



REFRESH

NEWSLETTER

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cheaper production of pharmaceuticals
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Humanoid robot opens new
directions for research and education



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We demonstrate that the region's transformation is driven by a wide range of specific activities that complement and reinforce one another.

Dear REFRESH friends,

Time has flown by, and we are pleased to bring you another issue of our newsletter, covering recent developments, outputs, and achievements of the project. REFRESH has now entered its second half, and I am deeply honored to announce that it passed the mid-term evaluation with flying colors. The project was designated as exemplary and recognized for its multiplier effect and potential for further development. We see this as confirmation that a path built on connecting research, education, business, and the public sector makes sense and delivers tangible results.

Every project can be described in numbers: the number of publications, new jobs created, the volume of collaboration with companies, or success in attracting talent. These indicators will not be missing from this issue either, because we certainly have much to be proud of and, in many areas, we have been exceeding our planned targets for quite some time. However, as I have repeatedly emphasized, there is something even more important behind these results. It is the people, new ideas, and partnerships that have the potential to transform the Moravian-Silesian Region in the long term.

On the following pages, you will find just a few of the many examples of how this collaboration is brought to life. From regular engagement with industry and the arrival of top-tier researchers from around the world to the strengthening of the international dimension of our laboratories and new research findings addressing today's technological, environmental, and social challenges. Together, they demonstrate that the region's transfor-

mation is driven by a wide range of specific activities that complement and reinforce one another.

If I were to highlight one article in particular, I would like to draw your attention to the interview with Radomír Smolka, a member of the Tatra Trucks Board of Directors responsible for research and development. It offers a valuable perspective from an industry partner on the importance of linking the academic and applied research communities, a principle that lies at the heart of REFRESH.

It is precisely this ability to connect disciplines, institutions, experience, and people that we consider a key prerequisite for the future competitiveness of our region. We believe that the partnerships established through the project will continue long after it has ended.

My thanks go to everyone who is part of this change – the researchers, students, and partners who move the project forward every day.

Have an inspiring read.

Igor Ivan
Director of REFRESH
and Rector of VŠB-TUO

REFRESH - indicators

goals × current standing

**CZK
450m**

Total revenue from collaboration with companies during the project

50

Projects co-developed with the public administration

**CZK
412m**

Total revenue from collaboration with companies during the project

143

Projects co-developed with the public administration

15

Project applications submitted under European grant schemes

10

Excellent researchers (ERC laureates, H2020 project investigators, Highly Cited Res.)

450

Publications in IF journals

53

Excellent researchers (ERC laureates, H2020 project investigators, Highly Cited Res.)

1527

Publications in IF journals

29

28 funded

Project applications submitted under European grant schemes

**106
FTE**

New jobs in R&D

15

Filed patent applications

**100
FTE**

59% from foreign countries

New jobs in R&D

9

Filed patent applications

The project receives exemplary rating in the mid-term evaluation

Two years after securing funding from the Operational Programme Just Transition, REFRESH has reached another important milestone. The project team and partners came together not only to mark this anniversary, but also to celebrate the excellent results of the project's mid-term evaluation. Alongside networking activities, the meeting provided an opportunity to reflect on the achievements delivered so far.

"The project was assessed as refreshing (true to its name) and exemplary. It demonstrates a strong multiplier effect and significant potential for securing additional long-term funding," the evaluation report notes.

According to REFRESH Director and Rector of VŠB-TUO, Igor Ivan, the project's outcomes are already helping address key challenges faced not only by the Moravian-Silesian Region. These include the transition from fossil fuels to low-carbon energy sources, the growing need for robotization and digitalization across industry, and the development of new materials based on more affordable, sustainable, and geopolitically accessible resources.

REFRESH aims to build a robust innovation ecosystem in the Moravian-Silesian Region, with a strong focus on attracting talent and developing four specialized living labs. Supported by a CZK 2.5 billion grant from Operational Programme Just Transition, it is the largest project in the history of VŠB-TUO. It is implemented in cooperation with the University of Ostrava and other project partners.



Simrjit Singh



At the Materials & Environment Lab, Simrjit Singh focuses on developing highly efficient monolithic photoelectrochemical devices and modules for next-generation solar hydrogen production technologies. His research employs 2D and 3D materials with tunable functional properties and incorporates emerging concepts such as electric and spin polarization to improve catalytic performance and overall device efficiency. Positioned at the intersection of materials science, nanotechnology, device physics, and electrochemistry, his work is aimed at advancing materials and devices for sustainable energy systems and optoelectronic applications.

