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Russia in the Global Hydrogen Race

Advancing German-Russian Hydrogen Cooperation in a Strained Political Climate

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In October 2020, Russia adopted a roadmap for hydrogen development, and a full-length Hydrogen Development Concept is expected soon. Even though Russia remains somewhat sceptical about hydrogen's much-vaunted transformative potential, it is interested in using its natural gas wealth to become a leading exporter of this new energy carrier and views Germany as a key partner in this effort. In the absence of a serious national decarbonisation agenda in Russia, stimulating hydrogen production primarily for exports and without significant domestic demand will be a challenge. Still, amid Russia's steadily worsening political relations with the West, clean energy (and hydrogen in particular) is one of the few promising areas of cooperation between Germany and Russia, with the potential to become a major steppingstone for the development of hydrogen value chains in both countries.

Mirroring the rapidly rising global interest in hydrogen, the idea of its exportation has become one of the most hotly discussed topics in Russia. In late 2018, the government-funded EnergyNet Infrastructure Centre, which is tasked with promoting Russian companies' technological leadership in the energy market, published a report urging Russia to act fast in seizing its share of the future global hydrogen market. The report proposed several pilot projects using the existing spare capacity in the Russian power generation system to produce clean hydrogen for export from nuclear or hydro energy at a competitive cost. In 2019, another renowned think tank, the SKOLKOVO Energy Centre, authored a detailed report explaining the latest hydrogen developments internationally and Russia's potential in this emerging sector. Since then, hydrogen has become the subject of high-level conferences and forums, Duma roundtables, and countless media articles. The adoption of Germany's National Hydrogen Strategy in June 2020, which clearly states the need for hydrogen imports and emphasises the importance of international partnerships, has lent even greater impetus to Russia's ambitions to become a hydrogen exporter and thereby preserve its position as an energy supplier in the age of global energy transition.

Hydrogen Policy-Making in Russia

In 2020, Russia adopted two key policy documents outlining its hydrogen development

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plans. The first is the Energy Strategy until 2035, which was adopted in June 2020 and is premised on the continuing importance of hydrocarbons while also setting the goal of making Russia one of the world's leading producers and exporters of hydrogen. The export targets in the Strategy stand at 0.2 million tons by 2024 and 2 million tons by 2035. While the Strategy does mention the need to stimulate domestic demand for hydrogen (e.g. in the transport sector and for energy storage), its overall export orientation is unmistakable.

The second document, the Roadmap for Hydrogen Development until 2024, was adopted in October 2020 and assigns a special role to Gazprom and Rosatom in meeting the goals set in the Energy Strategy. The Roadmap emphasises Russia's perceived competitive advantages in hydrogen (such as technological know-how and R&D, the existing resource base, significant spare capacity in the power generation system, a developed transport infrastructure, and geographic proximity to major consumers) and outlines the first steps to be taken.

At the moment, energy circles in Russia are awaiting the adoption of a full-length detailed Concept for Hydrogen Development, in which Russia will reportedly emphasise strategic cooperation with Germany, France, Japan and South Korea. The draft Concept estimates that by 2050, Russia will export between 7.9 and 33.4 million tons of hydrogen annually, earning up to $100 billion in revenues. There is vivid discussion among Russian experts on the key directions of hydrogen policy and on striking the right balance between exports, domestic demand and hydrogen technology development. As many caution, building a strong hydrogen economy at home is essential to becoming a leading hydrogen exporter.

Importantly, hydrogen development in Russia is not (yet) part of a larger drive for decarbonisation. Russia has not introduced carbon regulation and its commitments under the Paris Agreement are unambitious, amounting to a reduction of 30% from the 1990 level of emissions by 2030. Given that emissions fell precipitously following the dissolution of the USSR in 1991, this target has already been reached by default (in 2018, emissions stood at ca. 52% of the 1990 level). In the draft Strategy for Low-Carbon Development, even the most climate-friendly scenario includes an absolute rise in emissions from the current level.

