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Renewable Energy and Decentralized Power Generation in Russia

An Opportunity for German-Russian Energy Cooperation

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Renewable and decentralized power generation are a centerpiece of Germany's domestic energy transition *(Energiewende)* and a major element of its international efforts to promote this goal. Recently, the renewables sector has also been advancing in Russia, albeit from a lower level. Thus, it is time to explore the status quo and analyze the potential for sustainable energy cooperation. In the context of the current deterioration in EU-Russian (energy) relations, crafting a sustainable energy partnership that is based on innovation, with an emphasis on electricity cooperation, might present an added value.

Focusing on energy efficiency and renewable energy (RE) is not a new idea – it was part of the modernization partnership of Germany and the EU with Russia in 2009/2010. Yet, it has not produced the wished-for results. Since then, however, the overall environment has changed significantly in the energy and climate realm with the global oversupply and the consequent price decrease of hydrocarbons as well as the signing of the Paris Agreement.

Two Key Countries in the Changing Energy World

Germany has served as a frontrunner in the past with a pilot role for industrialized countries and aims to profit from innovation and technology. Russia, in turn, has a lot to lose as a hydrocarbon exporter whose economic structures and state budget rely on the export of hydrocarbons to Europe. The *Energiewende* has already impacted the dynamics in the partnership, as the import demands for hydrocarbons are less predictable and will have to change more drastically in the next decade.

Thus, at least on an abstract level, there are good arguments to rethink German-Russian sectoral interfaces and redesign energy relations. 1) Both Russia and the EU member states have signed the Paris Agreement; Russia and Germany have a strategic partnership based on fossil fuel trade and infrastructure. 2) There are existing business relations as well as interconnections between the European continental grid and the Russian UPS/IPS (i.e., the Unified Power System and the synchronized integrated power system with Ukraine, Kazakhstan,

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Kyrgystan, Belarus, Azerbaijan, Tajikistan, Georgia, Moldova, and Mongolia). 3) If an energy transition is to be accelerated globally, it makes much sense to develop partnerships between "frontrunners" and hydrocarbon-abundant countries. Focusing on electricity cooperation is conducive to a forward-looking partnership because electrification, the use of RE, and decentralized energy will play a major role in the future. In order to implement and speed up the energy transition, international cooperation is key to exploit markets of scale and further reduce costs.

Legal Framework and Targets in Russia

Russia's target of reducing greenhouse gas emission by 25 to 30 percent by 2030 compared to 1990 under the Paris Agreement is not ambitious – socio-economic changes alone had already brought an approximate 40 percent reduction in CO_2 emissions between 1990 and 2000.

Since the adoption in 2009 of the Russian Energy Strategy to 2030, the legal and regulatory framework has advanced but remains inconsistent in its ambitions, and the renewables-based power-generation target has been amended several times. The respective presidential decree of 2009 set a target of 4.5 percent by 2020, excluding large hydropower plants of more than 25 megawatts (MW). A deployment of approximately 15–25 gigawatts (GW) would be necessary to achieve the target. The governmental resolution of April 2013 on Energy Efficiency and the Development of the Energy Sector lowered the target to a minimum of 2.5 percent by 2020. In 2014, the government supported the aim of commissioning a total installed capacity of 5.9 GW renewable capacity in the national wholesale market by 2024 (excluding large hydropower plants). The respective decree from 2009 was amended in February 2017. The target is divided into three renewables technologies: solar, mini-hydro, and wind, with the latter covering the majority share of 3.5 GW. This regulation is in line with the 4.5 percent target for RE by 2024 in the national balance of power production and final consumption, whereas the Draft Energy Strategy for 2035, published in 2015, sticks to the target of at least 2.5 percent.

Total installed RE capacity was approximately 53.5 GW in 2015, according to the International Renewable Energy Agency. The bulk of it came from large hydropower plants, which represented 48.1 GW, followed by bioenergy. As of 2017, according to the Russian Ministry of Energy, hydropower, solar, and wind represent a share of more than 20 percent of the country's total installed power capacity of about 236.34 GW.

