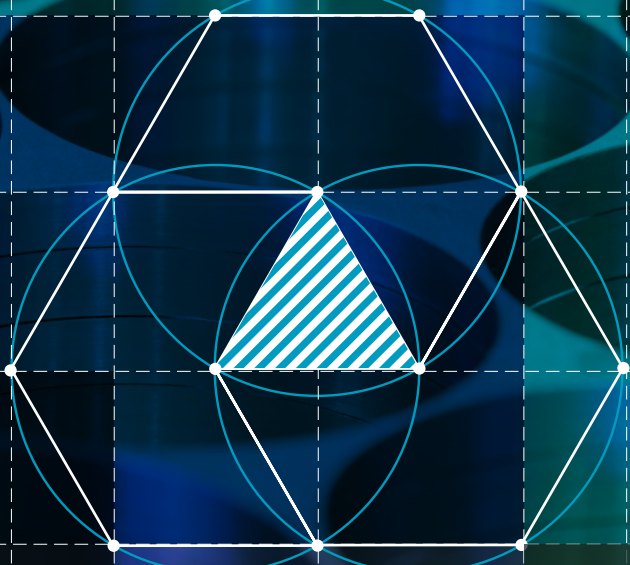
NEW BUSINESSES

TVEL.
NEW AREAS
OF BUSINESS



TVEL
ROSATOM

ABOUT THE COMPANY

TVEL, THE FUEL COMPANY OF ROSATOM, IS A LARGEST NUCLEAR FUEL PRODUCER OVER THE WORLD SHARE OF TVEL IN THE INTERNATIONAL FABRICATION MARKET IS 16%.

Every sixth reactor in the world operates with the fuel of TVEL. In addition, TVEL is the largest producer of enriched uranium product covering the demand of more than a third of the world market.

New areas of business activities became a promising vector in development of the Fuel Company. These activities are based on the state-of-the-art production capabilities, in-house research and development unit, wide range of the Company competences, high-qualified personnel, as well as successful experience in business.

In the purposes of maximally prompt implementation and manufacturing of new products the Fuel Company applies not only the in-house capabilities, but employs different forms of collaboration with the business and research institutions. To develop the new business the Fuel Company within its structure establishes the sectoral integrators, i.e. the specialized companies that coordinate the progression of a specific business.

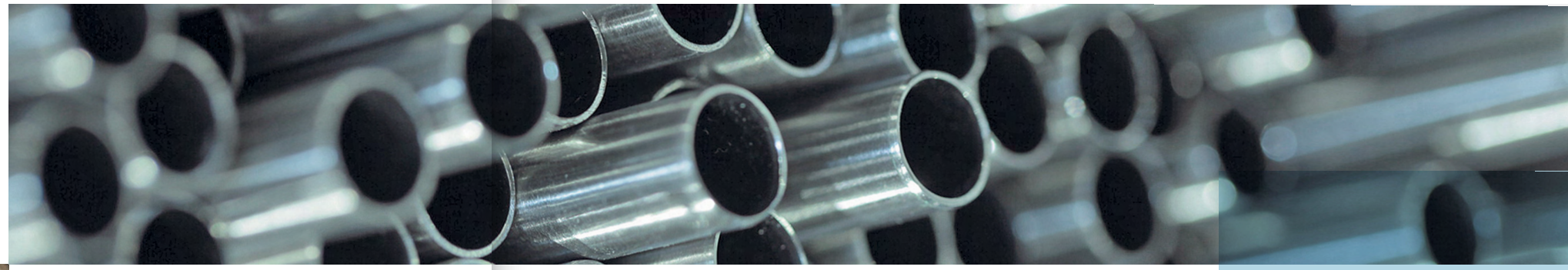
TVEL creates new businesses in high-tech industries responding to the demands and needs of the modern market in innovative products and technologies.

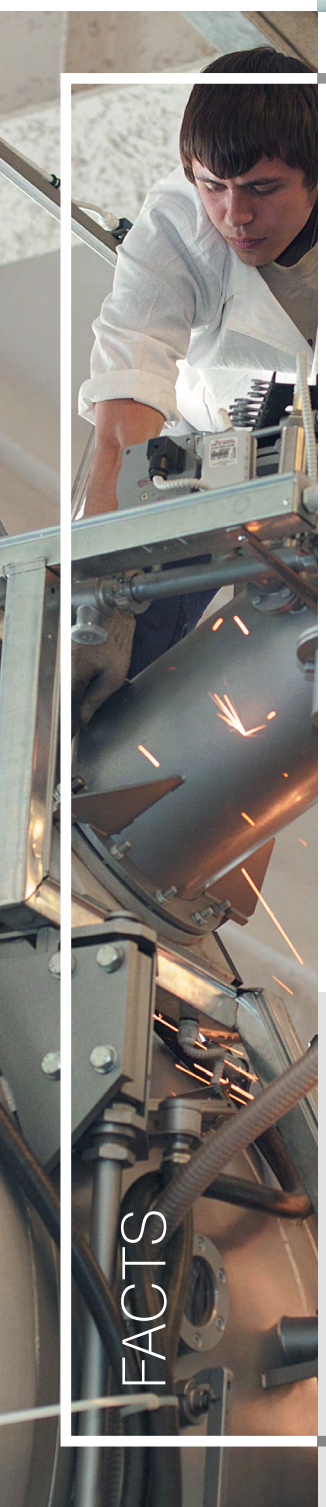
New business areas: metallurgy, and energy storage, chemical industry, and 3D-printing technology, digital technology.

Already today, the enterprises of the Fuel Division of Rosatom shape the future.

Fore more detailed and updated information, please visit the company website: **www.tvel.ru**

TVEL_Nuclear **Fuel Company “TVEL”**





FACTS

1

Industry Metallurgy Center was established on the basis of Chepetsk Mechanical Plant, the only Russian manufacturer of products made of zirconium and its alloys, high-purity metallic calcium and a wide range of metal products for high-tech industries.