A gaping omission in Russia's current policy documents is green hydrogen, although the new Hydrogen Concept will likely introduce some mention of it. Russia is home to limited wind and solar capacity — less than 3 GW in total, installed mainly in the past few years and accounting for less than 1% of the total electricity generation. As for large hydro (ca. 49 GW of installed capacity), the extent to which it is suitable for producing renewable hydrogen deserves further investigation. While there are no green hydrogen projects in Russia at the moment, a handful of companies have indicated potential interest. Enel Russia, which is active in Russia's wind power market, is currently constructing a 201 MW windfarm on the Kola Peninsula in Murmansk Oblast that is expected to be completed in December 2021. Together with Rusnano, Russia's large innovation development institution, Enel Russia has announced plans to produce 12,000 tons of green hydrogen annually at this windfarm for export to the EU. However, there is a great deal of uncertainty about this pilot project, from the cost of such hydrogen to the available transportation routes (as there are no gas pipelines in Murmansk Oblast).

Key Actors in Russia's Hydrogen Development Plans

Gazprom

In light of the expected fall of future demand for natural gas in the EU, exports of low-carbon hydrogen — produced from natural gas — could be a potential lifeline for Gazprom's business model. Gazprom is already a major producer of hydrogen — to the tune of some 360,000 tons annually —

although most of it is "grey" hydrogen produced by steam methane reforming (SMR), a process which releases large amounts of CO_2 into the atmosphere. The corporation has begun actively lobbying the EU to adopt a technologically neutral approach to hydrogen, focusing on total CO_2 emissions instead of prioritising renewable hydrogen.

A key challenge for Gazprom will be to find scalable and economical ways to reduce the carbon footprint of its hydrogen production — be it by deploying carbon capture, utilisation and storage (CCUS, a technology that is not currently used in Russia), or methane pyrolysis (a promising novel method in which hydrogen and solid carbon, rather than CO_2, are produced from methane). Gazprom is cooperating with Tomsk Polytechnic University in refining the latter technology, yet its technology readiness level (TRL) remains low. However, several forms of methane pyrolysis are being developed internationally (e.g. by the Karlsruhe Institute of Technology in cooperation with Wintershall Dea).

It is often argued that Russia's vast network of gas export pipelines (which is exclusively controlled by Gazprom) gives it an advantage as a potential hydrogen exporter. In October 2019, Eurogas Secretary General James Watson said that the Nord Stream 2 gas pipeline, when completed, could potentially transport as much as 80% hydrogen. The reality is more complicated. Gazprom's representatives have openly expressed scepticism regarding transporting hydrogen or hydrogen-methane blends through their gas pipelines, citing safety concerns. According to Gazprom, no studies have been undertaken to determine to what extent and at what cost this gas infrastructure could be used to transport hydrogen and what share of blending is possible without risking hydrogen embrittlement. While the Ministry of Economic Development suggested in April 2021 to provide all independent hydrogen producers access to the gas transportation system, this proposal is likely to face fierce opposition.

Instead, Gazprom's leadership has repeatedly expressed a clear preference for producing hydrogen on site in Europe, close to large industrial consumers. At the German-Russian Raw Materials Forum in December 2020, Gazprom's Alexander Ishkov floated the idea of building a hydrogen production facility in northern Germany, at the site of the landfall of Nord Stream 1 and (if completed) Nord Stream 2, where hydrogen would be produced from Russian gas using either SMR with CCUS, or methane pyrolysis. In late 2020, Gazprom announced the creation of a new company, "Gazprom Hydrogen", that will be responsible for advancing Gazprom's hydrogen business. On the whole, however, Gazprom is yet to go beyond declarative statements and undertake concrete efforts in clean hydrogen development.

Rosatom

Rosatom's hydrogen plans have received limited media attention in Europe so far, even though it included hydrogen development as a priority in its corporate R&D policy in 2018 and is implementing several pilot projects. As the Russian state's nuclear corporation and most technologically advanced large company, Rosatom is interested in the entire hydrogen supply chain. Over the next few years it plans to act as an investor and developer, with a longer-term goal of becoming a hydrogen technology provider — including launching the production of electrolysers (which, for now, Russia imports). In April 2021, Rosatom signed an agreement with the EDF Group to cooperate on low-carbon hydrogen projects in the area of transport and industrial decarbonisation in Russia and Europe.

