The Current State of the Green Sectors of the Economy in the Conditions of Innovative Transformation

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Abstract: The basis of the Russian energy sector is natural gas: it accounted for 60% of primary energy consumption in 2018. The structure of the Russian energy sector from an environmental point of view is more favorable than in many other major economies of the world. In particular, in India and China, the basis of primary energy consumption is coal (more than 40% and more than 60%, respectively), the most polluting fossil fuel. However, in terms of the development of renewable energy sources, Russia lags far behind the world. Hydropower is well developed in Russia: it accounts for about 3% of primary energy consumption and 17.6% of electricity generation. At the same time, most Russian HPPs were built even before the start of the transition to a market economy and are large projects characterized by significant environmental damage. The rest of the RES, including the world's most dynamically developing areas such as solar and wind energy, are at the initial stage of development in Russia: they accounted for only 0.03% of primary energy consumption in 2018 and 0.28% of electricity generation in 2019. For comparison, according to REN21, in the world, modern RES, excluding hydropower and traditional biomass, already provided 7.4% of primary energy consumption in 2018 and 11.4% of electricity generation at the end of 2019. According to Ember, Russia is the largest economy in the world, which has practically no modern renewable energy.

1 INTRODUCTION

In Russia, there is also a significant lag behind other countries in the field of reducing the energy intensity of GDP. According to the Ministry of Economic Development, the most rapid progress in this area was observed from 2000 to 2008, when the Russian economy was shifting to less energy-intensive industries and the reduction in energy intensity of GDP was 35%. Then progress in this area slowed down, and in the period from 2008 to 2018 it was possible to reduce the value of this indicator by only 9%. In 2018, the energy intensity of Russian GDP exceeded the global average by 46% (Ministry of Energy and Environmental Protection, 2008). The development of renewable energy technologies and the improvement of energy efficiency are limited by the conservative and extremely inertial state policy in the energy sector, as well as the low cost of traditional energy resources. Traditional energy in Russia enjoys significant government support. In 2017, according to estimates by the International Renewable Energy Agency (IRENA), Russia ranked fourth in the world in fossil fuel subsidies after Iran, Saudi Arabia and China (Dedicoat, 2016). The amount of Russian energy subsidies was almost evenly distributed among the oil, gas and electricity sectors, and their total amount was almost 30 billion US dollars per year. The subsidization of renewable energy sources in Russia, however, is so insignificant that data on it are not available. In recent years, renewable energy sources have been provided with incentive state regulation in the wholesale electricity and capacity market,as well as in retail electricity markets; in the near future, support for microgeneration due to renewable energy sources with a connection to the

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grid will begin to function. As a result, in the period from 2014 to 2019 inclusive, RES-based power plants were built in Russia with a total capacity of 1.7 GW. However, this is equivalent to only 0.7% of installed capacity and about 0.2% of generation (Global Environment Forum, 2014). By 2025, 5.4 GW of renewable energy power plants or less than 2.5% of installed capacity will be built on the wholesale electricity and capacity market, which will provide less than 1.2% of generation (Agenda for the 21st century, 1992).

According to the Association for the Development of Renewable Energy (ARVE), in accordance with the existing plans for the development of renewable energy, in Russia by 2030 it will be possible to avoid emissions of 12 million tons of greenhouse gases into the atmosphere, which is equivalent to only 1% of the total emissions in Russia (Sukhinina, 2013). This decline is unacceptably low and inconsistent with the goals of the Paris Climate Agreement. Currently, none of the state programs related to the development of the transport complex of the Russian Federation or its individual elements, as well as the regulation of the sphere of control of emissions of harmful substances into the atmosphere, does not provide for the implementation of measures directly aimed at reducing greenhouse gas emissions. According to NIIAT and MADI experts, risks of growth in gross greenhouse gas emissions from road transport remain in the forecast period due to (Federal Law No. 174-FZ, 1995):