2

Fuel Company TVEL is the supplier of superconducting materials for International Thermonuclear Experimental Reactor ITER and developer of superconducting line for a major international research project — Future Circular Collider implemented by the European Council for Nuclear Research (CERN).

3

The prospects for the development in the area of «Energy Storage» are associated not only with the modern production and technological base, but also with availability within the structure of the fuel company of the only manufacturer of lithium products in Russia — Novosibirsk Chemical Concentrates Plant.

4

The Fuel Company offers simulation and re-engineering services, BIM design of industrial sites, predictive analytics solutions for big data processing, robotics and intelligent data processing solutions, trusted network hardware manufacturing.

5

The Industry Integrator on “Additive technology” offers to the customers a full range of 3D printing works and services, ranging from production of printing powders to 3D printers, including software, delivery, and maintenance.

ADVANTAGES OF THE COMPANY

FUEL COMPANY TVEL CREATED A BUSINESS-ACCELERATOR INTENDED FOR EXPOTENTIAL REDUCTION OF DURABILITY FOR DEVELOPMENT OF PROJECTS AND BRINGING NEW PRODUCTS TO THE MARKET, FAST ESTABLISHMENT OF A SUSTAINABLE HIGH-TECH BUSINESS.

- Flexible customer-oriented approach
- More than 20 years of successful business experience
- Orientation to elaboration and promotion of demanded in the market promising high-tech, including digital, products
- Large range of incorporation formats and opportunities for collaboration: from industrial cooperation to business alliances
- Opportunities for involvement of investments
- Assistance in selection of the most promising projects and its rapid commercialization
- Incorporated powerful scientific and technological cluster that provides research and engineering development
- Availability within the structure of Fuel Company TVEL of production enterprises that posses the competence, technologies and equipment for manufacturing of products in a wide range of fields — from metallurgy and chemistry, to additive technologies, systems of electricity accumulation and digital products
- Support by regional authorities

BUSINESS-
PARTNERS

A MEANINGFUL TOOL FOR SCALING IN DEVELOPMENT OF NEW BUSINESSES BECAME THE INITIATIVE ON ESTABLISHMENT OF NEW BUSINESS-PARTNERSHIPS IN THE REGIONS OF FUEL COMPANY TVEL PRESENCE UNDER SUPPORT OF AUTHORITIES

Signature of road maps on business cooperation with the heads of the regions of the Fuel Company presence (Udmurt Republic, Vladimir, Tomsk, Irkutsk and Novosibirsk regions). Application of various cooperation formats: from industrial cooperation to business-alliances, implementation of the program for establishment of industrial-innovative clusters. Several dozens of promising projects are already in progress. Implementation of joint projects through integration of capabilities of the Fuel Company and regional scientific and production enterprises, so providing the most competitive integrated offer to the market.

NEW AREAS OF BUSINESS

TVEL CREATES NEW BUSINESSES IN HIGH-TECH INDUSTRIES RESPONDING TO THE DEMANDS AND NEEDS OF THE MODERN MARKET IN INNOVATIVE PRODUCTS AND TECHNOLOGIES

BUSINESS-
ACCELERATOR

THERE IS A BUSINESS-ACCELERATOR OPERATING WITHIN FUEL COMPANY TVEL THAT ENSURES THE DEVELOPMENT OF START-UPS AND NEW PROJECTS FROM IDEA TO INDUSTRIAL IMPLEMENTATION

This lays the foundation for the dynamic growth of new businesses. In addition to financing, the project teams in the business accelerator receive the qualified consulting and recommendations from the market experts.

The business accelerator format is one of the modern tools of venture corporate investment, which the world's leading industrial companies are increasingly using to finance the new developments. The accelerators are built on the principle of a «funnel»: from the total number of applications submitted, on average, less than half go through the incubation stage (idea development), then follow the verification of the selected proposals in the simulation mode, as well as verification by potential customers. In case of successful passage of all stages the company performs the funding of the investment project.

CRITERIA FOR SELECTION OF NEW BUSINESS AREAS

High-tech products that are in demand in the Russian market and possessing an export potential

Opportunity of using the business-accelerator for fast establishment of sustainable high-tech businesses

Opportunities for involvement of investments

ADDITIVE TECHNOLOGIES

ENERGY STORAGE DEVICES

METALLURGY AND SUPERCONDUCTING MATERIALS

SPECIAL CHEMISTRY

MACHINE-BUILDING

DIGITAL TECHNOLOGY

METALLURGY AND SUPERCONDUCTING MATERIALS

FUEL COMPANY TVEL INCORPORATES A METALLURGICAL PRODUCTION PLANT SPECIALIZED IN MANUFACTURING OF FINISHED PRODUCTS FROM ZIRCONIUM, TITANIUM, CALCIUM, HAFNIUM AND NIOBIUM FOR HIGH-TECH INDUSTRIES.

JSC Chepetsk Mechanical Plant (JSC CMP) is a modern metallurgical facility of full production cycle within the structure of Fuel Company TVEL. Possessing the unique scientific and technological competence, as well as highly qualified personnel

Fuel Company TVEL promptly responds and meets the needs of the customers from various industries in production of serial and new product ranges of extremely high quality. JSC CMP is the only in Russia manufacturer of products from zirconium and its alloys, especially pure metallic calcium, and calcium injection wire.