Nuclear-based hydrogen is an interesting proposition for Rosatom, which already produces some 4,200 tons of it annually. It would allow Rosatom to increase the load factor of its nuclear generation assets, some of which are operating below capacity (e.g. the Kola Nuclear Power Plant in Murmansk Oblast). Importantly, however, Rosatom maintains technological neutrality: its R&D programme encompasses a wide spectrum of hydrogen production methods, including

electrolysis, SMR with CCS, and high-temperature gas-cooled reactors (HTGRs). As a major player in the Russian wind market, with a 360 MW portfolio of completed projects and much more in the pipeline, Rosatom is also open to exploring green hydrogen production.

Currently, Rosatom is conducting feasibility studies on two hydrogen projects on the far eastern island of Sakhalin, which is expected to become the first hydrogen cluster in Russia. The first project, on the use of hydrogen in rail transport, is being implemented in cooperation with Russian Railways (RZD), Transmashholding (a machine-building holding) and the Sakhalin Oblast regional government. Seven suburban hydrogen trains are planned to be launched by 2025 and 13 more by 2030. Rosatom's role in the project is to produce hydrogen and create hydrogen fuelling infrastructure on the island. The second project aims to export low-carbon hydrogen to Japan. In September 2019, Rusatom Overseas, a subsidiary of Rosatom, signed a cooperation agreement with Japan's Ministry of Economy, Trade and Industry to conduct a feasibility study on exporting liquefied hydrogen from Russia to Japan. The results of the study should be available by summer 2021. Building on this project, in April 2021, Rosatom signed a memorandum of understanding (MoU) with France's Air Liquide (a leading industrial gases company) and the Sakhalin regional government on conducting a feasibility study on large-scale blue hydrogen production (30,000-100,000 tons annually). If implemented, this would become Russia's largest low-carbon hydrogen production project.

Novatek

Novatek is an independent gas company and a leading liquefied natural gas (LNG) producer in Russia. Although not explicitly mentioned in the Hydrogen Roadmap, the company has signalled its intentions to take part in hydrogen development in Russia. In January 2021, Novatek and Uniper signed an MoU on Novatek supplying blue and green hydrogen to Uniper's power stations in Russia and Europe. Also, Novatek is mulling plans to produce some 2.2 million tons of low-carbon ammonia (either green or blue) at its Yamal LNG port in Sabetta; an investment decision is expected in early 2022. Moreover, Novatek is considering switching its planned Ob LNG plant to clean ammonia production. Ammonia, like LNG, can be transported by tanker, which means that Novatek would not need to depend on Gazprom's pipeline system.

Hydrogen Technology Valley

Russia possesses a solid scientific background in hydrogen research dating back to the Soviet era. Several flagship universities are conducting research on hydrogen technologies ranging from energy storage systems and hydrogen-powered drones and automobiles to new hydrogen production methods like methane pyrolysis. However, much of this R&D is narrowly specialised and compartmentalised, the TRL is low, and commercialisation remains a challenge.

In November 2020, initiated by Tomsk Polytechnic University, six prestigious technical universities in Russia came together to set up the so-called "Technological Hydrogen Valley." The goal of this research cluster is to create synergies in hydrogen research and to establish cooperation with key business actors interested in hydrogen development in Russia, including Rosatom, Gazprom, Severstal, Gazprom Neft and Sibur. The consortium also plans to expand international cooperation, which is where German and EU research centres can come into play.

In what could potentially be a game-changer, AFK Sistema, a leading private investor in the Russian economy, has announced plans to launch an all-Russian hydrogen science and technology centre in Chernogolovka in partnership with the Institute of Problems of Chemical Physics. The centre would include a production facility for developing product prototypes (including hydrogen fuel cells and H_2 storage solutions) and promises to work

towards the commercialisation of hydrogen research in Russia.

First Initiatives for Building a Hydrogen Economy in Russia

Regional Hydrogen Clusters

Drawing on the European examples of hydrogen valleys, the EnergyNet expert centre has proposed the creation of three unique regional hydrogen clusters in Russia: in the Far East (Sakhalin), the northwest (St. Petersburg) and the Arctic.

