



ROSATOM

Key Operating Results of State Atomic Energy
Corporation Rosatom

2021

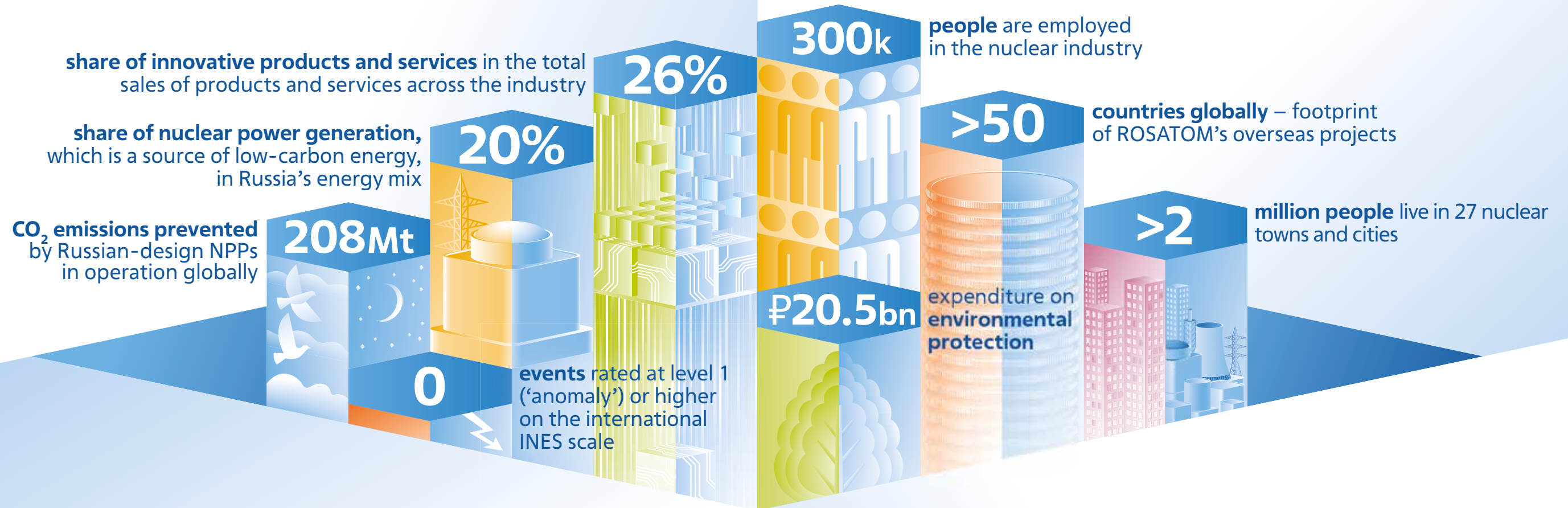


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ROSATOM Today



SAFE AND COMFORTABLE LIVING ENVIRONMENT

Clean Energy



COMMISSIONING OF NEW POWER UNITS IN RUSSIA AND ABROAD

ROSATOM put into operation power unit No. 2 of Leningrad NPP-2 equipped with an innovative new-generation 1,200 MW reactor and power unit No. 1 of the Belarusian NPP, which is the first new-generation power unit commissioned by ROSATOM abroad. The Corporation launched the construction of four NPP units in China, two units in India and one unit in Turkey. The construction and operation of an NPP comprising two power units create more than 3,000 new jobs and provide employment for more than 10,000 people in the sphere of nuclear infrastructure.

NPP LIFE EXTENSION ABROAD

The project to upgrade power unit No. 2 of the Armenian NPP and extend its life was completed with assistance from ROSATOM. The service life of the NPP was extended until 2026. This is a key nuclear energy project implemented jointly by Armenia and Russia. Its main objectives include extending the operating life of the Armenian NPP and enhancing its safety and performance.

SMALL NPPS

ROSATOM designed upgraded floating power units. A contract was signed for the supply of four floating power units for the Baimsky Mining and Processing Plant in Chukotka. ROSATOM designed an onshore small nuclear power plant, with the first NPP of this kind to be built in Yakutia. One 100 MW onshore NPP can supply zero-carbon electricity and heat to remote towns with a population of 100,000 without connection to the main power grid.