Zirconium

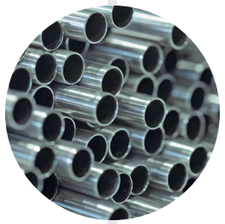
JSC CHMZ is the world leader and the only full-cycle producer of zirconium in Russia — from processing of ore concentrate to finished products from zirconium alloys. Zirconium is widely used in nuclear industry for fabrication of claddings for nuclear fuel elements, as an alloying element in the color and special metallurgy, thermal barrier coatings in production of aviation and aerospace equipment, power plants, technical ceramics. Zirconium is specified with high resistance to biological environments, so it is also used for production of bone, joint and dental prostheses, surgical instrument.

Titanium

Having the modern titanium production from smelleding the ingots to manufacturing of finished products, the enterprise mastered the production of a wide range of titanium rolling for companies in nuclear power, chemical, oil and gas, shipbuilding and medical industries, as well as complex alloys for aerospace industry. The basis and pride of the titanium direction in Fuel Company TVEL is the only in Russia production of seamless titanium pipes of a diameter from 3,0 mm to 325 mm. The production facilities are capable to produce more than 500 tons of finished titanium products per year.

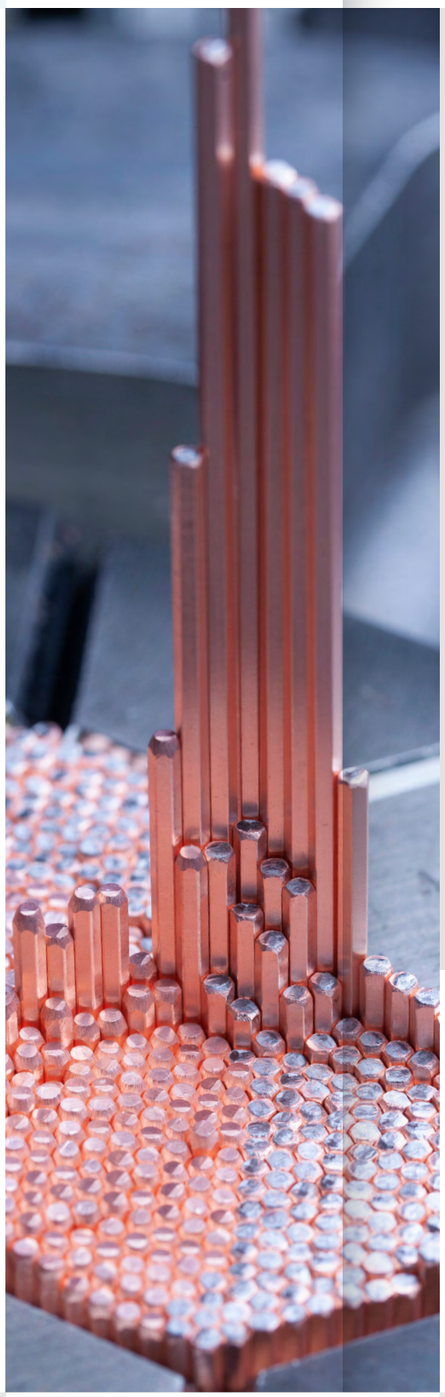
Calcium

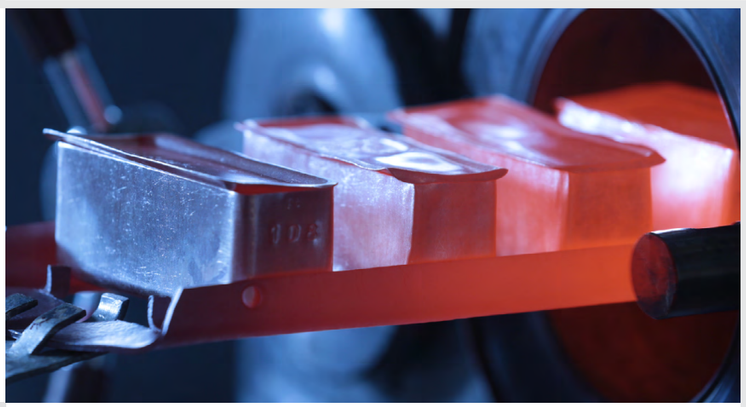
Fuel Company TVEL is only in Russia producer of metal calcium and calcium alloys, as well as calcium injection wire for furnace steel processing. This wire is used by ferrous metallurgy enterprises for refining the metallurgical melts in order to improve the technological properties of steel and improvement of consumer characteristics of finished metal products. Metal calcium is indispensable in the ferrous and non-ferrous metallurgy, as well as in the nuclear industry. Calcium injection wire (CIW) is produced under the brand «HighMet».



Hafnium

In 2018, Fuel Company TVEL established the only industrial site of metal hafnium production in Russia. Hafnium is indispensable in the nuclear industry, in the production of special refractory alloys for aerospace and powerful magnets, and it is also used as a dielectric in microelectronics.





TECHNOLOGY

- Electrolytic recovery of metals in salt melts
- Extraction of metals from solutions
- Extraction of raw material from acids, alkalies and melts
- Pyrometallurgical recovery of metals
- Powder metallurgy
- Granulation of melts
- Iodide refining of metals
- Remelting of refractory metals in vacuum-arc and electron-beam furnaces

Superconducting materials (SCM) and niobium

JSC VNIINM, a subsidiary of Fuel Company TVEL, is the only in Russia developer of structures and technologies for production of technical superconducting wires, and another subsidiary of TVEL, JSC CHMZ, is the only one in Russia industrial producer of low-temperature superconductors. 56000 km of CIW-wire was supplied along with deployment of manufacturing of products made of niobium and its alloys of high purity within the framework the project on construction of International Thermonuclear Experimental Reactor (ITER). Today, the powerful material and technical base for the development and industrial production of CIW established in VNIINM and CMP allows to quickly master the production of the wire for medical scanners, high-speed lines, superconducting materials. The wires are supplied to national and foreign manufacturers of superconducting equipment.

