A carbon-free world – What is Russia's response?

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The article reviews the impact of decarbonization and the global Energy Transition on Russia, analyzing Russia's position in relation to climate change and decarbonization agenda. Unlike some European countries, Russia has not yet made decarbonization of the energy sector a strategic priority. This is partially explained by the fact that there is a degree of skepticism among the stakeholders in relation to global climate change. Ranking fourth in the world in terms of primary energy consumption and the volume of carbon dioxide emissions, Russia continues to rely on fossil fuels, while its GDP energy intensity remains high amid relatively low energy prices and high capital costs. The share of RES in the energy mic (solar and wind power) is negligible and is not projected to rise above 1% by 2040. However, there is no denying that the Russian energy sector is beginning to feel the impact of increasing global competition, growing technological isolation due to sanctions and ongoing financial difficulties. Quite apart from the impact of global climate change agenda, these factors present Russia with the necessity to produce a new development strategy for its energy sector, which has been and remains crucial for its economy.

Introduction

Russia holds a strategic position in the global energy system, which means that its response to the decarbonization agenda impacts not only itself but also the rest of the world. In terms of primary energy consumption and electricity production, it holds the fourth place – after China, US and India. This also applies to the volume of carbon dioxide emissions produced while using oil, gas and coal for combustion related activities [2].

In addition, although Russia accounts for just 3% of the global GDP and 2% of the global population, it is responsible for 10% of global primary energy production, 5% of global primary energy consumption and 16% of international energy trade [1]. It is also the world's top exporter of energy resources (#2 for oil exports, #1 for gas exports and #3 for coal exports, according to BP and IEA in 2017 [2, 3]).

With an economy which is heavily reliant on hydrocarbon export revenues, Russia will face long-term challenges presented by the drive for decarbonization. In the past, it had managed to capitalize on its position as a top exporter of fossil fuels, growing its energy exports dramatically. From 2000 to 2005, energy exports went up by an unprecedented 56% [1], exceeding USSR's total energy exports, boosting the national economy and solidifying Russia's "energy superpower" position. However, the 2008 world financial crisis put a stop to this upward trend. In 2011-1014 export volumes stagnated even given high oil prices, and so did GDP at the oil price of 110 $/bbl, as the shortage of petroleum revenues made itself known. This undoubtedly pointed to profound structural economic problems.

In recent years Russia's oil and gas export revenues have declined from the peak of 2008-2012 following falling hydrocarbon prices. Still, as recently as 2017 hydrocarbons accounted for 25% of GDP and 39% of federal budget revenues, 65% of foreign export revenues, and nearly 25% of total investments in Russia's economy [4].

It follows that Russia views rising RES targets and a transition towards decarbonization as a significant potential threat to its export revenues and therefore to its economic security [5]. However, there is no denying that the role of hydrocarbons will unavoidably change in the next two decades as the global market is undergoing a major transformation. It is expected that a reduction in demand for Russian hydrocarbons coupled with changing global markets will mean that the contribution of oil and gas in the Russian GDP will halve from 31% in 2015 to 13-17% by 2040 (depending on the scenario, ERI RAS estimates) [1].

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Russia cannot hope that this downward movement will be mitigated by any internal factors. GDP growth projections have been revised downwards to 1-2% per annum due to the systemic economic crisis, international financial and technological sanctions and an unfavourable investment climate [6]. Gone are the years of high GDP growth (7-8% per annum) in the first decade of this century. Russia is feeling the impact of a stagnating economy, flat domestic energy demand, the necessity to keep domestic regulated prices unchanged and insufficient investment in deployment of new technologies. This situation, which limits investment capacity, is further compounded by high cost of capital in the domestic financial market and the negative impact of financial sanctions.

Russia's climate change policy

The global Energy Transition is to a large degree driven by decarbonization agenda. Following the signing of the Paris Agreement, individual countries and regions set goals for reducing the carbon footprint in the energy sector. Carbon taxes, emissions trading systems, etc. are being implemented to support national goals, and the effects are already seen in many economies – in 2008-2017, carbon content of electricity has decreased by 50-100 gCO_2/kWh in the European Union, United States, Canada, China, Australia, Kazakhstan and other countries [8].

To what extent is Russia following this agenda? The answer is not clear cut. The Russian Energy Strategy Up to 2035, a key document outlining Russia's strategic priorities in the energy sector, only mentions the Paris Agreement once: "In 2016, the Russian Federation signed the Paris Climate Agreement, which included, among other, the development by 2020 of a strategy of socio-economic development with a low level of greenhouse gas emissions for the period until 2050. In order to minimize possible negative consequences for the Russian fuel and energy complex from the implementation of this agreement, an extremely weighted approach is needed to take some additional regulatory measures to counter climate change" [9].