NUCLEAR RESEARCH AND TECHNOLOGY CENTRES

The 'first concrete' ceremony was held in Bolivia to mark the start of construction of a research reactor facility, which will form the core of the Nuclear Research and Technology Centre (NRTC). The NRTC will produce radiopharmaceuticals for more than 5,000 cancer diagnosis and treatment procedures annually. In addition, the Centre will irradiate agricultural products to improve their quality, extend their shelf life and significantly increase exports. ROSATOM and the Serbian government signed a General Framework Agreement on the construction of a Centre for Nuclear Technologies and an Agreement on the Establishment of a Joint Venture that will implement this project in the Republic of Serbia. Under the agreements, a Nuclear Medicine Centre with a cyclotron complex and radiopharmaceuticals production facilities will be built in the country within the next three years.

Integrated Environmental Projects

CLOSING THE NUCLEAR FUEL CYCLE

Construction of the BREST-OD-300 lead-cooled fast reactor was started in Seversk. Engineering designs were developed for a reactor unit equipped with a large sodium-cooled fast reactor, BN-1200M, with improved technical and economic characteristics. The transition to the closed nuclear fuel cycle will make nuclear power generation more environmentally safe; it will also help to create a major new source of fuel and will drastically reduce waste generation through waste processing and recycling.

INFRASTRUCTURE FOR THE MANAGEMENT OF HAZARD CLASS 1 AND 2 WASTE

A federal state information system for the management of hazard class 1 and 2 waste was developed and launched. The system is a 'one-stop-shop' solution enabling waste tracking and monitoring over its entire life cycle, from waste generation to disposal. It will also help to forecast capacity utilisation and optimise logistics.

PRESERVATION OF LAKE BAIKAL

Prioritised measures aimed at lowering the water level above the sludge layer were completed at the site of the Baykalsk Pulp and Paper Mill. Local wastewater treatment facilities were installed; utility networks were built for collecting contaminated wastewater from landfill sites and discharging treated water into the centralised sewerage system of the town of Baykalsk. These measures helped to prevent the potential threat of contaminated wastewater discharges into Lake Baikal and thus to preserve a unique natural site in Russia.

CLEAN COUNTRY

As part of the Ecology National Project, ROSATOM completed municipal landfill reclamation in Chelyabinsk, which involved the application of world-class state-of-the-art technological solutions. This helped to reduce air pollution in Chelyabinsk by 30% and completely cease discharges of harmful substances from the landfill into the Miass River. The project proposed by ROSATOM to remediate the Krasny Bor landfill near Saint Petersburg, where toxic industrial waste is stored, underwent a state environmental expert review. Preparations are underway for the industrial site rehabilitation project in Usolye-Sibirskoye, which will make it possible to set up new manufacturing operations at the site. The roll-out of solutions offered by ROSATOM in the regions will help to address a major social and environmental challenge of repairing environmental damage caused over the years by municipal landfills.

Development of the Arctic



NORTHERN SEA ROUTE

ROSATOM exceeded the 2021 target for escorting vessels, with cargo traffic along the Northern Sea Route totalling 34.9 million tonnes. Transit cargo traffic increased by 700,000 tonnes compared to 2020 and exceeded 2 million tonnes. The *50 Let Pobedy* nuclear icebreaker escorted the *Christophe de Margerie* gas tanker (Sovcomflot) very late in the season. In addition, the *Vaygach* nuclear icebreaker made an expedition to enable a convoy of eight vessels to navigate difficult sections of the route.

ROSATOM continuously improves transport and logistical accessibility of European Russia and the Far East, which is a necessary prerequisite for sustainable social and economic development of the region.