Dr. Singh has gained extensive international research experience at leading institutions worldwide, including the University of New South Wales in Australia, the University of Pennsylvania, and Eindhoven University of Technology. He played a pivotal role in uncovering the mechanism of magnetically tunable photocurrents and introduced a novel phenomenon known as the magneto-photofrionic effect. He has authored more than 40 peer-reviewed publications that have received over 3,000 citations, holds two patents, and has delivered numerous invited lectures at international conferences and seminars. He also serves as a reviewer for several high-impact scientific journals and as a grant evaluator for the Netherlands Research Council.

Simrjit Singh has served as principal investigator on prestigious research projects funded by programs such as Horizon Europe and the United States-India Educational Foundation. He has also received several distinguished fellowships, including the Marie Skłodowska-Curie Research Fellowship, the Fulbright-Nehru Postdoctoral Research Fellowship, and INSPIRE Faculty Research Fellowship.

Seung Yeop Yi



His research examines carbon-based single-atom catalysts, metal and oxide nanostructures, and alloy systems. In addition to electrocatalysis, he has contributed to the development of materials for battery electrodes and explored single-atom nanozyme systems for cancer therapy and chemical sensing applications.

He is a postdoctoral researcher at VŠB-TUO. At the Materials & Environment Lab, he develops and investigates novel catalytic architectures for a range of electrocatalytic reactions. His work is primarily aimed at tailoring electronic structures and

engineering interfaces to enhance reaction kinetics and improve material stability.

Dr. Seung Yeop Yi comes from South Korea, where he obtained his master's degree from Korea University before earning a Ph.D. in chemical and biomolecular engineering from the Korea Advanced Institute of Science and Technology (KAIST). Under the supervision of Professor Jinwoo Lee, his doctoral research focused on the rational design of electrocatalysts through the tuning of geometric and electronic structures for low-temperature energy conversion technologies, including fuel cells and water electrolyzers. He has published his research in leading journals, including *Advanced Materials*, *Small*, and *Chem*.

Ulrich Rde



Expert in applied mathematics, computer science, numerical simulation, fluid dynamics, and high-performance computing (HPC), Rde contributes to research activities within REFRESH's Industry 4.0 & Automotive Lab. Together with his research team, he focuses on leveraging advanced computing technologies, including GPU-accelerated systems, to solve complex problems in the physical sciences.

His involvement in REFRESH builds on more than ten years of collaboration with the Department of Applied Mathematics at the Faculty of Electrical Engineering and Computer Science of VSB-TUO. Over the years, they have jointly developed and participated in several European research initiatives, including Extreme Scale Computational Models of Granular Systems, Extreme Scale Solvers for Multi-Mechanics Problems, and Scalable Expert System for Computational Contact Mechanics in Crash Simulations.

Rde served for many years as Professor of Computational Science and Engineering at Friedrich-Alexander University (FAU) Erlangen-Nuremberg in Germany. He also headed the Parallel Algorithms Team at the Centre Europen de Recherche et Formation Avance en Calcul Scientifique (CERFACS). In addition, he serves as Editor-in-Chief of SIAM Journal on Scientific Computing and is a member of the editorial boards of the International Journal of Parallel and Emergent Distributed Systems, the International Journal of Computational Science and Engineering, and Elsevier's Journal of Computational Science.

Professor Rde has authored or co-authored more than 670 publications, which have received over 8,959 citations, and has been honored with numerous awards and recognitions throughout his career.

Olena Okhay



Olena Okhay is a materials scientist specializing in microelectronics, semiconductor devices, thin films, carbon-based materials, sensors, layered ceramic materials, and functional materials for energy applications. Within REFRESH at the Energy Lab, she investigates advanced layered ceramic materials for supercapacitors. Her research involves the characterization of key electrical properties and in situ structural analysis using X-ray diffraction, enabling the correlation of charge-storage performance with phase stability and the structural evolution of materials.

She graduated in 1999 from the National Technical University of Ukraine with a degree in Microelectronics and Semiconductor Devices, where she conducted research on high-temperature superconducting thin films prepared using pulsed laser deposition and lift-off lithography. In 2009, she obtained her Ph.D. in Materials Engineering from the University of Aveiro in Portugal, where her work focused on strontium titanate-based films for tunable electronic applications.

