Russia's CCUS sector needs state support to go global

Decarbonization turns Carbon Capture, Utilization and Storage projects (CCUS) into a new and specific industry sector, which is developing actively all over the world, including Russia. Several local companies are working on pilot projects. But to bring these projects to market, regulatory support is required.

by Julia Shershneva

To achieve the ambitious goals of the Paris Agreement, the economies should not only increase the capacity of renewables and switch transport to electricity, but also reduce greenhouse gas emissions from the existing infrastructure, primarily in carbon-intensive production of steel, cement, fertilizers and petroleum products. Carbon Capture, Utilization and Storage (CCUS) technologies can help in the decarbonization process.

According to the International Energy Agency (IEA), CCUS projects have been rapidly developing recently due to increased investment, with oil and gas majors also taking part. At the end of 2020, CCUS projects approaching the FID (Final Investment Decision) assumed a total investment of almost $ 27 billion, which is twice as much as in 2017. And due to introduction of the carbon border adjustment mechanism (CBAM) by the European Union, CCUS becomes for Russian exporters and industry as important as it is for the countries participating in the EU Green Deal.

That is why Creon Energy, with the support of partners Creon Capital, EY and Endion, organized Russia's first CCUS conference in September 2021, dedicated to CO2 capture, utilization and storage topics. The event organizers succeeded in bringing together a unique team of experts with various backgrounds: specialists in the oil and gas sector, mechanical engineering, agrochemicals, metallurgy, power, as well as representatives of government agencies and scientific institutions.

Vast potential: Russian CCUS market requires regulatory documentation

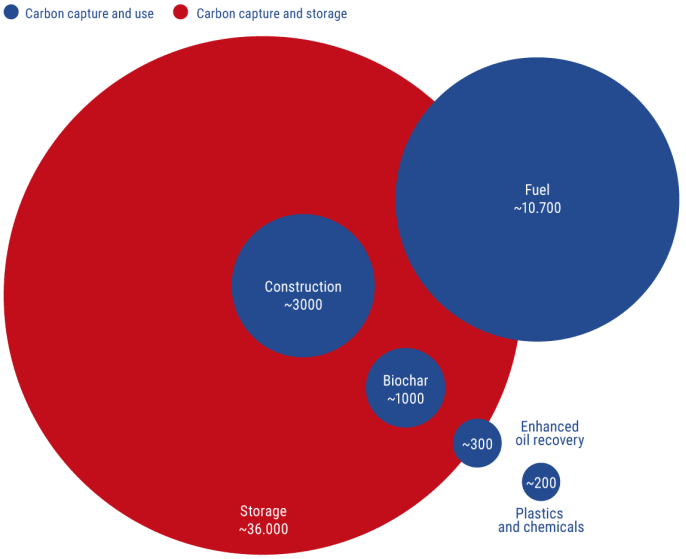
According to the Russian Ministry of Industry and Trade, at the moment the industrial use of CO2 mostly takes place in enhancing oil recovery and in production of fertilizers. But potentially carbon dioxide can be used in chemical production, paper, food industry and even in medicine. That means both direct use, when CO2 is not transformed chemically, and also its transformation into useful products. Fire extinguishers, flavors, dry ice, refrigeration equipment, construction materials, concrete, insulation, polymers, carbonated drinks – the range of applications for carbon dioxide is very wide.

The global potential for carbon capture will grow significantly in the next 10 years: according to McKinsey, the capture capacity will grow from the current 50 million tons to 0.5 gigatons per year by 2030. Rystad Energy estimates the global storage capacity of geological structures suitable for the disposal of CO2 at 11,500 gigatons. The largest disposal facilities, according to Rystad, are in Russia, the U.S., and Canada. It was in Russia that researchers confirmed the possibility for the storage of CO2 for a period of more than 100 years.