UPGRADING THE NUCLEAR-POWERED ICEBREAKER FLEET

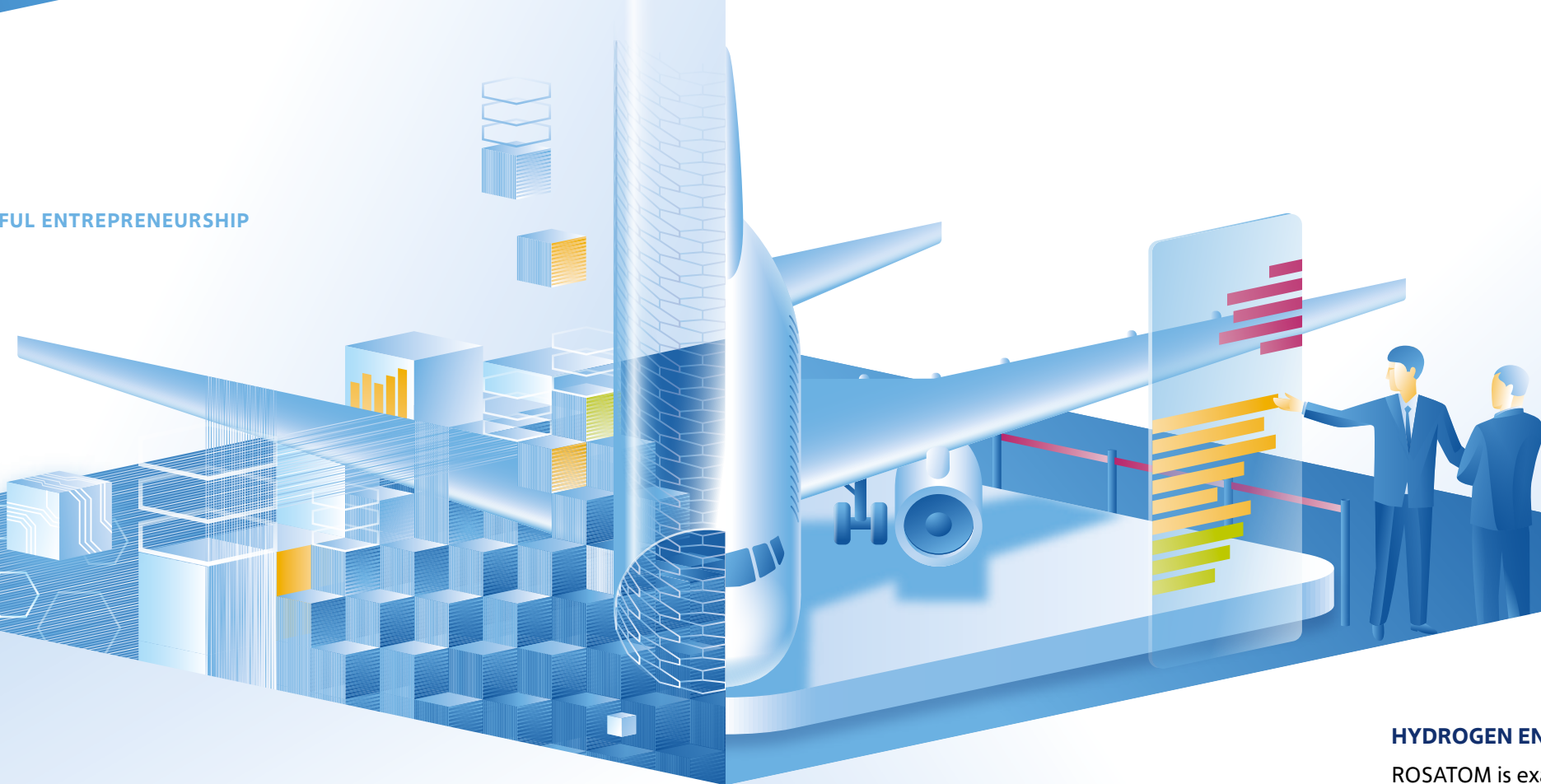
The first Russian follow-on Project 22220 nuclear icebreaker, *Sibir*, was accepted into service. Three new icebreakers, *Ural*, *Chukotka* and *Yakutia*, are under construction at the Baltic Shipyard. They are a follow-up to the *Arktika* multipurpose nuclear icebreaker commissioned in 2020. A unique Project 10510 icebreaker, *Rossiya*, with propulsion power totalling 120 MW is under construction in the Far East; it will be the world's most powerful icebreaker.

GREATER NORTHERN SEA ROUTE PROJECT

ROSATOM's project to create the Greater Northern Sea Route spanning from the Norwegian coast of the Barents Sea to the Korean Peninsula will enable complex transportation operations in a region characterised by a harsh climate after 2024. It will enable year-round navigation and will support sustainable supply chains and international trade.