Dr. Okhay also worked as a researcher at TEMA - Centre for Mechanical Technology and Automation at the University of Aveiro, Portugal. There, she contributed to projects involving smart-home technologies, nanopyzoelectric generators, semiconductor batteries, carbon-based sensors, and ferroelectric and thermoelectric materials. She currently serves as a visiting professor at the Technical University of Sofia in Bulgaria. She is the author of 50 publications and four book chapters, and has also acted as a guest editor and reviewer for a range of international academic journals.

Petr Kupka



The Vice Dean for Research and Development at the Faculty of Social Studies, University of Ostrava, Petr Kupka specializes in the study of urban marginality, informality, organized crime, and crime control. He examines these issues through an ethnographic and interdisciplinary lens, drawing on insights from anthropology, history, criminology, political science, and sociology.

He obtained his Ph.D. at the Department of Political Science, Faculty of Social Studies, Masaryk University in Brno, and later worked at the Faculty of Arts, University of

West Bohemia in Pilsen. Since 2020, he has been affiliated with the University of Ostrava. Together with his colleagues, he co-founded the master's programme in Social Work and Criminology, distinguished by both its focus and breadth. His long-term ambition is to build a criminological hub of regional importance at the Faculty of Social Studies.

Within REFRESH, his research focuses primarily on housing exploitation and crime control in socially excluded localities across the Czech Republic. He is also currently involved in projects exploring the autobiographical narratives of individuals convicted of different types of criminal offenses, as well as the transformation of private entrepreneurship in the Czech Republic during the transition period of the 1980s and 1990s. Since 2022, he has been a member of the board of the Czech Society of Criminology.

Alice Gojová



Associate Professor Alice Gojová has long devoted her research to social exclusion, community work, and participatory approaches that connect academic inquiry with the practical needs of individuals and communities. Her work explores how public institutions, experts, and local residents can collaborate in developing effective and sustainable responses to social challenges.

Within the REFRESH's Social Lab, she contributes to research on social cohesion, residential segregation, and the effects of regional transformation on everyday life. A

central principle of her work is that people most directly affected by social change should actively participate in shaping solutions rather than merely receiving them. Her research, therefore, brings together the perspectives of communities, professionals, and institutions while seeking to bridge the divide between academia, public administration, and real-world implementation.

She currently serves as Dean of the Faculty of Social Studies at the University of Ostrava. She earned her Ph.D. from Trnava University and completed her habilitation at the University of Ostrava in 2015. Alongside her research activities, she has been actively involved in the education and training of future social workers for many years.

Munish Kumar Gupta



Research on sustainable and energy-efficient production systems, additive manufacturing technologies, and advanced modeling and simulation techniques form the core domain of researcher Munish Kumar Gupta. His work focuses primarily on optimizing manufacturing processes, lowering energy usage and environmental impact, and applying data-driven approaches to contemporary industrial applications. A unifying thread of his research is the drive to translate findings into real-world applications.

Within Industry 4.0 & Automotive Lab, he focuses primarily on applying simulation and optimization techniques, implementing Industry 4.0 concepts, and developing sustainable, energy-efficient manufacturing solutions for the automotive sector and related industries. Its objective is to enhance process efficiency, minimize energy use and environmental impacts, and enable data-driven decision-making in advanced manufacturing environments. Among the most notable outcomes of REFRESH so far are advances in the modeling and simulation of manufacturing processes, innovative approaches to assessing energy efficiency and sustainability, and the optimization of process parameters in additive manufacturing, machining, and metal casting.

His research integrates advanced simulation and optimization techniques, artificial intelligence, and machine learning with specific practical needs. Over the course of his career, he has held positions at universities in Greece, Spain, and Turkey.

Valeria Di Sarli



Valeria Di Sarli, an Italian researcher involved in REFRESH's Energy Lab, specializes in chemical engineering, process safety, combustion phenomena, and industrial risk assessment. Since 2023, she has held the position of Research Director at the National Research Council of Italy and conducts her research at the Institute of Science and Technology for Sustainable Energy and Mobility (STEMS).

Valeria Di Sarli received both her bachelor's degree and Ph.D. in chemical engineering from the University of Naples, Federico II. Her research focuses on the flammability and explosiveness of liquids, gases, vapors, and dusts; flame propagation; energy materials; the detection of improvised explosive devices; and catalytic processes for energy and environmental applications. She also serves as an expert for the NATO Science and Technology Organization, the Italian Ministry of the Interior, and the European Defence Agency. At VŠB-TUO, she additionally contributes to the Centre of Excellence for Safety Research project at the Faculty of Safety Engineering.

