2% (slightly less than the 17% increase in renewable energy consumption), investment fell by 36%. It is noteworthy that in the period of 2015–2020, most of the gas liquefaction capacities, for which final investment decisions were made, were in projects in the United States [18]. In the field of pricing in the gas market, some importers (primarily some European countries and the United States) pursued a policy of promoting trade based on short-term contracts and peg to prices in gas hubs [18], which did not help reduce uncertainty and stimulate investment in new projects.

The stagnation of demand for energy resources in developed countries, against the backdrop of statements about the abandonment of NRER, became one of the key factors in the formation of a trend (which emerged in 2018) towards a decrease in world prices for these goods. This trend was reinforced in 2020 by the global economic downturn caused by the impact of the COVID-19 pandemic. At the same time, already in 2021, oil and gas prices began to increase, due to the recovery in demand in the face of limited production capacity.

In 2022, Western countries introduced new packages of sanctions against Russia. The new restrictions entailed some technical, organizational, financial, and logistical difficulties, which manifested themselves in the maintenance and repair of imported equipment in Russia, in delays in payments under foreign trade contracts, and an increase in the cost of chartering tankers. In an attempt to reduce the oil and gas revenues of the federal budget of Russia, mechanisms were introduced to limit the price of hydrocarbons exported by Russia. In May 2022, the European Commission published a plan to reduce energy imports from Russia and create a new European energy infrastructure – REPowerEU. The plan includes an increase in LNG imports from the US and Canada, as well as pipeline gas and LNG imports from Norway. It proposes strengthening cooperation between the EU and Azerbaijan (in terms of expanding the Southern Gas Corridor) and establishing an energy dialogue with the countries of the Middle East, North and East Africa, and Australia.

A striking and intensely hushed up geopolitical event in 2022 was the terrorist attack on the main underwater gas pipeline systems Nord Stream-1 and Nord Stream-2. Four months have passed but nobody has named either the perpetrators or the beneficiaries of this largest act of terrorism on the offshore energy infrastructure.

A highly unusual circumstance in the European market is the fact that since autumn 2021, gas prices and their volatility have settled at significantly higher levels than in East Asia. Prices continue to be maintained at such levels to ensure the attractiveness of this market for LNG exporters in the face of a rapid reduction in pipeline gas supplies from Russia. Previously uncompetitive LNG from the US is becoming a key source of gas supplies to the EU. In turn, the EU generates an important steady stream of profits for the United States, attaching an additional factor of political influence based on ensuring "energy security." Whereas in 2021 the United States exported 34 billion m^3 of natural gas to European countries (35% of the total volume of LNG exports from the United States), in the first half of 2022 these figures amounted to 39 billion m^3 and 68%, respectively [19].

At the same time, Asian buyers are also feeling the rise in energy prices. According to the speech by IEA Executive Director F. Birol at the opening of the 43rd IAEE Conference on August 1, 2022 in Tokyo, "this is the first global energy crisis." For the countries of Europe, the main objective during this crisis is to ensure the physical volume of hydrocarbon supplies in the face of infrastructural and institutional restrictions imposed by the EU itself. For Asian countries, the key objective is to maintain an acceptable price level in the context of the growing demand from China. In such a situation, an important factor in the development of the global gas market is the increase in pipeline gas supplies from Russia to China (there is a growing volume of gas exports to China through the Power of Siberia gas pipeline); the project of a gas pipeline to

Table 1. Russia's Energy Exports in 2020

Regional Energy Markets	Quantity, Mt	Value, bn USD
Coal & Coke		
Atlantic	89.5	5.3
South Asia	11.3	0.9
Pacific	112.8	7.1
Oil & Petroleum Products		
Atlantic	253.5	76.9
South Asia	9.6	2.9
Pacific	118.2	38.3
Natural Gas		
Atlantic	147.8	n.a.
South Asia	–	n.a.
Pacific	10.2	n.a.
Electricity		
Atlantic	–	3.7
South Asia	–	4.4
Pacific	–	..

Note: ".." – less than 100 thousand USD; n.a. – not available; "–" equals to zero.
Sources: [22].