CREON MARKET MONITOR: CCUS (CARBON CAPTURE, UTILIZATION AND STORAGE)

Application for captured CO_2 cover a wide range of materials

Technical potential of CCUS, metric megatons of CO_2 per year



SELECTED EXAMPLES

Fuel	
	Synfuel and macro- or microalgae fuel
Enhanced oil recovery	
	Conventional or unconventional CO_2 EOR and CO_2 EOR in residual oil zones
Construction materials	
	Cement and aggregates
Plastics and chemicals	
	Polyethylene, polypropylene, carbon fiber and methanol
Biochar	
	A charcoal derived from burning organic agriculture- and forestry-waste products
Storage	
	Saline aquifers and depleted gas reservoirs

*CCUS – Carbon Capture, Utilization and Storage. Excludes small amounts of CO_2 used for other applications, such as decaffeination, dry ice, food and beverages, fire extinguishers, and greenhouses.

Source: McKinsey

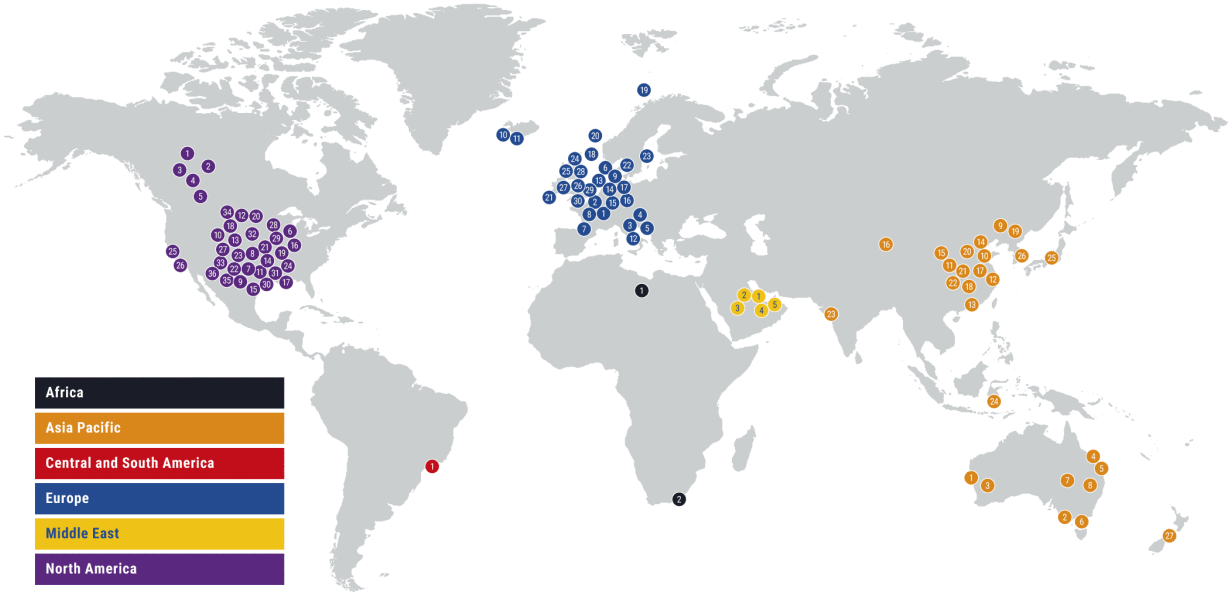
CO2 Capture and Use technologies are Russia's potential

At present, three technology areas are available for carbon dioxide capture: capture before combustion, capture after combustion, and capture after fuel combustion in an oxygen environment.

There are still few successfully implemented projects all over the world: according to the Global CCS Institute, as of 2020, there are 65 large-scale carbon capture and storage projects in the world - 26 of them in operation, 21 at the initial design stage, 13 at the final design phase, three are under construction and two are frozen. If we also take into account smaller-scale projects (see the graph), then there are more than 100 of them.