She has authored 94 publications indexed in the ISI/SCOPUS databases, which have received more than 4,387 citations. She is the holder of one patent and has been included in the Stanford ranking of the world's top 2% most-cited researchers.



Ing. Radomír Smolka

Czech industry needs not only new technologies, but also environment where they can be rapidly tested

Strong cooperation with industry partners is one of the cornerstones of REFRESH, helping to accelerate the transfer of innovation into real-world applications. To discuss this topic, we spoke with Radomír Smolka, Member of the Board of Directors at TATRA TRUCKS, who is responsible for development. The partnership between the two institutions has a long-standing tradition and continues to deliver tangible results.

One tangible outcome is the Tatra Force prototype equipped with an automated driving system. The project is structured in three phases, beginning with the integration of sensors and basic driver-assistance functions, followed by the implementation of lidar technology, and culminating in a stage where the vehicle will be able to control steering, speed, engine operation, transmission, and braking through dedicated software and hardware interfaces. The objective is to achieve Level 3 automation in the prototype vehicle.

How do you perceive the partnership between Tatra Trucks and VŠB-TUO?

We consider our cooperation with VŠB-TUO to be both natural and strategically important. Tatra Trucks has deep roots in the Moravian-Silesian Region, and the university is the nearest major technical and research institution with expertise that closely matches our needs in the development of advanced truck technologies.

Our joint projects have repeatedly demonstrated that the university can offer knowledge and capabilities with direct value for industrial practice. A good example is the development of the automated driving system for the Tatra Force vehicle, where we are working closely with the Mobility Lab VŠB-TUO and Valeo.

Tatra also places great importance on involving doctoral and master's students alongside academic experts in these projects. This approach creates a strong link between research, development, and the education of the next generation of engineers.

Which areas have seen the greatest progress so far, perhaps also thanks to REFRESH?

The most significant advances have been made in fields that are currently transforming the future of heavy-duty vehicles: automated driving, vehicle electronics, sensor technologies, software integration, and alternative propulsion systems.

A particularly important result of this collaboration is the first-generation Drive by Wire Truck Interface. This is not merely an experimental platform, but a technological foundation that enables developers to test algorithms and operating modes for both lower and higher levels of autonomy. Its validation has also opened the door to remote truck operation through the Truck Remote Control system.

REFRESH fits naturally into this effort, as it is built around the concept of living laboratories, where cutting-edge research is carried out in close cooperation with industry and with a strong focus on end-user needs. For Tatra, the most relevant areas include digitalization, robotization, transport automation, hydrogen technologies, battery systems, and advanced materials.

In April, we held a meeting focused on expanding our cooperation into additional areas. What specific opportunities are being discussed?

Our goal is to extend the partnership with VŠB-TUO well beyond a single project or technological domain.

We see considerable potential in further collaboration on vehicle electronics, control unit development, system integration, as well as software testing and validation. These are all disciplines that have become essential to the development of modern trucks. Equally important are cybersecurity solutions for vehicle systems, the processing and analysis of data from test vehicles, and the use of simulation tools to develop driving characteristics and advanced assistance functions.

Another area of interest is alternative propulsion. Tatra has been pursuing projects within the e-Drive family for several years, and the next phase includes the Tatra Force e-Drive FCEV 6x4, a vehicle powered by hydrogen fuel cells and equipped with automated steering and remote-control capabilities. The project is carried out by a consortium consisting of Tatra Trucks, DEVINN, and VŠB-TUO, with completion planned for mid-2028.

We also see strong opportunities in testing and development infrastructure. The REFRESH project is creating new facilities, including laboratories for fuel cells and battery storage, a testing ground for autonomous vehicle development, and advanced additive manufacturing technologies. These are exactly the kinds of capabilities that can help industrial partners accelerate the development, testing, and validation of new technologies.

Tatra has long invested in innovation and development. Which areas do you see as most critical for maintaining the competitiveness of the Czech industry today?

I would highlight four key areas: digitalization, automation, alternative powertrains, and the rapid transfer of research results into real-world applications. As vehicles become increasingly complex systems integrating mechanical engineering, electronics, software, sensors, and data processing, future competitiveness will depend on the ability to deliver complete technical solutions.