DECENT AND PRODUCTIVE WORK AND SUCCESSFUL ENTREPRENEURSHIP

Innovation for Business



COMPOSITE MATERIALS

ROSATOM completed the establishment of an integrated process chain for the production of composite materials covering all stages, from raw materials to finished products. The Corporation launched the production of PAN precursor (which is used as feedstock for the manufacture of carbon fibre). The past year saw the maiden flight of a Russian MC-21-300 production aircraft, with more than 30% of its components made from carbon fibre produced by ROSATOM. This is the world's first medium-haul airliner with composite wings.

ADDITIVE MANUFACTURING

MeltMaster 3D-250M printers were put into operation. They are designed to produce implants from titanium-based alloys. ROSATOM started pilot production of implants and plans to obtain a licence for the manufacture of customised and mass-produced products. Titanium implants produced by the Corporation are an optimal solution intended for use in traumatology, orthopaedics, oral and maxillofacial surgery.

PRODUCTS FOR THE OIL, GAS AND PETROCHEMICAL INDUSTRY

ROSATOM completed the construction and obtained permission for the commissioning of Europe's first and the world's third test bench for medium- and large-scale LNG plant equipment. The test bench is intended to be used for certification testing of both Russian and foreign equipment. This project has made it possible to produce Russian analogues for petrochemical equipment and has contributed to the development of new sectors of industry.

HYDROGEN ENERGY

ROSATOM is examining a number of commercial projects, which include hydrogen production from natural gas on Sakhalin Island to meet the needs of industrial enterprises, including through the decarbonisation of production processes. Some of ROSATOM's hydrogen projects involve the use of electrolysis units designed in-house. First samples of Russian technological solutions and equipment were produced; a decision was made to commission a test bench for electrolytic hydrogen production at Kola NPP. These projects launched by ROSATOM mark the start of development of the most promising technologies that will combine nuclear power with hydrogen energy, making it more sustainable and environmentally friendly.

SUPPORTING PEOPLE'S HEALTH AND WELL-BEING

Raising the Standard of Living in Nuclear Towns and Cities



SMART CITY

The roll-out of the Smart City digital platform continues in nuclear towns and cities. During the year, Smart City digital services were rolled out in 36 towns and cities across Russia, including 18 towns and cities where nuclear facilities are located. The adoption of these technologies enables municipalities to speed up administrative processes threefold (on average), while overall municipal budget savings from the relevant activities total up to 7% per year. The project helps to make urban management more efficient, cost-effective and flexible, including by involving local residents in urban environment management.

INDUSTRY PROJECTS IN NUCLEAR TOWNS AND CITIES

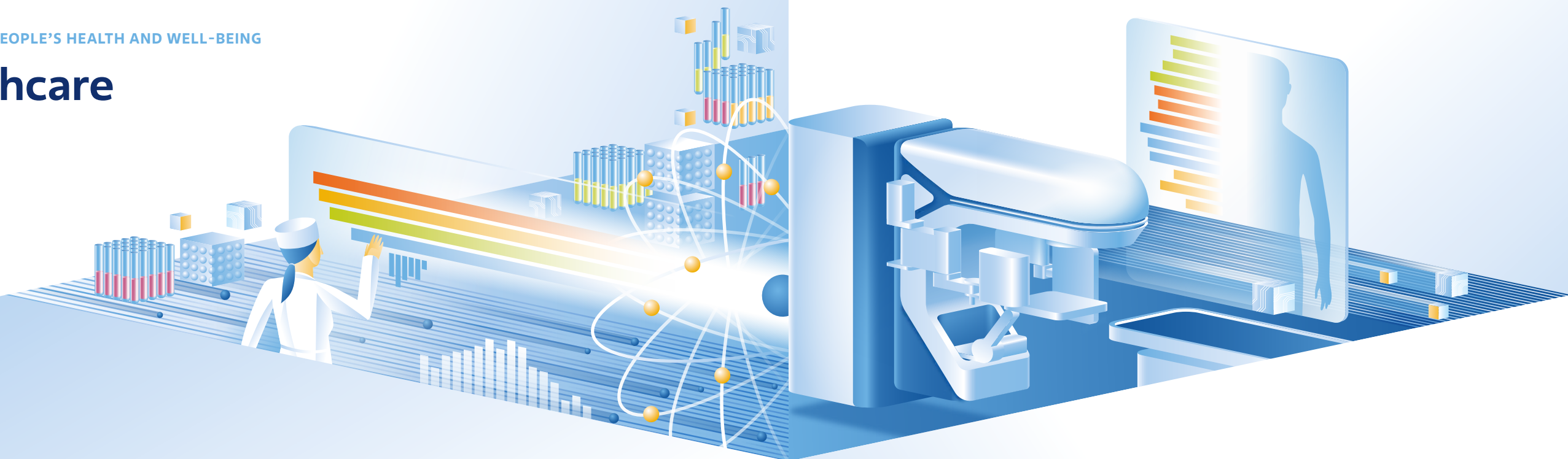
The project titled **ROSATOM's School** has made it possible to provide systematic support for initiatives undertaken by participating towns and cities, including designing effective education models for preschoolers and school students, developing children's talents, supporting teachers, and involving parents and local communities in the activities of educational institutions. In 2021, as part of a system-wide event for parent volunteers, ROSATOM identified