Besides the targets, Russian legislative and regulatory frameworks also establish rules for trading on wholesale and retail markets as well as offer incentives. A "premium scheme" for wholesale electricity prices for power produced from RE was introduced by an amendment in the 2003 Federal Electricity Law in 2007. Yet, this price scheme, which would have been equivalent to a feed-in tariff, remained only on paper, allegedly because of concerns about rising consumer prices as well as legal difficulties in developing a concrete implementation mechanism. In 2011, another support mechanism was added to the Federal Electricity Law: the promotion of RE through the capacity market. This scheme aims to ensure the financial viability of investments into renewables by concluding "Agreements for the Sale/Purchase (Supply) of Capacity" with RE project developers. A legal basis for this scheme was developed further in 2013 with Decree No. 449. It establishes regulatory mechanisms for selecting new RE projects and for the respective supply agreements. This capacity supply agreement foresees the obligation for all wholesale market consumers to purchase electricity over the duration of the contracts (15 years). The capacity produced by facilities is selected during annual tenders of renewables at a price that is usually multiple times higher than the price of capacity from existing conventional generation.

Although this is a significant step toward the creation of a regulatory framework designed to promote clean energy production in Russia, there are also restrictions. First, this scheme is only applicable to RE-based generation facilities eligible for the wholesale market (5 MW capacity or more). This regulation also makes it impossible for ordinary consumers to become "prosumers," for example with rooftop technologies. Moreover, it does not allow for the promotion of renewable energy technologies in the non-price (regions with fully regulated tariff system) and isolated regions of Russia, where the deployment of renewables may be economically feasible and supported by the availability of renewable resources; these are the regions of Arkhangelsk and Kaliningrad, the Komi Republic, and regions in the Russian Far East. Second, it includes only solar, wind, and mini-hydropower, and therefore defines renewable generation much more narrowly than the Federal Electricity Law itself. Finally, only projects in which 70 percent of Russian technology has been used (local content rule) may qualify to participate in this scheme, which might increase the overall cost of RE policy (if there are cheaper foreign alternatives available).

Legal incentives for RE on the Russian retail energy market were developed between 2012 and 2015. According to the regulation, the grid company (Distribution System Operator) in the relevant region is obliged to purchase the electricity from RE-generation facilities in order to compensate for transmission losses. The regulatory body, the Market Council, introduced regional support schemes for qualified RE projects. These projects enjoy long-term tariffs, which should guarantee returns on investment within 15 years. These support schemes have been employed in practice, but the number of successful cases are limited. This scheme is stalling due to the absence of sufficient motivation for local governments to develop RE power plants.

However, there is a significant challenge for businesses, as tariffs are only approved when the project is qualified, creating a significant upfront commercial uncertainty.

The Energy Efficiency and the Development of the Energy Sector program, introduced by the Russian government for the period 2013–2020, provides additional support measures for qualified RE-generation facilities with installed capacity of 25 MW or less. It covers up to 70 percent of the grid connection cost, up to a certain amount.

Deployment and Dynamics of Renewables

The landscape of renewable energy generation in Russia differs widely because of the geographic and meteorological diversity of the country. Most RE projects are located close to the demand centers. The Russian power market is traditionally a centralized one, in which state institutions have regulatory power and the state has strong controls over the unified grid system as well as the majority of the generating facilities on the wholesale market. The foreign companies ENEL, FORTUM, and E-ON/Unipro are the only major private owners. On the Russian wholesale market level, the regulatory framework is solid and (potentially) offers more financial and institutional support from the state, whereas on the retail level, niches in remote and decentralized areas are growing.

With regard to wind, Russia had its first auctions in 2014 and approximately 2.5 GW were awarded till 2017. The tender in 2017 is of historical importance for the Russian wind market due to the high interest from investors and strong competition between big players: Enel Russia, Fortum (with Rosnano), and Rosatom. In total, 43 projects with a total capacity of 1.6 GW – and with commercial operation dates between 2018 and 2022 – were selected.

It became evident that non-renewable companies were entering the sector: Rosatom, the Russian nuclear company, entered the wind energy market with awarded wind projects of approximately 1 GW. Also Rosnano, a state-owned joint-stock company aimed at developing and commercializing nanotechnology, is striving to enter this market. Together with the Finnish company Fortum, Rosnano created a 30 billion ruble investment fund for wind park construction. The Danish firm Vestas will join this initiative as a technology partner.

Solar plants have less of a presence in the Russian renewable energy landscape. Cumulative installed capacity in Russia amounts to 500 MW, with plans to extend this up to 1.8 GW by 2024. Most solar plants are of a smaller scale, with the 25 MW Orsk solar plant being one of the biggest. Although most PV installations are being carried out in the European part of Russia, PV technology started being introduced in isolated regions in 2015, which are disconnected from the centralized energy system. Hevel Solar is one of the major companies.

There are a number of drivers in Russia that explain the increasing focus on renewables and decentralized energy. New energy solutions are seen as a way to modernize the power system, but they are also part of a broader socio-economic development model to provide for the welfare of the population, achieve higher living standards, and renew the country's position in the global economy.