Tatra vehicles operate in some of the most demanding environments, serving the military, emergency services, mining, construction, and municipal sectors. Innovation is therefore driven by practical needs and real-world performance, whether in automated and remote-controlled driving, hydrogen and battery-powered vehicles, or new design and manufacturing methods.

Can experts from VŠB-TUO, and particularly REFRESH, which aims to strengthen links between research, industry, and regional transformation, contribute to this effort?

Absolutely. REFRESH can make a major impact by providing an environment where new technologies can be rapidly tested, validated, and transferred into practice. By connecting university research with industry and end-user needs, its living labs support innovation in sustainable energy, ad-

vanced materials, digitalization, robotics, and automation.

For Tatra, the Industry 4.0 & Automotive Lab is particularly valuable. Its focus on artificial intelligence, robotics, additive manufacturing, and advanced automation closely aligns with our development priorities and has the potential to shape the future of heavy-duty vehicle development, testing, and production.

How important is access to modern technologies and skilled talent for companies today?

It is absolutely critical. Today, competitiveness depends not only on products but also on the ability to innovate, adopt new technologies, and attract skilled talent.

This is why Tatra continues to expand its development activities not only in Kopřivnice, but also in Brno and Ostrava. By strengthening its presence in these locations, the company stays close to universities, research teams, technical talent, and strategic partners, while benefiting from strong research and innovation ecosystems.

Ing. Radomír Smolka

Radomír Smolka serves as a Member of the Board of Directors at Tatra Trucks, where he oversees research and development. He is regarded as one of the leading figures in the Czech automotive sector. A graduate of the Faculty of Mechanical Engineering at Brno University of Technology, he joined Tatra as an engine designer and has spent nearly his entire career with the company. He has contributed to the development of numerous key vehicle models and has long focused on innovation, special-purpose vehicles, and future mobility technologies.

Investments

To date, we have purchased equipment (investment) worth more than **CZK 427 million.**

The total cost of this item in the project is **CZK 730 million.**

We have spent almost **CZK 110 million** on construction investments out of a total of approximately **CZK 300 million.**





PROJECTS

How is Europe's public space changing? Researchers examine the growing influence of the far right

How and why is the radical right gaining influence in public spaces and shaping political decision-making across Europe? This is one of the central questions of the international R²CULT project. Since June this year, the University of Ostrava (UO) has joined the initiative alongside the Luxembourg Institute of Socio-Economic Research and the Leibniz Institute for Regional Geography. Researchers will compare developments in six European cities that have held the title of European Capital of Culture while also facing significant economic or social challenges. The selected locations include Chemnitz in Germany, Trenčín in Slovakia, and Veszprém in Hungary.

Previous studies have primarily examined the impact of the radical right on issues such as migration, foreign policy, and European integration. The R²CULT team argues, however, that similar shifts are taking place within European countries themselves and increasingly affect areas that may not appear politically contentious at first sight, including culture, urban development, and regional policy.

“We will examine how far-right political positions are reflected in the design and delivery of cultural projects, which strategies these parties employ to build support at the local level, and how closely their objectives correspond with the views of local residents and civic initiatives. Our analyses will concentrate on cities located in so-called neglected regions. The results may help improve our understanding of the constraints and opportunities associated with implementing cultural policies in the Moravian-Silesian Region,” said Ondřej Slach, principal investigator at the UO and Scientific Director of the Social Lab within REFRESH.

The project, *Mainstreaming the Radical Right at the Urban Scale: An Investigation of the Discourses and Policies in the European Capitals of Culture (R²CULT)*, will continue until April 2029. Funding is provided by the Czech Science Foundation, the Deutsche Forschungsgemeinschaft (DFG), and the Luxembourg National Research Fund (FNR).

Next-generation ultrafiltration membranes aim to eliminate even the most persistent contaminants from water

As part of the INSPIRE project, funded through the European ERA Fellowships programme, Manohara Halanur from the CEET Materials & Environment Lab will develop advanced ultrafiltration membranes for the removal of emerging micropollutants from water. By incorporating single-atom catalysts into the membrane structure, the project seeks to improve the efficiency of water purification from highly persistent and toxic contaminants. The two-year project has been awarded funding of approximately CZK 5 million.