Nanostructured conductors

The unique combination of high strength, electric conductivity, resilience to external impacts allows to include the nanostructured conductors based on CuNb alloy to a new generation of cable products. This innovative technology has the prospects of application for production of many types of high-tech equipment and industrial systems, including high-field pulse magnets for scientific research, contact networks for high-speed railway transport, aerospace and military equipment, nuclear power equipment.

FUEL COMPANY TVEL IS CERTIFIED FOR WORK WITH SPECIAL ALLOYS AND SUCH REFRACTORY METALS AS ZIRCONIUM, TITANIUM, NIOBIUM, HAFNIUM, ETC.

The technologies allow to produce high-purity metals and alloys with unique physical and chemical properties, the metal rolling products that meet the high demands on geometric parameters and surface quality.

- SHIPMENT OF MORE THAN 220 TONS OF SUPERCONDUCTING NBTI AND NB3SN SRENDOS FOR MAGNETIC SYSTEM OF ITER
- PILOT DELIVERY OF HIGH-SPEED LINES TO RUSSIAN RAILWAYS TESTING SITE
- SUCCESSFUL ACCEPTANCE TESTS IN CERN OF QUALIFICATION BATCH OF SUPERCONDUCTING NB3SN WIRE PRODUCED IN ACCORDANCE WITH «INTERNAL TIN SOURCE» METHOD FOR HL-LHC PROJECT
- CAPACITY OF TITANIUM PRODUCTION EXCEEDS 500 TONS PER YEAR
- TVEL ANNUALLY SUPPLIES TO CONSUMERS MORE THAN 5 400 TONS OF CALCIUM INJECTION WIRE, INCLUDING FOR EXPORT

SPECIAL CHEMISTRY

CHEMICAL PRODUCTION FACILITIES OF FUEL COMPANY TVEL ALLOW TO FABRICATE THE HIGHLY PURIFIED METALS AND MATERIALS, COMPLEX CHEMICAL COMPOUNDS APPLICABLE IN VARIOUS INDUSTRIES, MEDICINE, AGRICULTURE, AS WELL AS IN SCIENTIFIC RESEARCH

The enterprises apply the unique technology for production of chemical elements and compounds by gas centrifuge separation method, electrolysis, extraction, distillation, recrystallization, ion exchange and other modern state-of-the-art methods.

The target portfolio of TVEL chemical products consists of several key products:

Lithium products

Fuel Company TVEL is the only in Russia producer of metal lithium, chloride and lithium hydride, as well as lithium — 7 monohydrate hydroxide.

Lithium alloys and compounds are applied in production of glass and ceramics, protective coatings, lubricants. It is used in nuclear power, medicine, metallurgy and many other industrial sectors. Metal lithium and a lithium compound are essential components of modern chemical energy storage systems: lithium-ion batteries for automobiles and electronics, and primary lithium batteries.

Autocatalysts

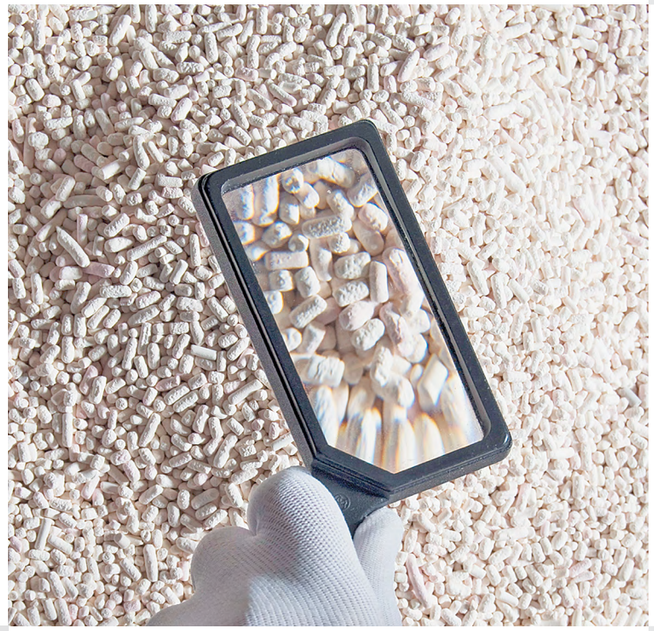
Fuel Company TVEL is a leading Russian producer of automobile and motor transport catalysts with a full technological cycle: from development to serial production.

The catalysts produced by Fuel Company TVEL:

- applied for vehicles equipped with petrol, diesel and gas engines of different capacity corresponding to international standards Euro 3 Euro 4, Euro 5, Euro 5+, Euro 6;
- installed in vehicles produced in the territory of the Russian Federation by corporations «Auto-VAZ», «RENAULT-NISSAN», «DATSUN», «SOLLERS»;
- installed in the exhaust system of AURUS cars, developed in accordance with «CORTEGE» project for transportation and escort of the top public officials

Titanium dioxide

Fuel Company TVEL is developing a new green technology for production of titanium dioxide based on fluorine technology. The start of industrial production is scheduled for 2022. Titanium dioxide is the most common white pigment and widely used in the production of paints and varnishes, paper, plastics, food and cosmetics.