The desire for a weighted approach becomes evident if we consider the following:

- There remains skepticism in relation to the anthropogenic nature of climate change among stakeholders – senior representatives of the Russian Academy of Sciences as well as many State officials. They have publicly questioned the very concept of anthropogenic climate change.
- Russia's greenhouse gas emissions in fact fell by around 30% in the 1990s, during the period of an economic downturn and economic restructuring. In 1998-2008 emissions were increasing in line with GDP growth. And in 2010-2016, although Russia's GDP increased by 73%, the volume of emissions went up by just 12% [10].
- As of 2017, the Russian energy sector has a lower carbon footprint than, for example, Poland, Germany, Australia, China, India, Kazakhstan, the Arab countries of the Persian Gulf, the USA, Chile, South Africa and other countries [11]. Around 35% of electricity is generated at carbon-free NPPs and large hydropower plants, and 48% comes from gas [11], with gas gradually displacing petroleum products and coal from the TPP fuel basket (the share of gas in the thermal plant electricity generation rose from 69% to 74% during 2006-2017).

The risks linked to the enforcement of climate agreements include:

- An impact on future fossil fuels exports (especially for coal exports, although natural gas exports could also be substantially affected by increasing emission reduction targets).
- Climate-related actions outside Russia could lower Russia's GDP growth rate by about a half of a percentage point [12].
- Russia faces the risks of growing market barriers to its exports of energy-intensive goods.

The combination of all the above factors lies behind Russia's unwillingness to set ambitious national decarbonization targets. Added to this is an objective need for investment for the implementation of decarbonization measures, not available in the current climate, and a resulting need to increase energy prices, which would potentially pose a risk of social unrest.

Finally, Russia's past decisions in respect of international environmental initiatives were made based on Russia's foreign policy. For example, in Soviet times, participation in global environmental initiatives was a way to collaborate with the West. In the 1990s, it was a means of integration in the international community and one of the major areas of US-Russian cooperation. In the 2000s, Russia used the environmental agenda for leveraging in negotiations with Western partners and attracting foreign investment [13].

It would take a similar perceived benefit this time to increase Russia's involvement in the international environmental cooperation. As of now, Russia has signed but not yet ratified the Paris Agreement, which stipulates a voluntary obligation to limit anthropogenic greenhouse gas emissions to 70-75% of 1990 emissions by 2030. If the agreement were not to be ratified, it would not improve Russia's position (and would likely trigger border carbon adjustment measures from other regions). It may help to diversify the economy, but there is no clear path for this at present.

Although Russia is not treating climate policy as a priority, it is not the case where technological development is concerned. The Russian government is aware of Russia's vulnerability in this area and does not wish it to fall behind the rest of the world where new energy technologies are concerned. At the same time "Energy Transition" technologies are definitely not the main focus of the Russian technological policy: the State Energy Development Programme approved in 2014 and amended in 2019 stipulates only "promotion of innovative and digital development of the fuel and energy complex" as a target together with all the new technologies in hydrocarbon production and processing – and there is no mention of low-carbon technologies [14].

As we have seen, cheap abundant hydrocarbons (primarily – natural gas) ensure both the competitiveness of the Russian economy and its energy security. Motivation for pursuing the climate agenda is limited to technological progress and Russia's desire to stay technologically up to date. Nevertheless, there is potential to create value for the Russian economy and attract investment in these key areas:

- Energy efficiency;
- Renewables;
- Decentralization and distributed energy resources;
- Digitalization;
- Hydrogen.

Energy Efficiency

As mentioned above, Russia has high energy intensity GDP, 1.5 times higher than the world average and that of the USA and twice that of the leading European countries [1]. The factors behind it include its sheer size, cold climate, a pronounced raw material structure, poor economic organization and lack of technological progress. The share of fuel and energy costs in the overall production costs in Russia is higher than in the developed and many developing countries [15].

Prior to the 2009 economic crisis, Russia was reducing its GDP energy intensity dynamically, and the gap between Russia and the developed countries was closing. A 40% reduction in GDP energy intensity was achieved in 1998-2008. However, post-2009 this reduction slowed down and even reversed.

Energy efficiency and conservation would be crucial for such an energy-intensive economy within the "Energy Transition". IEA estimates that 30% of primary energy consumption and great volumes of hydrocarbons (180 bcm of gas 600 kb/d of oil and oil products and over 50 Mtce of coal per annum) could be saved in Russia if comparable OECD efficiencies were applied [16].