“Receiving this grant is a significant milestone for me. It provides an opportunity to pursue cutting-edge research on catalytic membranes for the degradation of poly- and perfluoroalkyl substances, or PFAS. These fluorine-containing synthetic compounds are among the most challenging pollutants in water treatment today. My goal is to translate the project’s findings into practical applications that help protect aquatic ecosystems and support safer water quality standards across Europe,” said Manohara Halanur, who previously conducted research on membrane technologies at Tel Aviv University in Israel.

The research will investigate an innovative approach to PFAS removal by developing ultrafiltration membranes equipped with integrated single-atom catalysts. The technology will harness piezo-photocatalysis to achieve fast and energy-efficient degradation of PFAS. In this process, the catalyst is activated through the combined action of mechanical forces and light energy.



1

FTIR (Fourier Transform Infrared Spectrometer) equipped with a low-temperature DRIFT (Diffuse Reflectance Infrared Fourier Transform Spectroscopy)

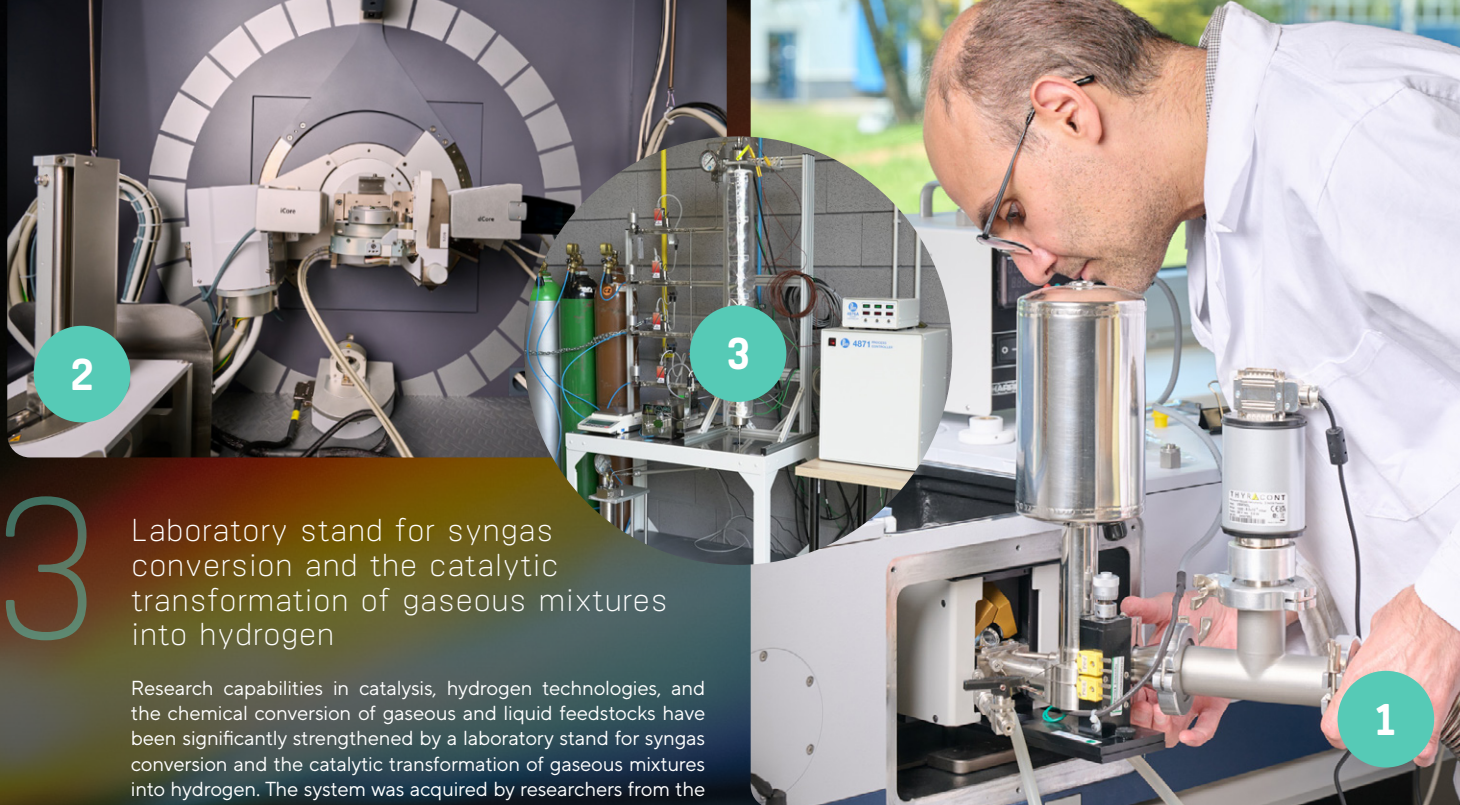
Contemporary materials research increasingly depends on the ability to observe chemical processes under realistic operating conditions. An FTIR spectrometer equipped with a low-temperature DRIFT reaction cell enables detailed investigation of surface phenomena that influence the performance of catalysts, adsorbents, and other functional materials. With its broad temperature range and capability to operate in controlled atmospheres, the system serves as a highly versatile platform for both fundamental and applied research. FTIR spectroscopy analyzes materials through their absorption of infrared radiation. Because every molecule exhibits a unique set of vibrational signatures, the technique can be used to identify specific chemical bonds and functional groups. In the DRIFT configuration, FTIR is particularly well suited for powdered, porous, and heterogeneous materials, including catalysts, where conventional transmission measurements are often impractical. The specialized reaction cell makes it possible to monitor samples in situ during experiments or reactions, whether under vacuum, reduced pressure, or in selected gas atmospheres such as CO, CO₂, NH₃, or Ar. The instrument can operate across a temperature range from approximately -150 °C to 900 °C, making it ideal for studying adsorption processes, catalyst activation, surface reactions, and temperature-dependent material transformations. In addition, its vacuum optics minimize interference from atmospheric moisture and CO₂, enhancing measurement sensitivity and improving the detection of weak or transient spectral features.