Overview of existing and planned CCUS facilities

Numbers of projects by region



Source: Global CCS Institute and IOGP data

According to the Ministry of Industry and Trade of the Russian Federation, in total the enterprises that have already launched emission capture systems are capable of capturing more than 40 million tons of CO2 per year. According to the consensus forecast of BP, the CCUS Global Institute and the UN, the volume of capture can be hundreds of times higher - at the level of 5-10 billion tons per year by 2050.

Application of CCUS at refineries, CHP and metallurgy

1. CCUS technologies for hydrogen production: option for refineries

In the technological portfolio of Gazpromneft Industrial Innovations, CCUS technologies are one of the most promising areas along with the projects for production of turquoise hydrogen, biodegradable plastics and biofuels of second and third generation. "We pay attention first to capture, and then to utilization, and we believe that this chain should work together, and not separately," says Artur Rakhmatullin, Deputy General Director for Development of Gazpromneft Industrial Innovations.

To capture carbon dioxide, the company is considering not only the traditional method of amine purification, but also membrane capture, which is considered to be more efficient and easier to control by instrumentation. For this technology, it is planned to use the tail gases of the refinery; it can be used at the pressure swing adsorption unit for the production of hydrogen as early as 2024. Such a plant will help capture up to 30,000 tons of CO2 per year and produce up to 1,000 tons of H2 per year. For the company, these achievements in future will reduce payments of the cross-border carbon tax and, in addition, will provide a commercial product.

CO2 captured by Gazpromneft Industrial Innovations is planned to be used (along with other applications) for carbonization of concrete. "Among the many solutions on how to utilize CO2, we monitor its reaction with various wastes, slags, clays to produce a valuable product in the form of bricks or blocks," said Artur Rakhmatullin. The approximate launch date for the construction materials production unit at Gazpromneft Industrial Innovations is 2027. Further development of this application will depend on the dynamics of the consumer demand.

2. Liquefaction and utilization of CO2 emissions using oxygen: technology for CHP

According to Vygon Consulting, the potential for CO2 capture in Russia is 1.1 gigatons per year. And most of this volume (43%) belongs to the power and heat supply. It is in this area that Cryogenmash sees great potential for CCUS technologies.

One of the ways to capture and utilize CO2 is associated with the consumption of oxygen. In the Oxyfuel combustion technology, fuel is burned with oxygen, for the production of which an air separation unit (ASU) is used. This makes it possible to obtain stoichiometric flue gases (CO2 and H2O) and to carry out a simple cycle of purification and compression of carbon dioxide for subsequent disposal.

"If cryogenic ASUs are integrated into CHPs, this will significantly reduce the specific energy consumption for oxygen production, increase the energy efficiency of power generating systems and stations, and ensure complete CO2 capture. So far, the main difficulty is to integrate CHP and ASU into a single complex," noted Alexander Mazin, Director for Strategic Development at Cryogenmash. More than 3 million tons of liquid carbon dioxide can be captured per year with the help of ASU with 1200 MWT power. If we assume that the quota per ton of carbon dioxide in the future will cost 30 euros, then with the maximum cost of the ASU of 7-10 billion rubles, the project costs can be recovered in 3-4 years, the company concluded.

3. CCUS technologies for metallurgical production: still in development

In order to reduce the carbon footprint of products, metallurgists are considering two options: a complete withdrawal from blast furnace production or replacement of natural gas with hydrogen in the process of direct iron reduction (DRI). In this case, you can get up to 0.3 tons of CO2 per ton of liquid steel, but this method makes steel three times more expensive. Renewable energy sources and cost-effective hydrogen will help to reduce the cost of the process, according to Ilya Pavlov, Director for Hydrogen and Innovative Decarbonization of PJSC "Severstal".

It is the direct iron reduction technological cycle that is one of the main sources of CO2 in metallurgical production. Other leading sources of emissions include CHP units, coke oven, blast furnace and converter gas (for the most part they are utilized to generate on-site electricity). Each of these sources of CO2 has different composition of gases, different temperature and different technological stream of production, therefore, the issue of capture and utilization is still unsolved for the metallurgy. The main challenge is how you can combine all of these streams into one source. To implement this idea, Severstal is looking for partners.