- continuing the trend towards an increase in the age of the car fleet, an increase in fuel consumption and greenhouse gas emissions due to the absence of a state program for the recycling of cars and a national system for the recycling of transport equipment;
- the absence of regulatory requirements for mileage (per 1 km) greenhouse gas emissions of new cars supplied to the domestic market, which leads to the fact that the level of greenhouse gas emissions of domestic cars (VAZ, GAZ, UAZ) is 1.5–2 times higher than norms emissions adopted in the European Union;
- preservation of the stereotype of transport behavior of owners of private cars and the growth of motorization in large cities;
- lack of an effective system for monitoring the technical condition of cars of individual owners in operation due to the destruction of the state technical inspection system, as well as due state control over the quality of petroleum products sold and their compliance with the requirements of the Technical Regulations of Vehicles;
- lack of reliable statistics on annual car mileage, which hinders incentives to reduce greenhouse gas emissions by replacing the transport tax with an environmental payment;
- non-fulfillment of state plans and programs for the gasification of road transport in terms of achieving target indicators for increasing the number of gas-balloon automatic telephone exchanges (natural gas), automobile gas-filling compressor stations (CNG filling stations).

The electrification of the transport sector is proceeding at an extremely slow pace. In 2020, there were only 6.3 thousand electric vehicles in Russia (0.014% of all vehicles), of which more than 90% were used. In total, there are about 400 charging stations in the country. At the same time, more than a million new electric vehicles were sold in China in 2019. Policies to stimulate the development of RES in the heating and cooling sector, as well as in the transport sector, are not implemented in Russia; there are no reliable statistics in these areas. However, according to industry participants, the demand for some renewable energy technologies, in particular heat pumps and pellet boilers, has recently been growing, primarily in the SME sector, and especially during a pandemic. This is due to the economic efficiency of these technologies. In the world, the heating and cooling sector, and even more so the transport sector, lags behind the electric power industry in terms of the introduction of renewable energy. At the end of 2019, RES generated 27.3% of all electricity in the world, including hydroelectric power plants, and 11.4% without them. In the heating/cooling sector and in the transport sector, the share of RES was 10.1% and 3.3%, respectively, excluding traditional biomass (Agenda for the 21st century, 1992; Sukhinina, 2013). However, in the near future, the spread of renewable energy sources in these sectors will accelerate due to their electrification, as well as in connection with the development of green hydrogen as a new energy carrier (Shakhgiraev, 2019).

The world has high hopes for Power-To-X technologies, which will allow converting electricity generated by renewable energy sources into new carbon-neutral fuels. Unlike electricity, these fuels will not be consumed at the time of production, but at any time, and they will be easy to transport. Green hydrogen is one example of PowerTo-X. These technologies are expected to accelerate the energy transition in the heating and transport sectors. Russia

has not yet taken measures aimed at the development of Power-To-X technologies.

Russia has not achieved the clean energy goals it set for itself. Thus, by 2020 it was planned to increase the share of renewable energy sources in electricity generation to 4.5%, excluding large hydroelectric power plants. This goal has not been achieved: according to Rosstat, in 2019 the value of this indicator was only 0.28%. It was also planned to reduce the energy intensity of Russian GDP by 40% by 2020 compared to 2007 levels. In reality, the decline was only about 10%. Currently, Russia does not have any relevant clean energy goals and does not plan to abandon coal generation, and also intends to increase coal production and exports until at least 2035. This is contrary to global trends and secures Russia's dependence on raw materials (Kadner, 2021).

2 RESEARCH METHODS

The breakdown of non-fossil fuel emissions is shown in the infographic below. The main sources of emissions in the industrial sector of Russia are: (1) metallurgy - it accounts for 44% of the sector's emissions, of which 39% is from the production of iron and steel; (2) the chemical industry – it accounts for 32% of the sector's emissions, of which 16% is accounted for by the production of ammonia, which is used mainly for the production of fertilizers in agriculture (Federal Law No. 174-FZ, 1995; Shakhgiraev, 2019);