China through Mongolia (with a capacity of 50 billion m^3 per year) and a project for the supply of 10 billion m^3 of gas from Sakhalin Island (under the contract signed with China in early February 2022) continues to be worked out [20, 21].

Summing up the analysis of the current stage of the global gas market development, we conclude that its architecture is being rebuilt (Building Back Better) under the significant influence of the political line of world actors, the beginning of which (influence) was laid long before the aggravation of the geopolitical situation in 2022.

IV. Energy Transport Infrastructure

Russia is the world's largest energy exporter. Table I shows the scale of energy exports in 2020 from Russia to three main markets: the Atlantic (mainly representing the countries of the west of Eurasia), the Pacific (the core of which is the countries of East Asia), and the South Asian (which unites energy importers from South and Middle (Central) Asia).

The prerequisites for a new infrastructure for energy export from Russia were in place even before 2022. The narrowing of the capacity of European energy markets and Russia's orientation towards the markets of the Asia-Pacific countries and India were enshrined in the Energy Strategy of the Russian Federation for the period up to 2035 (adopted in June 2020) and some sectoral programs. The current geopolitical situation dictates the need for an accelerated reorientation of energy exports from Russia from western to eastern and southern directions. Such abrupt changes adversely affect both Russia (increasing transportation distances in competitive markets leads to lower rental income) and importers (due to rising energy prices).

In the currently emerging situation, the countries of Western Eurasia, the United States, and some other energy importers will almost completely abandon imports from Russia in the next few years. In these circumstances, the potential of the energy infrastructure created in Russia and oriented to the export of almost 500 million tons of NRER per year, will have to find its customers in other markets.

First of all, the development impulse should be received by the economy of Russia itself, which can form more capacious domestic markets (for example, for natural gas). There will be an increase in the production of energy-intensive products (mainly intended for foreign markets, up to the highest possible processing), whose localized technological chains start from the Russian mining industry.

In addition, Russia will look for new buyers of its traditional energy carriers in already developed markets, increase the volume of NRER exports to the countries of Asia, Africa, and Latin America. To ensure these flows, it will be necessary to develop not only a new infrastructure for transporting energy carriers, but also to establish institutions for international energy cooperation to provide the creation and operation of such an infrastructure.

Russia is once again faced with the problem of providing maritime access to markets, since the use of long-distance water transport has a significant economic advantage over the NRER transportation by land. This time, the Northern Sea Route should play a key role. To do this, it is necessary to ensure integration between the NRER transportation infrastructure from the eastern and Arctic regions of Russia with the newly created logistics hubs on the Russian shores of the Arctic and Pacific Oceans.

Despite the geographic proximity of Japan and the Republic of Korea to Russia, the creation of a specialized export energy infrastructure (pipeline systems and power lines) between them will probably not be implemented

due to the influence of the geopolitical factor. The NRER export from Russia to the Pacific and South Asian markets will have to be carried out on the basis of the infrastructure of sea (and aeronautic, if it is created in the future) freight transport.

Implementation of the "energy transition" will require the creation of a new transport infrastructure for the "green" energy. At the same time, the "green" hydrogen transportation by any means of transport is cost- and energy-ineffective: a) a high level of costs for creation and operation of the necessary technological infrastructure, b) significant energy losses during hydrogen transformation from a gaseous state to a liquid state and vice versa, or during transformation into other types of energy carriers or hydrogen-containing substances [23, 24].

One of the possible technological solutions for transporting RES energy over long distances is the construction of international electrical networks based on high voltage direct current (HVDC) power lines. There are already projects for such international energy interconnections in the NEA region, for example, "Asian super grid" [25, 26]. The involvement of hydrogen technologies will likely give a second wind to such discussions, which will make it possible to create an international electro-hydrogen system that is significantly more resistant to changes in RES energy flows and to the risks of supply interruption.

Due to technological problems, hydrogen consumption will be concentrated near the places of its production, and its large-scale transportation over long distances will become possible (after 2050) only in the case of a breakthrough development of hydrogen technologies and a decrease in their cost. A possible option for a mutually beneficial solution to the problem of stimulating the development of hydrogen and renewable energy technologies may be the use of special financial instruments and the creation of new institutions for international energy cooperation based on "green" certificates for electricity and hydrogen.