Of all three, the Sakhalin cluster project is the most developed. In April 2021, Rosatom, the Sakhalin Government and Russia's Federal Ministry for the Development of the Far East and the Arctic signed an official cooperation agreement on the creation and development of this cluster. This island, whose governor Valery Limarenko formerly held high-level positions in Rosatom, is the proposed site for Rosatom's hydrogen projects described above, such as projects to explore exports of liquefied hydrogen to Japan, with the ambition of supplying up to 40% of Japan's demand by 2030, and potentially to other Asian Pacific countries. Sakhalin is also expected to become a testing platform for the use of hydrogen and hydrogen-methane blends, such as in the fields of heavy-duty mining equipment, and passenger transport. In the future, Sakhalin may also produce green hydrogen from wind power. Finally, Sakhalin is the first Russian region aiming at carbon neutrality (by 2025) and has been selected as a testing ground for carbon trading mechanisms that may be introduced in Russia in the coming years.

The northwestern cluster is expected to be centred in St. Petersburg. It will be oriented towards exporting hydrogen produced by electrolysis at the Leningradskaya hydro power plant but will also aim to use hydrogen to decarbonise certain industrial processes and transportation. This includes direct hydrogen iron reduction in the steel industry, hydrogen use in cement production and the use of methane-hydrogen blends for vehicles.

The proposed Arctic cluster is expected to draw on the potential of hydrogen use for energy storage in remote and isolated areas. Much of Russia's vast, sparsely populated Arctic territory is isolated from the national power grid and is supplied with environmentally polluting diesel at an exorbitant cost. This region stands to benefit most immediately from a switch to cleaner energy, as acknowledged by even the staunchest hydrocarbon supporters. Yakutia, Russia's largest federal region, has already implemented a number of hybrid diesel-renewable energy projects and is currently working on a pilot project with Moscow Bauman Technical University to use renewable hydrogen for energy storage. Another proposed pilot platform exploring hydrogen-based solutions for energy storage and transportation is the projected zero-carbon international Arctic research station "Snezhinka" (Snowflake), whose opening is planned for 2023.

Hydrogen as Industrial Feedstock

Due to the lack of domestic carbon regulation, the idea of using clean hydrogen to decarbonise industry has not yet gained acceptance in Russia. The currently discussed draft law on limiting GHG emissions has been rendered toothless by pressure from industry groups: it envisions only voluntary reporting of CO_2 emissions by large emitters and contains no restrictive measures such as emission caps or fines.

Nevertheless, the tightening of international climate policies is certain to affect Russia's large export-oriented companies, and some of them, especially in the metals industry, are beginning to take steps to reduce their carbon footprint. Russia's aluminium giant Rusal has introduced ALLOW, its own brand of "green aluminium" with a carbon footprint of less than 4 tons of CO_2 per ton. Rusal's "green aluminium" is produced with energy from large Siberian hydropower plants and its demand is expected to grow in the coming

years. Another promising example is NLMK, a leading steel producer in Russia, which is cooperating with Air Liquide in developing its hydrogen assets and reducing the carbon footprint of its steel. In January 2021, NLMK also signed a MoU with Novatek to cooperate on low-carbon technologies, CCUS and the use of hydrogen as a clean fuel in industrial processes.

Russian companies are closely watching developments around the EU's Carbon Border Adjustment Mechanism (CBAM), which is widely viewed in Russia as one of the most significant threats to its carbon intensive-economy. According to one oft-cited forecast by KPMG, Russia stands to lose up to €50.6 billion by 2030 as a result of the CBAM. Once the final design of the Mechanism becomes clear, Russian companies in the chemical, metals and petrochemical industries will intensify their efforts to reduce the carbon footprint of their products, and hydrogen may become one of the solutions in this process, next to using renewable energy, CCUS and investing in forests as carbon sinks. This may also open a window of opportunity for German and EU companies to provide technologies and know-how to aid Russia in industrial decarbonisation.