TECHNOLOGY

- Gas-centrifuge isotope separation method
- Methods of chemical purification: gas-centrifuge, rectification, crystallization
- Technologies of chemical synthesis, industrial electrolysis
- High competence in chemistry of fluorine and its compounds
- Global leadership in separation and purification of stable isotopes
- Development and production of catalysts for various processes
- Development and production of converters, automobile catalysts and catalytic manifolds

Stable isotopes

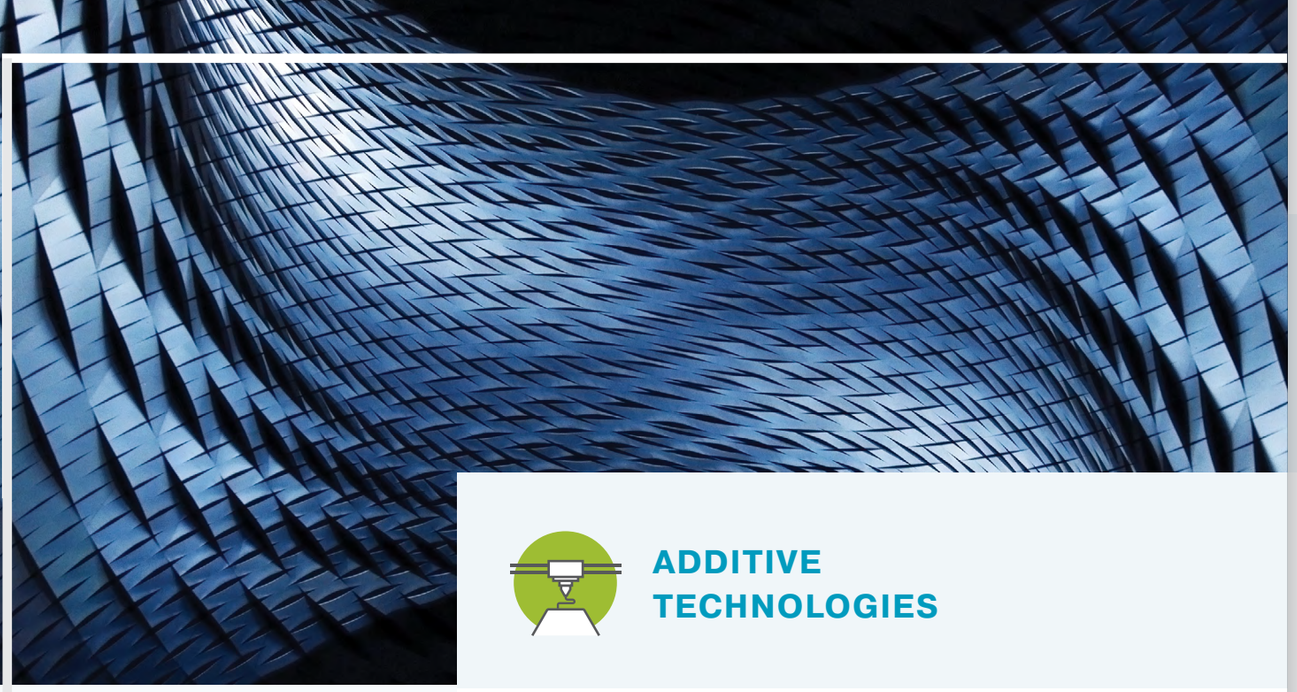
TVEL enterprises possess the technologies for fabrication of over 100 stable isotopes, the production scope attains hundreds of kilograms per year and makes up about half of the world market. TVEL produces 107 isotopes of 21 chemical elements: AR, B, W, GE, Fe, IR, CD, Si, KR, XE, Mo, Ni, Sn, OS, Pb, SE, S, Te, C, Cr, Zn, as well as radioactive isotopes: iron, krypton, carbon. Isotopic products are used in various fields, including nuclear energy, medicine and electronics, research on general chemistry, physics, biotechnology, meteorology, agrochemicals, and other areas of scientific research.

Fluorine products

Fuel Company TVEL is a leading manufacturer of fluorine products in Russia.

Hydrogen fluoride and hydrofluoric acid are valuable chemical products used in production of primary aluminum, electrochemical treatment of stainless steels and alloys, glass etching, in oil and gas industry for well treatment, in chemical and nuclear industries.

Lithium-fluorinated salts, as a component of an electrolyte, play a key role in lithium-ion batteries, acting as a carrier of lithium ions between the cathode and the anode. Lithium salt of hydrofluoric acid, lithium fluoride, is used as a material for production of optical lenses and prisms, as an additive to aluminum-electrolysis alloys, as flux in production of glass, ceramics and enamels, during welding and soldering.



ADDITIVE TECHNOLOGIES

An industry integrator in the area of «Additive Technologies» has been established on the basis of Fuel Company TVEL, it consolidates the efforts of the companies within the industry in the area of the additive technologies. LLC Rusatom — Additive Technologies (RusAT) possesses the production assets, highly qualified personnel and advanced developments in the field of additive technologies. The company is engaged in design development and production of 3D-printers, additive powders, components, software, as well as renders the services for 3D-printing.

THE COMPANY-INTEGRATOR CTRATED:

- Industrial production of metal 3D printers with construction area from 75 mm to 600 mm using SLM technology in printing;
- Package of dedicated 3D printer software;
- Software package «Virtual 3D-printer»;
- Production of metal powders for 3D printing;
- Fabrication of 3D printing products, including those for health care, nuclear and aerospace industries;
- Additive technology center for demonstration of the additive production capabilities.

Additive technologies are specified with a number of undeniable advantages: they allow to fabricate the products of the most complex forms unachievable with application of mechanical processing or casting. In addition, three-dimensional printing enables to significantly reduce the element weight and production durability. Modern 3D-printers are capable to be quickly re-adjusted in terms of the print settings for fabrication of products of various purposes and dimensions, single or mass production.

- THE MULTI-POWDER 3D PRINTING TECHNOLOGY IS UNRIVALED THROUGHOUT THE WORLD (3D PRINTER ALLOWS TO OPERATE TWO METAL POWDERS WITH TWO LASERS)
- COST IS 20% LOWER THAN EXISTING EQUIVALENTS
- SOFTWARE PACKAGE «3D-PRINTER» ALLOWS TO SIMULATE THE 3D PRINTING PROCESS AND OBTAIN VIRTUAL MODELS OF THE FINAL PRODUCT BASED ON INFORMATION ON THE PRODUCT (PHOTO/3D-MODEL) RECEIVED FROM THE CUSTOMER TAKING INTO ACCOUNT THE PECULIARITIES OF SELECTED EQUIPMENT AND MODES OF ITS OPERATION.