One of the most promising CO2 capture projects, which can be adapted for different applications - cement, glass, metallurgy, oil refining and power generation - is the DMX technology, which Axens Solutions is working on. This is a technology for capturing CO2 from flue gases, which uses a new type of absorber capable of separating into two phases (light and heavy) after saturation with CO2. “This gives big savings in the required energy for regeneration. In addition, this type of absorbent has a low sensitivity to oxygen, which results in low corrosiveness of the materials from which the equipment is made of. This means that you can use ordinary steel without additional processing. As a result, such an installation has a high potential for energy-saving and makes it possible to reduce the cost of capturing carbon dioxide by up to 30%,” Boris Golovin, Business Development Director of Axens Solutions, named some of the advantages of the DMX technology.

DMX technology has not yet entered mass production. The pilot plant, the DMX Demonstrator in Dunkirk, is slated for launch in 2022. At the initial stage, this unit will have a small capacity - half a ton of CO2 per hour, but it will already operate in an industrial mode and, according to Boris Golovin, will become the prototype of the first large-scale project, which will capture 1 million tons per year by 2026, and 10 million tons by 2036. After the launch of the project, the company already plans to offer the technology to customers: commercialization of the project is planned for the second quarter of 2022.

CO2 injection technologies for the future

1. Problems of CO2 storage

CO2 flooding as a way to store CO2 is a widely discussed method, but it is accompanied by a number of serious risks. Vyacheslav Terentyev, General Director of VNIINeft JSC, spoke in detail about CO2 flooding at the CCUS-2021 conference. The first two problems are associated with not yet fully studied chemical reactions that can occur when CO2 is mixed with other substances: when interacting with oil, asphaltene can spill onto the surface, a solid phase that even in laboratory conditions blocks any further reaction. During CO2 flooding, the acid may evolve which bites in the equipment and in the well itself.

The question also remains open regarding the use of old deposits as a storage facility for CO2. As Vyacheslav Terentyev noted, many wells were drilled 30-40 years ago, they are non-tight, and if carbon dioxide is injected there, in many cases it will flow to the surface.

An accompanying problem is that there are almost no completely liquidated deposits in Russia. If you start flooding CO2 in parallel with the extraction of any resource, then you need to completely re-arrange the infrastructure. Additional costs will be required for geological testing: at storage facilities, it will be necessary to drill control wells and monitor the field.

Finally, at the moment in Russia there is still no such type of license for the use of subsoil that can be used for the storage of CO2. However, in the future, when the issue of the license is resolved at the state level, it is VNIINeft that is ready to act as the operator of the CO2 flooding project. This is supported by the implementation of the pilot project of the carbon dioxide flooding technology at the oil field in Samara.

2. World experience in the field of geological carbon storage

In a global sense, the technology of CO2 injection into the reservoir is not new. As Ekaterina Sorokina, Project Manager of the Department of Digital and Integration Solutions of Schlumberger, noted in her report, the first carbon dioxide flooding projects appeared in the United States back in 1998. The peak of public interest arose in the 2010s: it was in those years that Schlumberger implemented more than 60 CO2 storage projects, both offshore (injection into depleted reservoirs in order to increase oil recovery (EOR) and onshore (injection into aquifers). The company has worked at various stages of projects, ranging from site screening to post-injection monitoring.

CO2 geological storage projects in the global market are regulated by two international ISO standards - 27914 and 27916. The first describes in detail how the geological storage of carbon dioxide should be studied and how the operator should behave during the entire injection and storage project. The second standard is based on the American experience in CO2 flooding for enhanced oil recovery. It regulates the accounting of produced and injected CO2, so that it can then be used for loans and tax breaks.