(3) production of mineral materials - it accounts for another 15% of the sector's emissions, of which 8% is the result of cement production. The key sources of greenhouse gas emissions in the agricultural sector are direct nitrous oxide emissions from agricultural soils (41%) and methane emissions from internal (enteric) fermentation of domestic animals (39%). Manure collection and storage systems accounted for another 11.5% of all emissions from the agricultural sector in 2018. The bulk of emissions in the waste sector are methane emissions from controlled waste disposal sites (66%). Since 1995, Russia has seen a steady increase in greenhouse gas emissions from waste, mainly due to an increase in the amount of municipal solid waste accumulated in landfills. The increase in emissions from waste in 2018 compared to 1990 was 64.7%. In the Inventory of anthropogenic emissions from sources and removals by sinks of greenhouse gases for 2020, waste is understood as "remains of raw materials, materials, semi-finished products, other products or products that were formed in the process of production or consumption, as well as goods that have lost their consumer properties." The calculation of greenhouse gas emissions includes both solid municipal and solid industrial waste, including agricultural waste, except for emissions from manure management, which are assigned to the "Agriculture" sector. In 2018, solid municipal waste in Russia accounted for almost 82% of all methane emissions from solid waste disposal, the remaining 18% came from emissions from industrial solid waste. Most of all waste is placed in large and very large controlled landfills. A small part of the waste is incinerated, with little or no prior sorting, which is a serious environmental problem (Eurostat, 2021).

The greenhouse gas emissions described above are due to human activities and do not include emissions from fossil fuel combustion. They are directly related to the 12th Sustainable Development Goal - "Responsible consumption and production", and their reduction is possible due to the introduction of the principles of the circular economy. These principles are based on the transition from a linear model of the economy, which includes three main stages: (1) resource extraction, (2) production and (3) waste generation, to a regenerative model. A regenerative or circular economy uses renewable energy, recycled and safe materials and generates almost no waste. Data from the 2020 Inventory of Anthropogenic Emissions from Sources and Removals by Sinks of Greenhouse Gases estimate that in 2018, 63% of greenhouse gas emissions from industrial processes came from the production of three materials: (1) iron and steel, (2) ammonia, and (3) cement. Together with the agricultural sector, emissions from these sectors accounted for nearly 60% of non-fossil fuel emissions. This means that in order to significantly reduce emissions in the non-energy sector, it is first necessary to introduce the principles of a circular economy in the production and consumption of iron and steel, ammonia, cement, as well as in agriculture. Similar conclusions are contained in foreign reports. According to a study by the Ellen MacArthur Foundation, which takes into account in industrial emissions emissions from the combustion of fossil fuels necessary to power production processes in the world (Kadner, 2021; Maliene, 2010).

Cement, steel, plastic and aluminum production accounts for 60% of industrial sector emissions. Also, according to the study, by 2050, almost half of global emissions from manufacturing processes can be avoided if the principles of the circular economy are implemented in five industries: cement, aluminum,

steel, plastics and food. In the IRENA report, iron and steel production, chemical and petrochemical production, cement and aluminum production are among the most energy-intensive and difficult to decarbonize industries. Steel, cement, plastic and ammonia are the key materials for the EU economy, accounting for about 20% of all greenhouse gas emissions, according to a Material Economics report on emission reduction opportunities in EU heavy industry. In Russia, non-fossil fuel emissions from aluminum production accounted for 1.3% of all industrial emissions in 2018, and aluminum was not among the top emitters. At the same time, the aluminum industry is one of the most energy-consuming, and Russia ranks second in the world in aluminum production. All things considered, the Russian Green Deal circular economy program is focused on reducing emissions from metallurgy, cement, ammonia and food production. Systematic work to reduce these emissions is currently not being carried out in Russia.

3 RESULTS AND DISCUSSIONS

The main sources of emissions in the manufacturing sector are (Shakhgiraev, 2019; Kadner, 2021; Maliene, 2010):

1. High-temperature processes. For example, the melting and shaping of steel and the production of cement clinker require temperatures of 850–1600 °C. Electricity is already being used for some of these processes, notably in electric arc furnaces for steelmaking, but in most cases technology does not yet allow it to be used.
2. Emissions during production. In the production of steel, cement and plastics, carbon is used not only to provide high-temperature conditions, but also as an integral part of the chemical process, which leads to significant carbon dioxide emissions. For example, in cement production, calcining limestone to produce calcium oxide releases a large amount of carbon contained in the rock. Eliminating such outliers is the most difficult. To reduce these emissions, the fundamentals of manufacturing processes need to be changed.
3. Emissions after end-of-life. Currently, the vast majority of materials, with the exception of metals, end up in landfills or incineration at the end of their lives, releasing large amounts of greenhouse gases. For example, when burning plastic, an average of 2.7 kg of CO_2 is released per 1 kg of plastic.