Decentralized electricity generation is obviously of interest to remote and distant regions because it is economically inefficient to extend high-voltage electricity lines to these regions. At this level, companies can work with the local or regional administration to find tailored solutions.

Beyond that, decentralized electricity generation is also interesting and attractive for industrial complexes. It offers opportunities for them and allows them to become more independent from the centralized power system. The current situation of relatively high electricity prices compared to the prices in the centralized systems, etc., provides an additional incentive to explore new energy solutions.

Finally, the objective to push for and create new economic branches is a motive for the political elite. Localization is one of the major paradigms of contemporary Russian economic policy. Russia intends to develop local innovative technologies in power generation, engineering, and other related industries. RE technology providers such as Siemens and Vestas started to invest in RE production facilities in Russia in order to serve local content rules.

Legacies and Modernization

Russia's power sector must be modernized. In view of the necessity to modernize the power-generating facilities – many of which were built in Soviet times and are highly inefficient compared to modern ones – the government has adopted the state program Energy Efficiency and the Development of the Energy Sector and a program for new capacity construction as part of the power-sector reform (so-called DPM). These programs, for example, foster the construction of modern and more energy-efficient power-generating facilities. In the last several years, a significant number of such facilities have been introduced to the market – the cumulative capacity of which was ca. 4.2 GW in 2016. However, this leads to an annual increase in the overcapacity of power-generating facilities, since old ones are not decommissioned as quickly as new ones are introduced. The issue of overcapacity is hampering the construction of new power plants. Russia faces an oversupply of power of about 20 GW in winter and 30 GW in summer. Russia has no policies so far to deal with this obvious challenge, for example with carbon prices or regulatory measures. In theory, this would require the right incentives and mechanisms for a gradual replacement of outdated capacity limits. This is a topic in the Draft Energy Strategy for 2035, which has not been approved but was first published in 2015.

Moreover, the expansion of decentralized energy and renewable deployment is closely linked to the issue of energy efficiency. From an environmental and climate focus, but also from an economic point of view, it makes the most sense to improve load-side efficiency at a first stage to avoid future overcapacities. This is obvious everywhere – if energy is saved on the consumer side, less capacity is needed on the generation side. There are huge gains to be expected from energy-efficiency measures. A REN21 report notes that efficiency gains in electricity generation range from 30 to 35 percent in the Russian Federation.

The problem with inefficient generation facilities is a systemic one. A significant share of overcapacity is produced by the “forced” and must-run generation facilities, which are mostly the combined heat and power plants (CHPs). There are generation facilities that are intentionally drawn out of the competitive capacity selection mechanism in the hope that they will be given the “forced” status and the corresponding higher long-term tariffs. CHPs exist in almost every city and provide heating for buildings as well as electricity. Russia was a frontrunner here. More than a third of the total installed capacity in Russia is from CHPs. Although in theory the combined generation is favorable from an economic and environmental point of view, in practice the infrastructure is outdated and faces some systemic problems. CHPs are primarily operated to produce heat and thereby provide the base load. Meeting the peak load in demand centers in wintertime can be a challenge. Flexibility is mostly provided by hydro, biomass, and gas.

The only way to improve efficiency would be to insulate buildings in town sections and to install decentralized generation technology. Related to that, of course, are the challenges posed by subsidizing heat and a lack of individual metering. Compared to the past, however, there have been slight improvements: The challenge of a cross-subsidization for gas, in which the domestic gas price is covered by higher export prices, is disappearing. Gas subsidies are being lowered, also in preparation for the common gas market of the Eurasian Economic Union (EEU). At the same time, there is a gas surplus to be sold, in particular by Gazprom. Relative prices will play a role in the future as to whether power generation from renewables will become even more competitive on the Russian-grid-connected electricity market.

Although a gradual replacement of old CHP blocks is taking place in several regions, it is a fragmented process that has to be carried out either by private companies that own the plants or by regional authorities, since there is no approved regulatory mechanism on the federal level.

If small boilers were to be turned into CHPs, efficiency would increase substantially, and additional electricity could be offered to the market. There are hundreds of thousands of small boiler houses (below 1 MW up to about 10 MW) that need to be modernized. This modernization began slowly more than a decade ago. The picture is very different across the various regions. Moreover, legislation does not offer sufficient incentives for the cost recovery for apartment owners.

Last but not least, there are the technological challenges, as new technology is needed for efficient modernization. Such technology is partially already there, with several local companies offering, for example, micro co-generation plants. The move toward digitalization is also being awaited.