To limit energy consumption growth, several measures would need to be taken:

- structural energy conservation (changing the industrial and product structure of the economy);
- technical energy conservation (potential energy saving of 25 to 40%).

However, a combination of insufficient investment, administrative hurdles, lack of long-term financing (loans) for efficiency projects and relatively low natural gas prices means that Russian energy intensity remains high. Robust policies and a substantial increase in the energy prices would be needed to reverse this pattern.

Renewable Energy Sources

As we have seen, fossil fuels predominate in the Russian energy mix, with natural gas providing 52% of total primary energy demand, coal – 18% and oil-based liquid fuels – also 18%.

Carbon-free energy sources are represented primarily by large-scale hydro and nuclear power (which enjoys strong state support). The role of solar, wind, biomass and other sources of renewable energy is negligible – less than 1% [1]. The total share of RES (including hydro, solar, wind, biomass and geothermal) in the Russian total primary energy consumption was just 3.2% in 2015. By the end of 2015, total installed renewable power generation capacity was 53.5 gigawatts (GW), accounting for around 20% of Russia's total installed power generation capacity (253 GW) with hydropower providing nearly all of this capacity (51.5 GW), followed by bioenergy (1.35 GW). Installed capacity for solar and onshore wind by 2015 totalled 460 MW and 111 MW, respectively [18].

According to the draft Energy Strategy of Russia for the period up to 2035 [9], the share of renewable energy in Russia's in the total primary energy consumption should increase from 3.2% to 4.9% by 2035. This includes Russia's approved plan to expand its total solar PV, onshore wind and geothermal capacity to 5.9 GW by the end of 2024.

In 2013 the Russian government passed Decree 449, which created a legal framework to establish a renewable energy capacity system in the country. It is designed to encourage the development of renewable energy in Russia, particularly focusing on wind and solar photovoltaics, and to a lesser extent, small-scale hydropower. Energy developers of projects can bid for capacity supply contracts with Russia's Administrator of the Trading System in annual tenders. Winning suppliers are paid both for the capacity they add to the energy system, and for the energy they supply [19].

Since then annual renewable capacity additions rose from 57 MW in 2015 up to 376 MW in 2018 (320 MW solar, 56 MW wind). What is more important –CAPEX in the renewables auctions declined significantly in the last two years: by 35% for wind and by 31% for solar, according to the Energy Ministry [18].

As technological policy is the main driver behind Russia's interest in renewables, the country is primarily focused on building its own RES manufacturing capacity. Russia has set quite high level of domestically manufactured equipment required to qualify for the highest tariff rates, an essential component of many Russian RES projects' long-term feasibility. The percentage of Russian-made equipment required to avoid tariff penalties was relatively modest in the early days of the auction system, but has now risen to 65% for wind farms and small hydro, and 70% for solar until 2020, with the long-term target level of domestically manufactured equipment set by the government at 80%.

These high levels have been behind several tenders, especially in wind farm development, for which there has been little to no Russian-made equipment. The requirements have encouraged foreign firms to partner with Russian power companies and manufacturers. Several international joint ventures were established including Fortum and state-owned technology investor Rusnano's wind investment fund and WRS Bashni, a partnership between Spanish developer Windar Renovables, Rusnano and Russian

steel firm Severstal. Wind equipment was installed by Vestas Manufacturing Rus in Nizhny Novgorod region, while SGRE (Siemens-Gamesa Renewables) and Lagerwey are also entering the Russian market [19].

The problem is that the current support mechanism will expire in 2024 – Russia's unambitious RES targets and ambitious local equipment targets will be nearly met by this time and an influx of foreign renewables developers might stop if no new incentives for the RES market are created. But in order to create these incentives the Russian government should first define the long-term role of renewables in its energy mix. This is difficult to do without decarbonization agenda: as a country with the world's largest natural gas reserves and the second-largest reserves of thermal coal, Russia does not see real value in switching from fossil fuels to zero-carbon energy sources. Despite the country's massive potential in wind and solar resources and the virtually limitless land available for development, the availability of oil, gas and coal is suppressing clean energy development.

According to IRENA [17], Russia theoretically has the potential to increase the projected share of renewables from 4.9% to 11.3% of total primary energy consumption by 2030. However, it cannot be achieved without a reassessment of energy strategy priorities and a wider transformation of the Russian energy system.

Decentralization, digitalization and distributed energy resources potential in Russia's centralized power system

Historically Russian energy system has always developed in an extremely centralized way. Russian electricity sector, for example, relies on a huge centralized power system, while distributed energy resources, including microgrids on renewables, are developing slowly and only in remote and isolated areas. Russia has one of the world's largest national centralized power systems with a single dispatch control – as of 2017, the total length of its trunk networks was over 140 thousand km, distribution networks –over 2 million km and installed capacity of power plants - 246.9 GW. This energy system was created and historically developed on a hierarchical basis with centralized long-term planning bodies. For decades the centralized model has been and still remains the basis of the energy strategy. The role of distributed generation has historically remained significant only in the remote areas of the Far East, Siberia and the Arctic, which are too expensive to connect to a single network.