The activities on establishment of Engineering Center of Additive Technologies have been deployed on the territory of JSC Moscow Plant of Polymetals (s subsidiary of Fuel Company TVEL), where created the demonstration site for development of the technology and rendering of 3D-printing services.

Similar centers are planned to be established in Novouralsk and Sarov.

APPLICATION

From nuclear and aerospace technology to health care

ENERGY STORAGE

Lithium-ion battery-based energy storage is a promising business area referred to the next generation of energy, electrical and transportation technologies.

An industry integrator in the area of energy storage systems has been established on the basis of enterprises incorporated within Fuel Company TVEL, this company is LLC Cathode Materials. Currently, the production facilities are concentrated at two enterprises of Rosatom Fuel Division:: LLC NPO Centrotekh in Novouralsk (Sverdlovsk region) and on the territory of Novosibirsk Chemical Concentrates Plant (PJSC NZHK), the largest producer and exporter of lithium products in Russia. Lithium-ion batteries do not require maintenance and special charging rooms. They are specified with such advantages as high energy density, unavailability of memory effect and long service life. Lithium-ion storage systems are capable to significantly reduce the equipment costs and improve the equipment efficiency.

Availability of corporate R&D center allows to develop both model systems and customized tailor-made integrated solutions. The team supports the project from R&D to production, renders the maintenance services. The integrator has a track record of dozens of implemented projects, the development of solutions with a single capacity of up to 1 MW is in progress.

- ENERGY STORAGE SYSTEMS ARE APPLIED IN PASSENGER, LOGISTICS, SITE-INTERNAL ELECTRIC TRANSPORT,
- IN EMERGENCY AND UNINTERRUPTIBLE POWER SYSTEMS, GRID PEAK MANAGEMENT SOLUTIONS, HYBRID SYSTEMS,
- GROWING DEMAND FOR PRICE-DEPENDENT ELECTRICITY CONSUMPTION SYSTEMS

Rendering of an integrated service on assessment of economic feasibility for replacement of traditional solutions with storage systems based on lithium-ion batteries and subsequent upgrading of existing customer equipment is assigned in a separate area of activities.

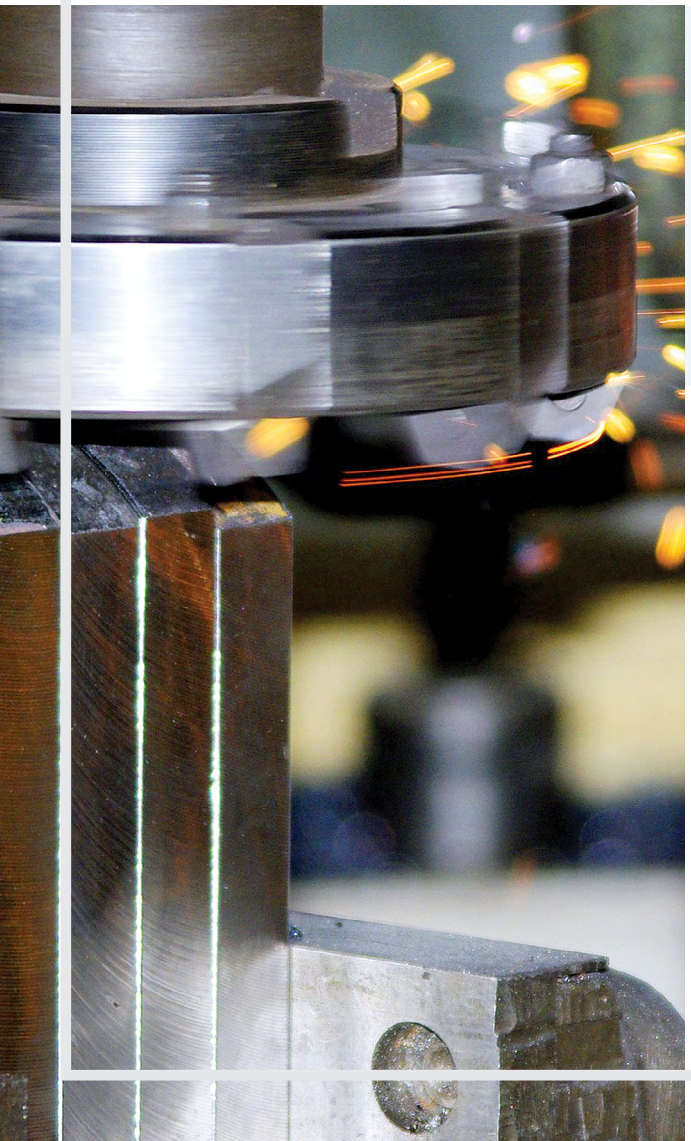
The available competencies allow to design and produce various types of energy storage systems for completely different applications and industries.

PRODUCTS

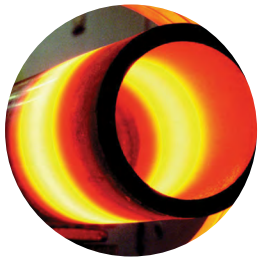
- Active materials for lithium-ion batteries;
- Stationary energy storage systems (to provide the electricity supply for remote and isolated regions, energy infrastructure facilities, uninterruptible supply sources);
- Electric energy storage systems for internal industrial site and logistics electric transport;
- Electric energy storage systems for passenger electric vehicles.