more than 100 parent initiatives aimed at improving the educational system in schools and kindergartens in the towns and cities participating in ROSATOM's School. The parent initiatives will be supported throughout 2022.

The project titled **ROSATOM's Territory of Culture** has been helping to introduce residents of its host towns and cities to the highlights of performing, figurative and dramatic arts and supporting local cultural initiatives for 15 years. It helps to involve local residents in cultural activities and unlock talent. Over 15 years since the launch of the project, more than 1,500 events of various types have been held in 25 nuclear towns and cities.

SUPPORTING PEOPLE'S HEALTH AND WELL-BEING

Healthcare



NUCLEAR MEDICINE

Registration was obtained for a new high-technology solution developed by ROSATOM: the Brachium device for high-dose-rate brachytherapy. It is designed for cancer treatment using the contact brachytherapy method, which involves intensive irradiation of cancer cells with minimal radiation exposure of surrounding healthy tissue, thus reducing overall radiation exposure from the treatment.

A prototype of the ONYX radiation therapy facility was produced. This work forms part of a project to create a Russian radiation therapy facility. The project is aimed at developing the core of a competitive high-technology nuclear medicine industry based on radiation technology in the Russian Federation. The ONYX radiation therapy facility enables effective treatment of tumours regardless of their size and location.

ISOTOPE PRODUCTS

A positive opinion was obtained for designs and cost estimates for the establishment of a modern pharmaceutical enterprise at the Karpov Institute of Physical Chemistry to produce isotope products for medical applications. It will become the world's leading manufacturing enterprise producing a wide range of radiopharmaceuticals for the provision of high-technology medical assistance to cancer patients, as well as patients with rheumatic disorders, endocrine and heart diseases.

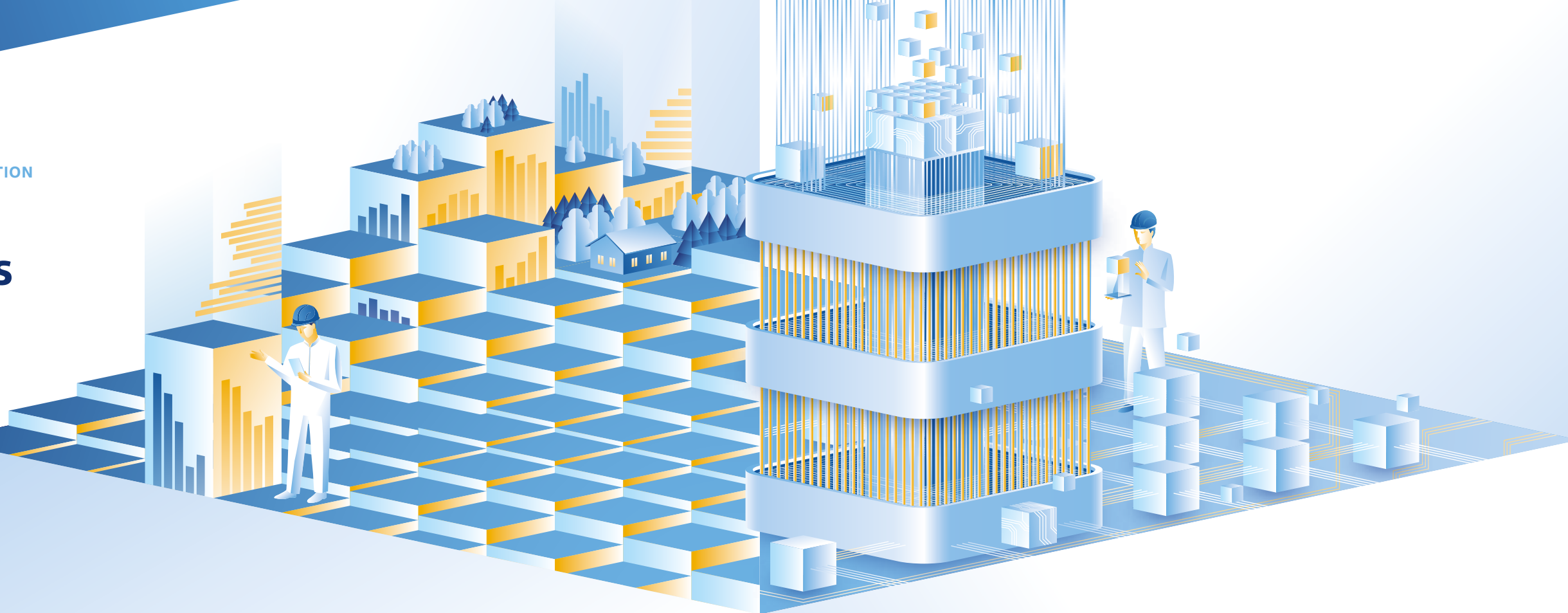
Russian nuclear medicine products are used in more than 50 countries worldwide. The scope of cooperation includes 10 areas, such as isotope products, healthcare services and equipment.