However, distributed energy resources (DER) penetration in the centralized system has begun, as is the case elsewhere in the world.

Decentralization in power sector started when globally the role of the economies of scale in power generation ceased to be significant due to technological improvements. The catalyst for this change was the emergence in the 1980s of gas turbines and reciprocated gas engines technologies. It was the reciprocated gas engines global market that showed steady growth rate (CAGR 17%) until the late 2000s [20]. For example, in USA distributed generation has played a role in the electric power sector for several decades [21]. Historically, these DERs have consisted of dispatchable resources; however, the recent increase of non-dispatchable PV capacity marks a change in this trend. BNEF' forecast shows that decentralization ratio will exceed 15% (as it is in Germany in 2017) in 8 countries by 2040 [22].

Global annual distributed generation capacity additions have already exceeded centralized one, and non-generation types of DER have even more potential than distributed generation (Demand Response and Energy Efficiency potential in USA in 2014 (37 GW) is higher than in CHP (18 GW) and Solar (8 GW) [21]. Similarly to other countries, integration of distributed energy resources into the Russian electricity sector became noticeable in the 2000s, but in the past 17 years it was limited to distributed generation only.

The development of this process in Russia is driven not by global climate change or energy independency concerns, but by economic considerations of the largest electricity consumers. Almost all Russian big industry companies (including oil & gas industry leaders like Gazprom, Rosneft, Lukoil, Novatek, Sakhalin Energy) are involved in distributed generation projects in order to get more affordable power supply.

Micro-generation using renewables for households in Russia is still largely confined to enthusiasts. There are just a few cases in place in several regions, all of them were stimulated almost only by economic expediency reasons.

Non-generation types of DER in Russia are in a very early stage of development. Demand response technologies began to develop in the country in 2016-17, but only a small proportion of power consumption is affected (54 MW in the second price zone of wholesale power market, or 0.1% of total capacity in this zone). Demand response in retail electricity market is in the experimental stage. Energy efficiency policy has not yet achieved significant results. According to I. Bashmakov [23], GDP energy intensity in Russia in 2017 is just 10% lower than in 2007 (at the same time, initial energy efficiency target set in 2008 was to reach 40% decline in GDP energy intensity by 2020). Substantial federal budget subsidies were allocated but very limited change occurred, and as a result the initial target was significantly scaled down to 9.41% and federal funding discontinued [24].

However, distributed energy resources have significant potential in Russia. According to the study by SKOLKOVO Energy Centre [25], only part of this potential is sufficient to cover over half of needs for generating capacities (about 36 GW by 2035). The most promising type of DER in Russia is distributed co-generation (~17 GW). On-site self-generation units of electricity consumers are able to additionally provide ~13 GW, demand response –up to 4 GW, energy efficiency technologies - 1.5 GW and rooftop PV systems - 0.6 GW. Full use of DER scenario shows possibility of covering the entire gap by 2035. While DER

have been widely analyzed in the international literature, in Russia there was no integrated assessment of their potential in response to future development needs of the national power system.

The Russian government needs to make systemic changes in the structure and policy of the Russian power sector in order to support maximum deployment of DER technologies. A consistent combination of centralized generation and DER seems the most effective approach.

Digitalization of the energy sector as a whole and of the power sector in particular is part of a global trend. This creates new opportunities for the power sector – after all, it is becoming more and more difficult to manage power systems with a high ratio of decentralization or penetration of intermittent renewables. Russian authorities regard digital transformation of the energy sector as a technological challenge and it can be said that Russia places an emphasis on this part of the Energy Transition.

In 2018 Vladimir Putin signed a decree establishing a special state program of "Digital Economy" in which energy infrastructure is mentioned as one of the key components. The Energy Ministry has also developed its special "Digital Energy" project [14], focused primarily on digitalization of regulation, for large scale introduction of the digital technologies in the energy sector.

Conclusion

Russia's attitude towards decarbonization and "Energy Transition" is multi-faceted. Although it is willing to introduce some aspects of this trend, Russia has not chosen to accept the decarbonization agenda. It is focusing only on the technological components which it plans to introduce in a traditional centralized manner. However, for Russia to adapt to the profound transformation of the global energy system, it will at some point need to produce a long term coherent strategy for both domestic energy market and exports.

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