All in all, a slow modernization process is underway, but opportunities for RE projects are limited. The Russian framework should become more flexible and transparent.

Challenges, Hurdles, and Next Steps

Although the policy is moving toward more support of RE generation, there are several serious challenges ahead – the main one being a still rather underdeveloped but very complicated and non-transparent regulatory framework for RE generation. Complex price formulas, combined with fragmented regulatory bodies, do not contribute to investors’ confidence. There is a mismatch in frameworks and planning as well as a lack of long-term predictability, as described above.

The existing regulatory framework for construction, territorial planning, technical and security provisions, the grid, dispatching, etc., hardly takes into account the specifics of RE facilities and their functioning. In essence, this implies unreasonable costs for RE investors.

Further development of the Russian renewables segment depends on long-term prospects. The current support scheme for the wholesale market is in place until 2024. The target volumes are distributed over a time span from 2015 to 2024 and are available in tenders. An operator can bid for projects with a commercial operation date plus five years. This means that the tender for RE projects in 2019 will be the last, due to the expiration of the current support program and the absence of quotas for wind and solar. A prolongation of the incentive scheme that includes the setting of new capacity quotas is strongly needed in order to maintain and foster the growing trend in the wind segment, which was witnessed in 2017, with the possible expansion to other technologies. It is an extremely important period for strategic decisions that will define the future of the RE industry in Russia for the next 10–15 years (at least). Russia is at a crossroads between providing a predictable framework for an accelerated RE deployment or a setback for this trend.

There are major challenges ahead for the Russian power sector. Energy power generation and modern grids are characterized by high investment costs and long-term returns. New technology is needed for an efficient modernization. This creates opportunities for German/EU–Russian cooperation and exchange.

Rationale for Collaboration

Admittedly, renewable and decentralized energy is mostly associated with small and green PV, solar heat, and onshore wind in Germany. An end stage of how the sector will look – and how the system and market will function – is difficult to predict. This is complicating the planning of the networks but also the adequacy of generation – locally, regionally, nationally, and EU-wide – as the German electricity market is to be integrated further into the EU's. Compared to Russia, the drivers and motives are very different in Germany, with the emphasis being on mitigating climate change and environmental stewardship. In general, Russia has a more centralized approach. Russia understands decentralized energy as not necessarily being associated with renewables, but rather as an alternative outside the centralized system that is associated with "clean energy technologies."

Beyond these differences, a convergence of facts and a commonality of challenges is evident. In any case, the electricity sector will be key for these energy systems and economies. Germany/EU and Russia need to modernize and cope with (outdated or greenhouse gas-emitting) overcapacities. Both face challenges in adapting the grid and introducing information technologies to improve balancing and operation. The modernization of CHP generation is a challenge for Russia, one that has already been met in the eastern part of Germany. In fact, CHPs (in different sizes) are also pillars of a sustainable energy system with intelligent sector-coupling. Both have to adapt to electricity becoming decentralized, connected, and smart. It remains uncertain how developments will unfold. This is why the exchange and flow of information is so important on all levels: between universities, cities, towns, regions, and countries in the scientific, research, business, technical, and regulatory realms. Supposedly apolitical issues can have a huge political impact: It is about addressing common challenges for a greater good.

Also, from a foreign and security policy angle, electricity exchange, interconnections, and (de-)synchronization of grids should receive more attention. Its sociopolitical implications are huge and, thus, its geopolitical dimensions regarding the stability and resilience of economies. The development of the common electricity market as part of the EEU by 2019 will bring challenges of its own. Russia and Germany have the political objective to (re-) integrate

German *Energiewende* – Features and Challenges

Four features characterize Germany's *Energiewende*:

- RE is *one of the three pillars* of the *Energiewende*, proclaimed in 2011; by 2020, 18 percent, and by 2025, 40–45 percent of Germany's energy supply should be based on renewable sources. Sustainable energy has been a prominent topic in Germany since the 1980s. In 2016, 12.6 percent of the primary energy mix and 18.6 percent of the electricity mix were supplied by renewables.
- *Feed-in tariffs and priority access for renewable energy* as well as the renewable-energy surcharge kicked-off massive deployment and significantly contributed to bringing price curves down, making onshore wind and photovoltaics competitive with conventional generation. Therefore, the renewable energy feed-in law was revised and a *tailored mechanism for tenders* was introduced for solar and wind in April 2016.
- *Restructuring and incumbents*: On the wholesale level, the dominant market position of the four major electricity incumbents dropped from 80 percent in 2011 to 62 percent in 2015; on the retail level, their market share was only slightly above a third. They split the future green sector from the conventional power-generating business, as support schemes and the cost-efficiency of renewables provides a new business model.
- *Prosumers*: About 50 percent of renewable-energy capacity is owned by citizens, individuals, farmers, local communities, etc. This approach of micro-generation and micro-ownership – the "prosumer" model – creates acceptance for the *Energiewende* and was triggered by the specific support scheme of feed-in tariffs and the primary access guaranteed for small-scale PV. Around 1.5 million PV installations of different sizes exist in Germany.