The price ceiling mechanism for Russian oil introduced by the EU, the G7 countries and Australia is ambiguous in terms of preventing price increases on the world market. Importers will be able to put price pressure on other suppliers, who, in an attempt to prevent falling prices, may begin to limit the volume of supplies. In this regard, the reduction in the oil production quota adopted in October 2022 by the OPEC+ cartel [27] should not be viewed as an act of solidarity for fear that the precedent with the imposition of sanctions may be repeated, but as a measure, the introduction of which is dictated by the economic interests of exporters of crude hydrocarbons.

The influence of all considered factors are superimposed in time, and they are interconnected. Thus, by now, a bifurcation point has formed in the development of global and regional energy markets, which will have the most serious impact on the further development of Russia, and its energy transport infrastructure in particular.

Prospects for the development of international energy infrastructure in the NEA region

The strategic problem for Russia is not building new export logistics chains, but the ability of its economy to ensure the technological development of energy and related industries. In the context of a situation close to monopsony in the energy markets, pressure from energy importers to lower prices can be offset by an increase in the production and export of energy equipment and energy services. For example, in the case of trilateral cooperation between Russia, Mongolia and China on the conversion of Mongolia to gas, it is possible to form packages linking the import of LNG or natural gas with the supply of relevant equipment and services.

In the long term, the main factor of uncertainty in energy markets is related to how stable the new geopolitical architecture, which is still being formed, will turn out to be. Plans to create a gas hub in Turkey are a confirmation of this circumstance. Economically, the situation on the market is far from optimal, and after the end of the military conflict in Ukraine, we can expect the establishment of working trade and economic relations between Russia and European countries.

Since projects related to the creation of a new energy infrastructure are characterized by capital intensity and long payback periods, the duration and scale of changes can be indirectly judged by the Final Investment Decisions (FID) taken by "Western" investors, which make it possible to replace the import of Russian energy resources.

The energy infrastructure in the NEA region will continue to develop, regardless of the pace of implementation of the "energy transition" policy. China needs to reduce its dependence on coal. Japan, the Republic of Korea and Taiwan are likely to be forced to increase their imports of increasingly "green" energy carriers from "friendly" countries, and not from Russia. However, the very fact of the availability of world-class energy resources in Russia creates conditions not only and not so much for their monetization (both NRER and RES), but for the socio-economic development of the country.

The implementation of the emerging opportunities in the transforming energy markets calls for the creation of new institutions for international energy cooperation, including institutions for financing energy infrastructure facilities and mechanisms for bilateral and multilateral energy cooperation.

V. New Institutions for Energy Markets

The main objective of the forthcoming transformation of new export energy markets for Russia is to establish new, efficient institutions for energy cooperation – both in the NEA region and in the world markets as a whole. The significance of these institutions lies in the fact that they are mandatory for the functioning of the transport infrastructure, through which energy resources are physically transported from exporters to importers. The

quality of market institutions determines the financial efficiency of the energy transport infrastructure, not to mention the prospects for its further development or the creation of new types of energy transport systems.

The existing institutions of the NRER markets, which have already transformed, in connection with the geopolitically determined refusal of the countries of the western part of Eurasia to import Russian NRER, should primarily include those associated with the immobile infrastructure of specialized energy transport systems, i.e., pipeline and electric power ones. Institutions designed for the trade in energy resources by sea and air transport (mobile infrastructure based on reloading logistics hub ports), due to their almost global nature, will still have to facilitate the unhindered access of energy resources to all markets where they have consumers. Consequently, efficient international institutions for trade in energy carriers, which are transported using the international maritime and air infrastructure, become vital for Russia. Such institutions provide mechanisms for guarantees, insurance, pricing, transit, re-export, certification, and other tools for energy trading in physical and financial markets.