The recycling of materials usually requires much less energy than the production of new materials. For example, the production of recycled steel requires only 10-15% of the energy that would be spent on the production of new steel. When processing materials, it is usually possible to use electricity, which can be produced by renewable energy sources. Another important aspect of recycling is that it reduces not only greenhouse gas emissions from burning fossil fuels, but also emissions from manufacturing processes, which are particularly difficult to reduce. Thus, in industrial sectors, the most important principles should be (1) reducing waste generation, (2) significantly increasing the utilization rates of assets, especially buildings and equipment (i.e. reducing the need for new cement, steel and aluminum), (3) recycling in the use of products and the use of secondary resources. This will reduce the demand for new steel, aluminium, cement, plastic, and hence the emissions from their production. The first group of measures can be implemented by reducing the generation of waste at all stages of production and consumption of products and increasing the efficiency of resource use. The second group of measures can be implemented through the promotion of product sharing (sharing), the development of rental services, and the extension of the service life of goods. As for recycling, for some materials (for example, for steel) it has already been established, and electricity, including from renewable sources, can be used to provide energy. But there is significant potential to increase the share of steel recycled and the quality of scrap metal collected. Recycling of other materials, such as plastic, needs to be significantly increased through the development of collection and sorting of plastic waste. Emissions from ammonia production can be reduced primarily through the development of agriculture with minimal use of fertilizers - regenerative or organic agriculture (Kadner, 2021).

The solution to this problem is closely related to the transition to sustainable agricultural practices and sustainable diets. The Russian organic food market is at the initial stage of development. Sustainable diets, which should be understood as diets with a higher content of plant products compared to animals, are not common in Russia. At the same time, according to available estimates, about 75% of an individual's carbon footprint falls on three areas: food, housing, mobility. Therefore, along with the use of energy from fossil fuels and travel by private cars and planes, the overconsumption of meat and dairy products are among the areas for action with the greatest potential for reducing lifestyle-related greenhouse gas

emissions. According to the IPCC report "1.5 degrees", achieving the goal of not exceeding the increase in the average global temperature by more than 1.5 ° C requires action not only at the level of the state and business, but also fundamental changes in the way of life of people. At the same time, changes in diets in the direction of reducing the consumption of meat products are given in the report as one of the examples of necessary measures. Today, per capita greenhouse gas emissions from food consumption in Russia are more than double the levels compatible with avoiding a global average temperature increase of more than 1.5°C. There are no official guidelines for sustainable diets in the country (Federal Law No. 174-FZ, 1995).

In recent years, Russia has taken measures aimed at the transition to more rational models of production and consumption. Clause 2 of Article 3 of the Federal Law “On Production and Consumption Wastes” dated June 24, 1998 No. 89-FZ fixed the hierarchy of priority areas of state policy in the field of waste management: (1) maximum use of raw materials and raw materials; (2) waste prevention; (3) reducing the generation of waste and reducing the hazard class of waste at its source (Eurostat, 2021). Government Decree No. 1589-r dated July 25, 2017 approved a list of types of production and consumption waste containing useful components, the disposal of which is prohibited. Some of the items on this list (scrap and waste containing ferrous and non-ferrous metals, lamps and waste containing mercury) are prohibited from burying from January 1, 2018, the rest of the waste - from January 1, 2019 (paper, cardboard, tires, polyethylene and polypropylene waste, glass containers) and from January 1, 2021 (electronic devices, including computers and parts thereof, telephones, voice recorders, etc.; electrical appliances, including refrigerators, kettles, electric coffee makers, microwave ovens, air conditioners, etc.; banking equipment, accumulators, wires and cables) (Maliene, 2010).

Businesses and non-profit organizations are involved in the process of solving the problem of responsible production and consumption by implementing projects to recycle waste and refuse disposable goods and packaging; the sharing economy begins to develop in the country. In most large settlements, infrastructure for separate waste collection has been created - access to it is available in more than 80% of cities with a population of over 100,000 people. At the same time, not all container sites are equipped with tanks for separate collection of waste, and as a result, such collection is available to less than 20% of the country's population. The culture of separate collection is not well developed in Russia, which negatively affects the volume of collection of recyclables and its quality.