The major challenges that are important to mention:

- *EU integration*: German policies and market development have to be seen in the context of the EU: The EU has submitted a common "Nationally Determined Contribution"; it agreed upon a framework to enlarge the share of renewables to 20 percent by 2020 and to achieve at least a share of 27 percent of renewables by 2030.
- *Grid expansion, generation adequacy, and digitalization*: Although an overcapacity of generation exists currently, this will change over the coming years with the phase-out and replacement of nuclear, and potentially coal-fired generation. Load patterns will change, as large production sites and demand centers have to be connected over greater distances. Grids and market designs have to be adapted. Digitalization is needed to more effectively balance supply and demand.
- *Green growth and jobs* have been part of the narrative; the effects of incentive schemes on technology and innovation as well as on domestic manufacturing sites are less straightforward than hoped for as, for example, PV mass production has moved to China. The impact of the new tender system has to be observed on this front as well.

their national electricity systems into larger markets and to decouple and de-synchronize the existing interfaces. At the moment, the UPS/IPS includes Ukraine, Moldova, and Georgia, which are striving for deeper integration with EU markets, and it delivers power to China, Norway, and Finland. Moreover, it operates synchronously with the power systems of Latvia, Lithuania, and Estonia. There exist concrete plans in the

Baltic countries and in Ukraine to de-synchronize from the UPS/IPS though, and to synchronize with the European grid. Common RE projects can help in dealing with negative effects on both sides.

Recommendations

In theory, electricity sector cooperation could be expanded between Germany and Russia, as both have signed the Paris Agreement and face similar challenges, outlined above. Theoretically, a revitalization of a transnational scheme within Article 6 of the Paris Agreement could be imagined, if Russia raises its climate ambitions. The same is true for EU and EEU carbon markets.

For the moment, the slow but steady shift in Russia toward supporting RE opens a window for cooperation. There is considerable room for improvement and European expertise in the areas of renewable, local, and decentralized energy; in technology- and know-how exchange; but also in the business-to-business format, which could contribute to a more transparent, flexible, and business-friendly environment for the Russian RE market.

With regard to innovative technical solutions, mutual and cross-sectoral benefits can be exploited if synthetic gas/biogas and small-scale liquid-/compressed natural gas backup solutions are taken into consideration as well, for example where co-generation in remote/decentralized areas is necessary, thereby exploiting ways to replace diesel generators. Small, local CHPs with the flexibility to shift between power and heat production for large public buildings, shopping malls, etc., provide opportunities as well.

In order to exploit the broader political, social, and environmental value, cooperation should be extended beyond small lighthouse projects. Modern energy comes closer to people, and there is a clear interaction between societal and political changes. There is an element of "empowerment and participation," which offers room for mutual engagement and common exchange. This area is potentially promising for German-Russian city partnerships, the transfer of (dual) vocational training, and university cooperation.

There are good reasons to assume that RE partnerships have a very different nature from long-term hydrocarbon trade partnerships; they are much more short-term, on-site, and ad hoc. In order to craft out a long-term relationship, the exchange of the best and worst practices in the operational, technical, and regulatory realms should be included. If the issue can be lifted to a "stronger partnership in political responsibility," there is more added value to be explored. This presupposes that EU and US sanctions do not affect technology-exchange in this realm. A clash between geopolitics and global public goods has to be avoided.

Since regulatory accommodations between neighboring markets are important, and exchanges on regulations and appropriate policies are a component of an RE-based partnership, a dialogue on the further development of the regulatory framework for international electricity grids should be initiated and maintained, both between the EU and Russia and between the EU and the EEU. This could be carried out by an advisory board that brings together engineering expertise, transmission operators, and regulators. The EU would be well advised to accompany this process in order to avoid possible future fault lines between the regulatory frameworks of the EU and EEU power markets. There should be awareness that electricity lines create a common space and that the accommodation of terms, standards, and norms would be needed and favor exchange and cooperation.

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