Hydrogen in the Transport Sector

The transport sector is set to become the first hydrogen technology niche in Russia for a number of reasons: there are emerging Russian technology providers, concrete pilot projects (such as the Sakhalin hydrogen train), and an interest on the part of investors. There is also a successful demonstration project, the hydrogen-powered tram in St. Petersburg developed by the Krylov State Research Centre in 2020. President Putin, too, has recently emphasized the importance of hydrogen-based public transport, calling to launch the production of hydrogen buses by 2023.

Today, Russia's most advanced company specialising in hydrogen technologies such as fuel cells and energy storage solutions is InEnergy, a start-up established in 2015. InEnergy has received funding from the Russian Venture Fund and closely collaborates with the Institute of Problems of Chemical Physics. Its staff are actively involved in processes of hydrogen policy-making as well. Currently, InEnergy is partnering with Russia's truckmaking giant, KAMAZ, to develop hydrogen bus prototypes, one of which is expected to be presented this autumn. KAMAZ, which already produces lithium-ion electric buses, has included hydrogen-powered buses and trucks in its R&D programme for 2021.

Finally, the wealthy Moscow City Transport Department, which is investing heavily into an electric bus fleet, has shown interest in hydrogen-fuelled buses (which may be more suitable for Moscow's frosty winters). Rosatom and Transmashholding, which are planning to create a joint venture to promote hydrogen mobility solutions, are hoping to participate in implementing this vision.

What remains critical, however, is the creation of hydrogen fuelling infrastructure. Today, Russia is home to a single H_2 fuelling station located in Chernogolovka. When presenting hydrogen-powered bus and truck prototypes at a recent conference, a KAMAZ spokesman drove the point home by saying the prototypes are meant for export, as hydrogen infrastructure in Russia is still lacking. One positive initiative in this direction is the proposed Moscow-Kazan Hydrogen Highway.

Still, competition among technologies remains a concern. Hydrogen is a new entrant to an area in which other forms of mobility have greater visibility and funding. One of them is Russia's state programme to promote natural gas as a fuel for vehicles, which has received large amounts of funding and is run by Gazprom's subsidiary Gazprom Gazomotornoye Toplivo.

Rationale and Prospects for German-Russian Cooperation

Given the deep security crises between Russia and the West, any proposal for deeper

engagement with Russia is bound to be controversial. Yet, if there is political will for cooperation, sustainable energy remains one of the few promising and mutually beneficial areas. Besides, energy trade already requires mutual flanking to manage the effects of decarbonisation.

The German and Russian ministries responsible for energy signed a letter of intent on April 20, 2021. For Germany, benefits of cooperation include not only potential access to low-carbon hydrogen, but also the opening of a market for German hydrogen technologies and, more strategically, a special role in accompanying Russia's adaptation to a decarbonising Europe. A German-Russian hydrogen partnership could play a crucial role in common research, innovation and scaling of technologies. Germany's decision to include hydrogen as a priority area in the bilateral sustainable energy relationship with Russia and to open a Hydrogen Office in Moscow are corresponding steps.

Working towards a decarbonised future requires finding ways to engage large hydrocarbon exporters in reorienting their oil-based growth models. Given that the EU is the most important market for Russia's hydrocarbon exports, its decarbonisation agenda represents a serious challenge to Russia's economic model and rent economy. In a decarbonised energy world, conversion rather than resource extraction will play a greater role, and technologies and know-how will gain importance, creating new business models and completely new value chains based on availability of technologies and their respective innovation and life cycles. As in any transition, this process will create winners and losers. While falling hydrocarbon rents will affect Russian elites, the transition may also offer a lifeline to many companies and corporations. German-Russian cooperation on hydrogen technologies can incentivise modernisation, transform the energy sector and certain aspects of industry, and help to smooth Russia's transition to the new energy landscape. It could also boost bilateral cooperation in business, technology and science.

Geography matters, and Russia is here to stay as a neighbour and supplier of raw materials (such as platinum and iridium for electrolysers). Moreover, to make climate-neutral Europe a reality, it is also important to be conscious of the "Green Paradox": if Europe simply discontinues importing hydrocarbons from Russia, these resources will not stay buried in the ground but will be sold cheaply to fast-growing Asian economies, producing no net gains for the global climate. It would thus be preferable to harness Russia's fossil fuels — for example, by producing low carbon hydrogen with CCS, turquoise hydrogen by pyrolysis, and by addressing methane leakage.