ASSISTANCE TO HEALTHCARE INSTITUTIONS

ROSATOM actively assists in enhancing the capabilities of healthcare institutions affiliated with the Russian Federal Biomedical Agency (FMBA) to prevent the spread of COVID-19. Hospital facilities have been upgraded; ventilators and diagnostic equipment have been purchased; oxygen and drugs have been supplied to ROSATOM's host towns and cities; systematic PCR testing has been arranged. Healthcare workers have been provided with personal protective equipment. To date, ROSATOM has provided assistance worth over RUB 2.6 billion.

DIGITAL TRANSFORMATION

Digital Products



QUANTUM COMPUTER

ROSATOM created a four-qubit quantum computer based on ytterbium ions. This is a real breakthrough marking significant progress in the development of a quantum computer. Researchers succeeded in developing a system comprising four qubits (basic units of quantum information) without increasing the number of ions. They achieved this by applying a proprietary technology for scaling up quantum processors using multilevel data storage media. Experiments demonstrated that this approach can improve the quality of implementation of quantum

algorithms. This is a major scientific breakthrough achieved by a joint team of researchers from the Russian Quantum Centre and the Lebedev Physical Institute of the Russian Academy of Sciences.

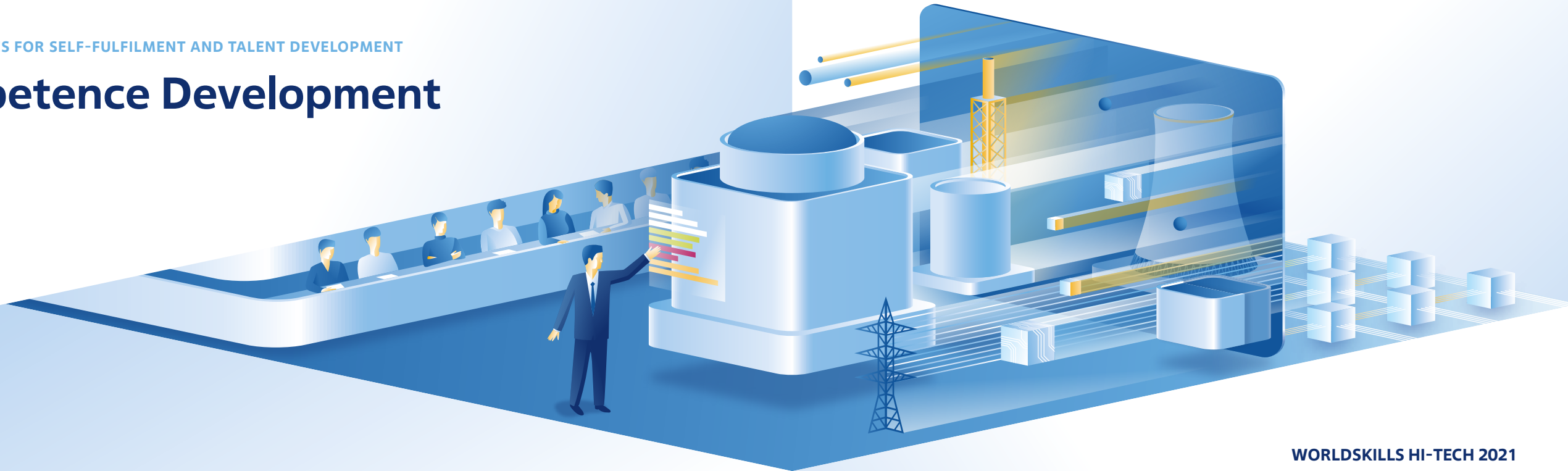
LOGOS PLATFORM

ROSATOM developed a digital platform for solving complex engineering problems and conducting multidisciplinary research. Logos Platform is a flagship digital product for engineering analysis and supercomputer simulation. It is a computing platform integrating various modules forming part of the Logos suite, as well as computer-aided engineering (CAE) software designed by a variety of Russian software developers.

LOGOS HYDROGEOLOGY

The new module is designed primarily for solving a wide range of hydrogeological problems in industry, including ensuring environmental safety of industrial facilities and managing the risk of emergencies. The new module is especially relevant as an environmental stewardship tool amid the evolving ESG agenda and the growing importance of environmental aspects for industrial development.

Competence Development



HIGHER EDUCATION

A programme was launched to establish a National Centre for Physics and Mathematics in Sarov. Moscow State University opened a branch in Sarov, which will form part of the National Centre. Youth laboratories were established and started operating; a research and development board was established; 50 students enrolled on Master's degree programmes. Thus, ROSATOM and the country's leading university are launching a joint local programme in nuclear towns and cities to train world-class researchers focusing on various disciplines, including theoretical physics and laser science, computational mathematics and supercomputers.