Schlumberger cooperates with DNV, which provides validation and certification services for all engineering and research activities in the field of geological storage of CO2. Certification of geological storage projects in accordance with international standards is of interest for companies focused on Western partners and product export.

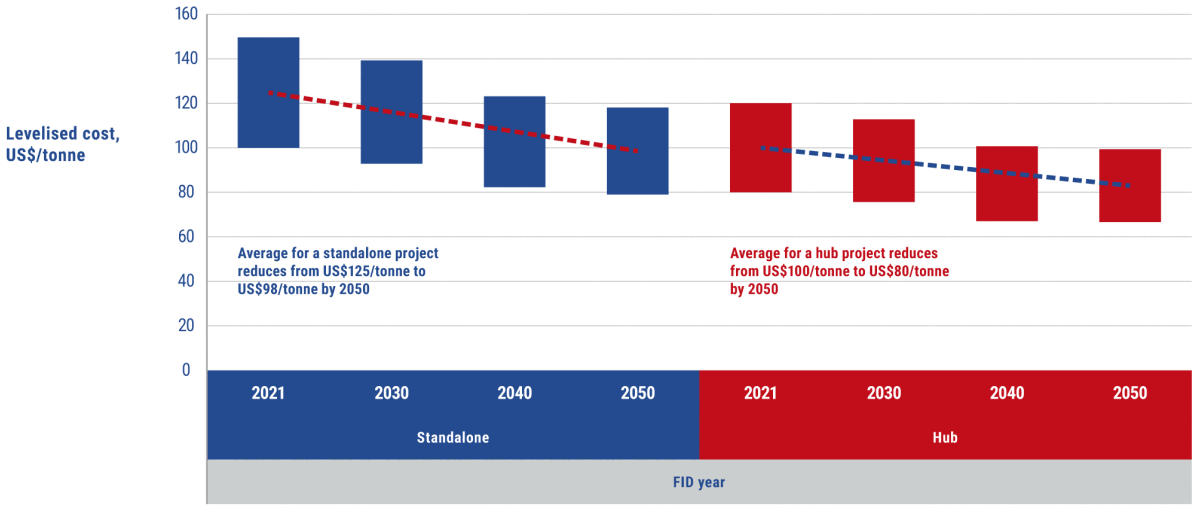
“The world practice of project certification can be adapted for the Russian Federation as well. In the future, the cost of these projects will decrease, because everyone will gain experience, standardize their business models, and a market for major service providers will be set up,” Ekaterina Sorokina predicted.

Gazprom Neft a technological leader in the emerging CCUS industry in Russia

Russia has a powerful geological potential for the implementation of carbon dioxide capture and storage technologies. According to the estimates of the International Energy Agency, the Russian Federation accounts for about 20% of the underground storage of CO2. Without CCUS, achieving the global goals of decarbonization is impossible, but the implementation of these projects will require high costs.

Wood Mackenzie estimates that the average cost of CCS today is higher than the price of carbon emissions, and the price will remain at that level for some time. Current global capacity of CCS is around 60 million tons per year and could grow to 400 million tons per year by 2030. As the industry expands and technology improves, consultants forecast cost reductions of about 20% by 2050. A role in this, according to the study, can be played by abandoning the individual nature of projects and switching to standardized projects that can be scaled up and developed in other territories.

CCS levelised costs: multi-user hubs versus standalone projects



*Hub means a CO_2 transportation and storage service, which is developed and operated separately to the capture projects. Hubs will receive CO_2 from multiple sources from potentially multiple industries. The cost to use a hub for transportation and storage will be opex, on a per tonne basis, similar to an offtake arrangement in LNG or oil and gas production. Example of hubs in development are Northern Light (Norway), East Cost Cluster (UK) and Alberta Carbon Grid (Canada).