On paper, there is a solid foundation for developing a hydrogen partnership between Germany and Russia and for rapidly building up hydrogen production and delivery chains. This includes the existence of a significant gas infrastructure (with parallel strings of pipes that enable a gradual phase-out of gas transport and the repurposing of said pipes and compressors for hydrogen), long-standing corporate joint-venture across gas value-chains, as well as close business ties and technological and scientific cooperation.

The strained political ties remain a major obstacle. Besides, a number of hurdles need to be addressed by both sides. The first is the general chicken and the egg problem that affects hydrogen development worldwide, namely: how, why and when should new value chains, let alone transport, be changed and created if neither demand nor supply is secured? In the past, long-term contracts across the vertically integrated value chain with price-linked contracts helped to overcome such hurdles. Against the regulatory framework in the EU, new mechanisms and contractual schemes to reliably match supply and demand must be developed and transport secured. Low-carbon and carbon-neutral hydrogen will not just face a significant price gap with grey hydrogen, but even more so with other alternative fuels they are to replace.

The second challenge — again not specific to, but highly relevant for Russia — has to do with the categorisation of hydrogen. German political discourse tends to focus on the "colours" of hydrogen rather than on the relative carbon footprint of different hydrogen production methods. This represents a constraint and voluntary limitation when compared to many other hydrogen importing countries. In fact, there are many good reasons to look at the carbon content, and, for the sake of consistency and transparency, to adopt taxonomy thresholds as reference points. As we have seen above, Russia is considering a wide range of hydrogen production methods, including at large hydro and nuclear power plants — an approach it shares with many of its potential partners such as France, South Korea and Japan. While it is clear that Germany's support scheme for long-term and market-based importation, "H2 Global", will exclusively support green hydrogen, the jury is still out on the importation and consumption of other types of low-carbon hydrogen.

The third obstacle is technology scepticism and critical views of CCS in Germany. It might well be a wise industry approach to produce hydrogen on site in Germany. But such a scheme has its pros and cons. On the one hand, it would quickly allow Germany to flexibly address its hydrogen demand and further develop key technologies. On the other hand, it would require — in the case of blue hydrogen — the development of a CO_2 network and/or storage facilities.

From the Russian perspective, past experiences with changing EU regulation present a major hurdle. If there is political will to prioritise sustainable energy as well as to overcome these mutual barriers and to restore trust, then it could once again be time to implement large projects across the value chain. The building blocks are obvious. It is not an issue of technical feasibility, but of negotiable economic challenges and political prioritisation. A climate-neutral Europe has much to gain from repurposing the embattled Nord Stream 2 (partly) for hydrogen and making it a central part of a new Hydrogen-Technology-Pipe deal. Such a deal could and should be expanded from a bilateral arrangement to an inclusive European project.

Conclusion

Russia is signalling its interest in joining the global hydrogen race and envisions itself as a future hydrogen supplier for Germany and the Asia Pacific. However, it should be aware that becoming a key hydrogen exporter goes hand in hand with building a strong hydrogen economy at home. If Russia wants to secure its place in the global energy transition it cannot avoid the adoption of more ambitious decarbonisation policies at home. Also, when it comes to hydrogen, Russia cannot assume it will remain an indispensable supplier for the EU by default. Leading economies like Germany have many other options for partnerships. As the hydrogen race intensifies, with governments and corporations committing large funds to the sector, Russia needs to take a risk and muster the political will and resources to seize its share of the future hydrogen market.

As for Germany, it should consider the comparative carbon content of different kinds of hydrogen as the main criteria, or at least send clear signals regarding the types of hydrogen that it is willing to buy from Russia (and others) in order to create certainty for potential investors. Well thought-out pilot projects are critical at this early stage. Last but not least, industrial decarbonisation in Russia is an untapped and very promising area of bilateral cooperation which deserves much greater attention.

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