4 CONCLUSIONS

The Strategy for the Development of the Industry for the Processing, Recycling and Neutralization of Production and Consumption Waste for the period up to 2030 sets an ambitious goal - to increase the share of MSW recycling in Russia from 8.9% in 2016 to 80% by 2030. The document spells out the 3R principle (prevention of waste generation, reuse, recycling into secondary resources), but at the same time, not a single action from the action plan of the strategy is aimed at reducing the volume of waste generation. The document focuses on work with already generated waste: processing of the general flow of MSW, disposal, incineration in cement kilns. Public procurement is currently not focused on waste prevention and promotion of the development of a circular economy. In the Federal Law of April 4, 2014 No. 44 (law on public procurement), the environmental characteristics of the procurement object are mentioned as one of the possible criteria for evaluating applications for the execution of a state contract. However, there are no mechanisms or specific general requirements to encourage the setting of environmental criteria. This means that the environmental criterion can only be used if there is a certain interest of the enterprise, making the purchase. Recently, the world has been implementing the “zero waste” approach based on changing patterns of resource and product use. As a result of conscious lean consumption and use, waste generation is reduced, reuse, repair, recycling and composting are promoted. By 2050, the implementation of this approach only in the waste management sector can reduce global greenhouse gas emissions ranging from 3% of the 1990 level to 9% of the current level. Emission reduction in the waste sector is based on three main areas of action: waste prevention; increasing the reuse, recycling and composting of waste; technological innovations to reduce emissions from landfills and wastewater. The “zero waste” approach also makes it possible to radically reduce emissions in other sectors, since consumer waste is directly related to the production of consumer goods, and therefore to the extraction of primary resources, transportation, processing and production. The contribution of the consumer goods sector to annual greenhouse gas emissions is about 45%, and a circular economy with a focus on reducing the use of raw

materials and materials (zero waste principles) can reduce annual greenhouse gas emissions from a reduction in primary production and resource use by 40% or by 3.7 billion tons by 2050 (Kadner, 2021).

Changing consumption patterns and reducing packaging can reduce waste by at least 1% per year. The reduction of greenhouse gas emissions will amount to more than 800 million tons of CO2-eq. Waste prevention, the promotion of reuse systems, new delivery systems and downstream recycling and composting can reduce waste generation and emissions from landfills and incinerators by up to 90%, reducing emissions by more than 500 MtCO2-eq. In general, in Russia there is no coordinated movement towards a circular economy and corresponding new business models, there are only a few examples of the introduction of elements of such an economy (Shakhgiraev, 2019; Kadner, 2021). Also, there are no attempts to systematically implement the principle of "zero waste" at the national level. Thus, we can conclude that Russia has so far achieved little in this area, and in order to change this situation, a lot of work remains to be done in the coming years.

REFERENCES

Directive No. 2008/98/EC on waste and the repeal of a number of Directives. Ministry of Energy and Environmental Protection. https://web.archive.org/web/20170925181621/http://narodirossii.ru/?p=15667.

Dedicoat, K., 2016. *Circular economy: what it means, how to get there*. pp. 52-68.

State of play with extended producer responsibility, opportunities and challenges, 2014. *Global Environment Forum*. pp. 58-64.

Agenda for the 21st century. United Nations Conference on Environment and Development. Rio de Janeiro. 1992.

Sukhinina, E. A., 2013. Basic provisions and comparison of international environmental standards in the construction industry. *Bulletin of the Saratov state. tech. university.* 1 (73). pp. 209-215.

Federal Law No. 174-FZ of November 23, 1995 (as amended on July 2, 2021) “On Environmental Expertise”. Electronic fund of legal and normative-technical documents. https://docs.cntd.ru/document/9014668.

Shakhgiraev, I. U., 2019. Green structures in the concept of sustainable development of modern cities. Regional building complex: investment practice and implementation of PPP. *Materials of the All-Russian scientific and practical conference*. pp. 376-383.

Kadner, S., Kobus, J., Hansen, E., 2021. *Circular Economy Initiative Deutschland: Circular Economy Roadmap for Germany.* Munich/London: acatech/SYSTEMIQ. p. 104.

Maliene, V., Deveikis, S., Kirsten, L., Malys, N., 2010. Commercial Leisure Property Valuation. *International Journal of Strategic Property Management.* 14(1). pp. 35-48.

Sustainable development in the European Union: Monitoring report on progress towards the SDGs in an EU context, 2021. Eurostat, p. 412.