Source: Wood Mackenzie

There are more and more carbon capture and storage projects around the world. The largest of them, such as the Nothern Lights in Norway, are implemented with government support. It is this factor that will become key for the development of the CCUS industry in Russia. “Gazprom Neft is ready to act as a technological leader for our country, but it cannot be done without the help of regulators,” said Alexandra Vertlyugina, head of the company's integration programs.

What is happening in Russia at the legislative level

After the publication of the EU regulation on a cross-border carbon tax, the Ministry of Economic Development of Russia estimated an additional financial burden on Russian exporters at € 50.6 billion until 2030. Against this background, in early September, the Russian authorities instructed a working group, which included representatives of several ministries, headed by Anatoly Chubais, to prepare an agreed position of Russia on the CBAM. As a result, on September 24, Prime Minister Mikhail Mishustin signed a government decree setting out the directions of financing and criteria for the selection of "green" projects, as well as requirements for the verification of financing instruments and for the verifiers themselves. Projects were divided into "green" and "adoptational".

Along with the activities aimed at creating a state regulator, the Federal Law N 296-FZ "On limiting greenhouse gas emissions" will come into force on January 1, 2022, which defines climate projects, a register of carbon units and absorption of greenhouse gases. Climate projects can include both projects aimed at reducing emissions and projects aimed at absorbing them. Absorption can occur both at the expense of natural and anthropogenic objects. “This means that from the point of view of Russian legislation, now projects such as carbon farming, carbon territories, projects to absorb emissions through special installations can already be considered climatic,” commented Natalia Aristova, director of legal services at EY.

According to her, the Ministry of Economic Development is also preparing a project according to which amendments may be made to the Tax Code to reduce the cost of implementing climate projects in Russia. “This project contains a number of attractive measures, including exemption of carbon units from VAT,

exemption from income tax, benefits not only for entities implementing climate projects, but also for works and services purchased for the implementation of projects," added Natalia Aristova.

The Sakhalin experiment is also being carried out, within the framework of which not only the setting of targets is introduced, but also a system of quotas and payments for non-fulfillment of quotas. So far, the project exists in the form of a draft law, but it is assumed that the carbon trading system there will be launched next summer, and in the future other regions of the Russian Federation will adopt the experience of this territory.

How to make money on CCUS projects

Not only the consequences of the introduction of CBAM remain relevant for Russia, but also the investment attractiveness of the CCUS projects. As noted by EY expert Andrey Sulin, the working option so far is to trade carbon units in voluntary or regulated markets. EU ETS is regulated by a European directive, geography is limited to countries where this directive is adopted and operates. Voluntary markets are easier: partly because of this, over the past 10 years, the number of national and local mechanisms for obtaining project carbon units in this market has grown 6 times. There is one "but" though: the cost of units in voluntary markets is negligible compared to the cost of a ton of carbon in regulated markets.

The reason is that the voluntary market is considered to be highly risky due to lack of proper regulation and lack of confidence among investors that this or that unit has been properly verified and in fact confirms the fact of carbon utilization. Why, then, are these markets growing so actively? Because against the background of the Green Deal, many countries declare their intentions to introduce instruments similar to the CBAM. "Investors expect that the voluntary market will develop and at some point there will be regulatory mechanisms. Then it will become a convenient channel for commercialization," concluded Andrey Sulin.

What financial assistance can a CCUS project receive?

1. Government support, available now

One of the options for industry-wide government support instruments is support measures for the introduction of the best available technologies (BAT) in production, a special investment contract (SPIC) and an investment protection and promotion agreement (SZPK).

By concluding a SPIC, participants receive the "Made in Russia" status before other market participants. It can also be used to provide additional benefits when completing capture projects.

With the SZPK, you can get a subsidy to reimburse the costs of creation (construction), modernization and (or) reconstruction of the supporting and (or) accompanying infrastructure necessary for the implementation of the investment project. A complete list of projects for which funds can be obtained is contained in Federal Law 825 of 12/14/2020. Upon contacting the Ministry of Industry and Trade of Russia, the list can be supplemented with new items.