In the context of the political coalitions formed and the multipolarity of the globalization process, the transformation and/or creation of new institutions vital for Russia (representing "hard" mechanisms for ensuring international energy cooperation) requires significant acceleration of the use of "soft" mechanisms for strengthening mutual trust of partners in the international arena [28].

Maritime transportation of NRER (hydrocarbons, coal, enriched uranium) from Russia to new importers in the Atlantic and South Asian markets requires free passage of the Danish straits, Black Sea straits, Malayan straits, the Suez Canal, and exit from the Russian Arctic to the Pacific Ocean through the Bering Strait. In addition to smooth passage of these critical sea lanes, Russia needs non-discriminatory pricing mechanisms for Russian energy, as well as low transaction costs. The mutual correspondence of such institutions and facilities of developing transport infrastructure should fully cover the entire logistics supply chain – from export terminals, through transit and main routes (both with and without a linear, immobile infrastructure), to unloading and processing of import documents, transfer of energy carriers and energy services to importers, and receiving payment by Russian exporters in full.

The institutions of technical and financial regulation of the processes of energy resources transportation are of particular importance for new energy markets in the NEA region such as the markets for electricity and hydrogen energy carriers. For example, the problem of creating an international energy interconnection "[East] Asian energy ring" has been discussed for several decades [29, 30]. The main obstacle to the implementation of this project is the lack of guarantees of compliance with the national requirements of the participants in the field of energy security, that is, the absence of basic regional institutions for energy cooperation.

In turn, due to huge energy losses during the renewable energy transportation over long distances, the hydrogen carrier market in NEA at the first stages of its development (for several decades after 2030) will bring about an additional need for natural gas in the gas market, supplemented by the necessity to create a new market for CO_2 sequestration services and the institutions for trade in green certificates for hydrogen. With the development of the electric power interconnection of the NEA countries, hydrogen will also be used as a renewable energy storage device to supply fuel to peak sources and to supply local hydrogen carriers markets.

Russia can participate in the creation of a regional market for green certificates for electricity and hydrogen. This will not only contribute to the achievement of climate goals but will also solve the problems of the lack of effective technologies for long-range hydrogen transportation, stimulate domestic consumers of green energy, and support the development of hydrogen technologies. Under such a scheme, on the side of buyers of certificates, hydrogen consumption increases and a market for carbon capture, storage, and utilization (CCS (carbon capture and storage), CCUS (carbon capture, utilization, and storage)) is created, and on the side of sellers of certificates, the development of renewable energy generation and the use of hydrogen technologies are encouraged.

VI. Conclusion

The paper describes the main groups of factors influencing the modern processes of transformation of energy markets. The growing influence of the geopolitical factor, the importance of institutions of international energy cooperation, the need to factor in the relationship between economic development and the transformation of energy infrastructure both at the national and international levels are indicated. The main attention is paid to the NEA region, as one of the most significant for Russia in the forthcoming period of diversification of buyers of energy resources exported from the country. The reorientation of energy exports from the Atlantic to the Pacific and South Asian markets is connected both with objective reasons (stagnation of energy consumption in Europe and its rapid growth in China) and with the EU policy of voluntary abandonment of Russian energy resources.

The effects of geopolitical factors will manifest themselves in the political consolidation of the new poles of globalization, with a corresponding transformation of the institutions of energy cooperation and the international infrastructure for the transportation of energy carriers. Along with prompt measures to establish a new infrastructure to export energy resources from Russia, the strategy of Russian energy business actors should be to strengthen foreign economic relations with the countries of

the Asia-Pacific region and southern Eurasia. Such relations should be based on a balance of interests, which implies the intensification of the development of the technological and industrial potential of the Russian Federation.

The accelerated development of export of energy-intensive products, the commercialization of domestic energy and hydrogen technologies, and their subsequent export should become important areas for improving Russia's trade balance. Such a vector of expansion of energy markets is dictated by the inevitability of the transition of the world energy sector to renewable energy sources and the globalization of energy supply systems.

A proposal has been put forward that Russia can initiate the creation of a regional market for green certificates for hydrogen, which will help solve the problem of technical and economic inefficiency of long-distance transportation of hydrogen carriers.

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