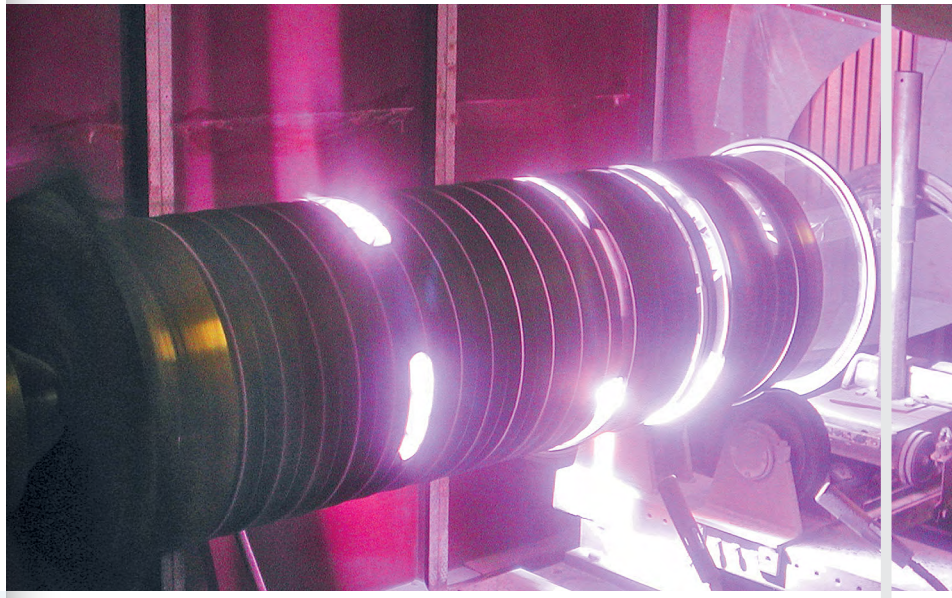
MACHINE-BUILDING

MACHINE-BUILDING SECTOR OF FUEL COMPANY TVEL IS PROVIDED WITH LARGE PARK OF METAL-PROCESSING, GALVANIC, WELDING AND OTHER EQUIPMENT FROM LEADING INTERNATIONAL MANUFACTURERS



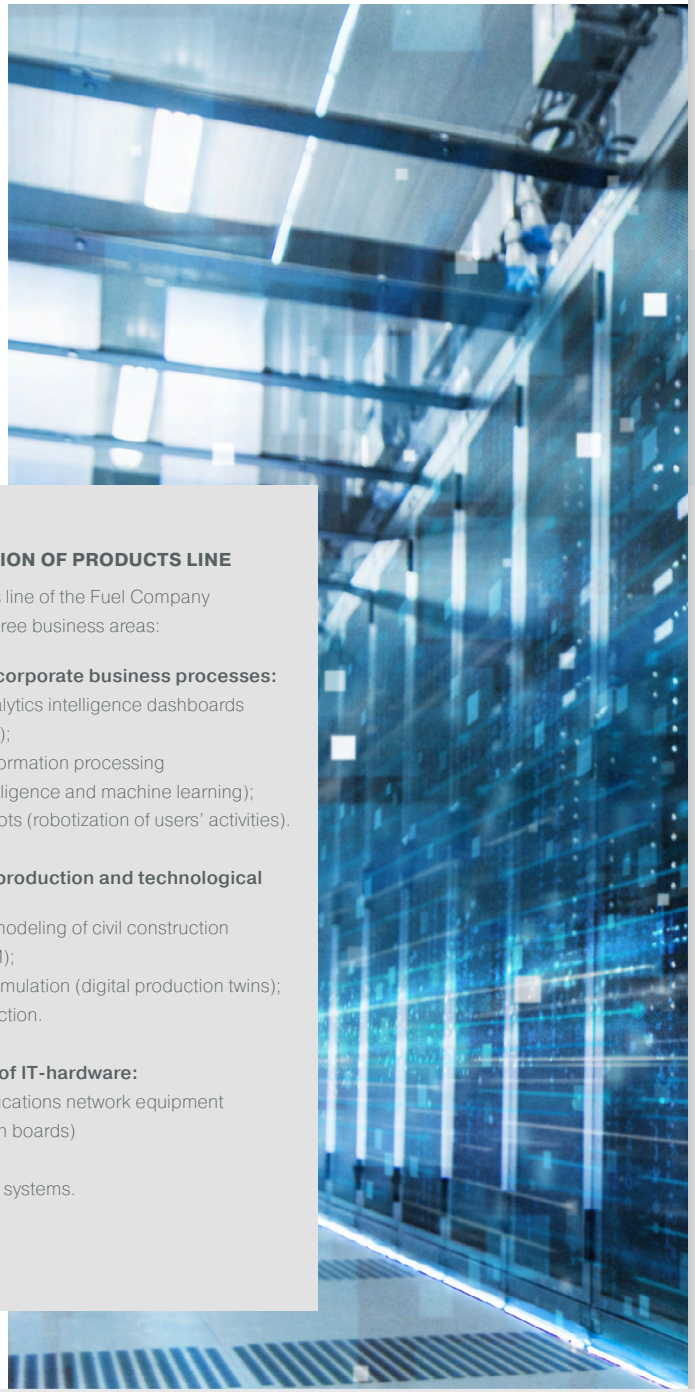
The Company has put into operation the state-of-the-art processing centers, CNC machines, equipment for hydroabrasive, plasma and laser cutting, 5-coordinate machines for tooling production, spring-infused equipment, etc. A wide range of equipment allows to perform all necessary range of works: preparatory, casting, machine works, welding, heat treatment, electroceramics, heating equipment, galvanic coating, forging-pressing, humming and lining, etc.





FUEL COMPANY TVEL FOUND A NEW APPLICATION OF GAS-CENTRIFUGE URANIUM ENRICHMENT TECHNOLOGY

The unique developments laid in the basis of the gas-centrifuge operation are capable to be used in other industries, including those for production of import-substitution products of general-industry purposes. The capabilities of the companies incorporated within Fuel Company TVEL allow on the basis of the new technological level engineering developments to find the solutions addressing the technological challenges for a company of the fuel and energy sector.