Most of the listed state support measures are currently in effect for new and relatively new projects. For those that were implemented 5-10 years ago, these tools are not suitable.

2. Green finance

Russian market participants can also source funding for CCUS projects in Europe. Florian Willershausen, development director of CREON Capital, a company that also invests in ESG and renewable energy sources, said that the efforts of many large investors are now concentrated on the financial market.

Norwegian investment funds, on the one hand, still earn from oil projects, but on the other, they have already withdrawn $ 16 billion from coal and oil companies and are investing in renewable energy sources ($ 20 billion) and CCUS. The European Bank has decided not to participate in coal-related projects at all. And even the private business of the United States is gradually leaving such projects. As BlackRock CEO Larry Fink said, "there will be a fundamental restructuring of finances soon."

“Significant financial resources are now concentrated on the market, and there are not enough green projects for them. By placing a green bond in Luxembourg, you can get financing cheaper than a classic project,” said Mr. Willershausen. As an example of a successful entry into the European market, he cited the deal of Russian Railways in 2019, when the state corporation successfully placed green bonds on the Luxembourg Green Exchange focused on investments in energy and water conservation and reduction of greenhouse gas emissions. Maturity is 2027, coupon price: 2.25, which, in the opinion of Mr. Willershausen, is a decent option in relation to the market.

Among the potential areas of green business for Eurasia, the development director of CREON Capital highlighted carbon offset (creation of a renewable energy fund in which energy and carbon-intensive industries invest, investments in afforestation and forestry, participation in certified ETS trading), new technologies (gas-based blue hydrogen pilot projects in Europe, production and sale of biofuels for export, synthetic chemistry for industrial applications, solar heating solutions) and technology localization (energy efficiency solutions, CCUS and RES in Eurasia).

Potential European partners for Eurasia include Siemens Energy, Air Liquide, Enel, Schneider Electric and others. “Russia will be facing a new industrial revolution, and it is necessary to prepare for it now,” summed up Mr. Willershausen.

At the CCUS 2021 conference, CREON Capital Development Director Florian Willershausen and Business Development Director of the Kazakh company AIFC Green Finance Center LTD Manas Gijduaniev signed a memorandum of understanding and partnership aimed at strengthening cooperation in the field of carbon capture, storage and processing.

The agreed areas of cooperation include support for Kazakhstan in its efforts to fulfill the obligations to reduce greenhouse gas emissions, announced by the country under the Paris Agreement. The parties will also jointly explore opportunities for the implementation of projects in carbon capture, utilization and storage (CCUS), and will exchange experience in this area. Kazakhstan will recieve support in the issuance of "green" financial products (green bonds, social and sustainable bonds) in Luxembourg to finance environmental projects, as well as to attract joint investments.

Summary

The decarbonization program is setting new challenges for the global industry. Carbon Dioxide Capture and Storage (CCUS) technology can significantly reduce the impact that industrial production has on the climate. The CCUS technology is now transforming into a new industry sector around the world. And Russia is keeping pace with this trend.

The CCUS 2021 conference participants came to the conclusion that the industry needs the support of the federal authorities. Based on the experience of CO2 capture and storage projects already implemented in Europe and the world, it is the indirect influence of regulators through benefits and preferences or direct subsidies for CAPEX that could help bring pilot projects (that remain to be below profit at the moment) to the industrial market.

"The development of the CCUS industry reminds me of the story of introducing and developing the utilization of the associated petroleum gas, in which we participated actively several years ago," said Sanjar Turgunov, CEO of CREON Energy. - At the initial stage, it was believed that all projects were unprofitable. However, thanks to the initiative at the state level, the APG processing was transformed into a specific industry sector. I am sure that the same will happen with the CCUS. The CREON Group is ready to assist the industry players as much as possible to convey their position to the state and to build value chains even at an early stage," Turgunov said, summing up the conference discussion.

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