ROSATOM assists in providing training to foreign students at leading Russian universities forming part of the Consortium of Core Universities of ROSATOM. In 2021, more than 2,000 foreign students from 65 countries were studying nuclear and related disciplines at Russian universities. Every year, the Corporation's enterprises and resource centres organise internship for more than 500 foreign students.

The first overseas branch of National Research Nuclear University MEPhI (NRNU MEPhI) opened in 2019 in Tashkent continues to provide training in four disciplines: Nuclear Power Engineering and Thermal Physics; Nuclear Physics and Technology; Thermal Power Engineering and Thermal Physics; Electric Power Engineering and Electrical Engineering. Currently, there are 221 first-, second- and third-year students studying at the Tashkent Branch of NRNU MEPhI.

WORLD SKILLS HI-TECH 2021

More than 30,000 engineers and workers in the nuclear industry participate in the WorldSkills movement. In 2021, ROSATOM's team consistently topped the medal table of the 8th National Competition of Cross-Industry Skilled Professions for Workers in High-Technology Industries held in accordance with the WorldSkills methodology for the seventh time. The team members won a total of 34 awards: 21 golds, 9 silvers and four bronzes. This is the highest number of medals won in the competition. ROSATOM's team also won the top prize of the competition, the Master of Industry Development certificate from the Industry Development Fund, for the sixth time. This reflects the efficiency of the Corporation's personnel training system and the high level of professionalism of employees in the industry.

Contact Details and Useful Links

STATE ATOMIC ENERGY CORPORATION ROSATOM

Address: 24 Bolshaya Ordynka Street, Moscow, 119017

Multi-line telephone service: +7 (499) 949-45-35

Email: info@rosatom.ru

CONTACTS FOR THE MEDIA

Andrey Cheremisinov,

Director of the Communications Department

Tel.: +7 (499) 949-44-12, 949-46-34 (reception desk)

Email: press@rosatom.ru

CONTACTS FOR INVESTORS

Irina Danilova, Director for Treasury

Tel.: +7 (499) 949-29-79

Email: IIDanilova@rosatom.ru

OFFICIAL CORPORATE WEBSITE

<http://www.rosatom.com/>

OFFICIAL PUBLIC REPORTING PORTAL

<https://www.report.rosatom.ru>

OFFICIAL WEBSITE FOR PLACEMENT OF ORDERS FOR THE PROCUREMENT OF GOODS, WORK AND SERVICES FOR ROSATOM

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