DIGITAL TECHNOLOGY

FUEL COMPANY TVEL WIDELY APPLIES THE STATE-OF-THE-ART DIGITAL TOOLS THE COMPANY HAS APPROVED A DIGITIZATION STRATEGY, WHICH ENVISAGES THE IMPLEMENTATION OF MORE THAN A HUNDRED IT-PROJECTS

The focal point in the strategy belongs to the projects that promote the digitalization of production processes. The goal is to create a united digital ecosystem, where interact all participants in the production cycle of the Fuel Company.

An important area of the digital strategy is the development of the product lifecycle management, application of the engineering design systems, and simulation technologies for elaboration of digital design twins and conduct of virtual product tests in the purposes of significant reduction of the research and development durability and achievement of competitive advantage of future products on this basis. The Fuel Company is actively involved in implementation of breakthrough technologies.

The company implements the projects in the field of artificial intelligence and robotization of the activities, it is starting the implementation of the project «Digital Assistant», development of use of big data and predictive analytics for production processes.

To achieve the maximum efficiency, along with the internal digitization strategy, the Fuel Company has approved a strategy for the development of information technologies in product lines, which will allow to create the profitable business through new solutions and developments in the field of information technologies.

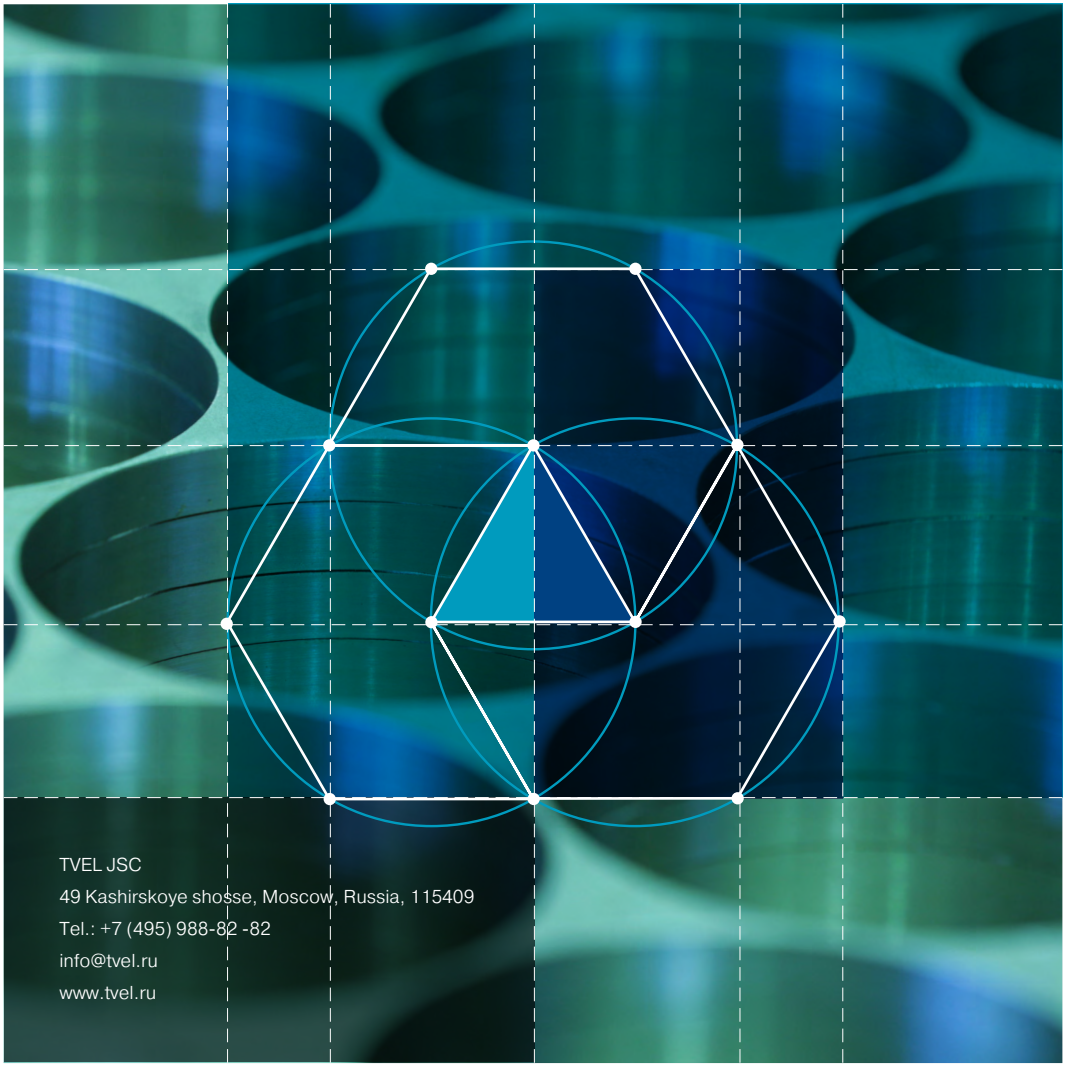
COMPOSITION OF PRODUCTS LINE

The products line of the Fuel Company consists of three business areas:

- **Support to corporate business processes:**
  Business analytics intelligence dashboards (Dashboards);
  Intelligent information processing (artificial intelligence and machine learning);
  Software robots (robotization of users' activities).

- **Support to production and technological processes:**
  Information modeling of civil construction projects (BIM);
  Production simulation (digital production twins);
  Digital production.

- **Production of IT-hardware:**
  Telecommunications network equipment (commutation boards)
  Servers;
  Data storage systems.



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