2

X-ray powder diffraction (XRD)

The performance of many materials is governed by their crystalline structure, the arrangement of atoms within the material, which directly influences their physical and chemical behavior. X-ray powder diffraction (XRD) provides a precise, non-destructive method for investigating this structure. It enables the identification of crystalline phases, determination of their relative abundance, estimation of crystallite size, and assessment of internal strain. Consequently, XRD is widely applied in the study of functional materials, nanomaterials, thin films, and battery components. At MEL, researchers use the Empyrean Series 3 diffractometer, a modular platform that can be configured for a broad range of experimental needs. The system supports measurements in both reflection and transmission modes, thin-film characterization, SAXS/VSAXS analysis, and X-ray reflectometry. Equipped with motorized sample positioning, interchangeable optical components, and microanalysis capabilities for areas smaller than 300 × 300 μm, it is suitable for both routine materials characterization and advanced localized investigations.

One of the instrument's major advantages is its ability to monitor materials in real time as environmental conditions change. XRD experiments can be conducted in ambient air, under vacuum, or in inert and reactive gas atmospheres, including N₂, H₂, CH₄, and CO₂. A high-temperature reaction chamber enables the observation of structural changes over a temperature range of 25 - 900 °C and at pressures between 1 mbar and 10 bar. Dedicated holders for button cells and an electrochemical cell further allow in-operando investigations of battery materials during charge - discharge cycling.



3

Laboratory stand for syngas conversion and the catalytic transformation of gaseous mixtures into hydrogen

Research capabilities in catalysis, hydrogen technologies, and the chemical conversion of gaseous and liquid feedstocks have been significantly strengthened by a laboratory stand for syngas conversion and the catalytic transformation of gaseous mixtures into hydrogen. The system was acquired by researchers from the Centre for Energy and Environmental Technologies through RE-FRESH as part of their involvement in the Energy Lab initiative.

The equipment, valued at approximately CZK 3.1 million, enables chemical reactions to be performed in both gas and liquid phases at temperatures of up to 500°C and pressures reaching 200 bar. These operating conditions provide broad opportunities for experimental studies, including the evaluation of novel catalysts and the optimization of reaction parameters for thermochemical conversion processes. The laboratory unit features a three-zone heating jacket together with multipoint temperature monitoring on both the reactor wall and within the reaction chamber, allowing precise control and detailed observation of reaction conditions. The system is further equipped with mass flow controllers for dosing up to four gaseous media, a high-pressure pump for liquid feedstock delivery, a product cooling unit, and a high-pressure separator for liquid products. In addition to enhancing ENET's research infrastructure, the facility also offers an attractive platform for expanding cooperation with industry partners.



New catalyst paves the way for cheaper production of pharmaceuticals and agrochemicals

An international research team, including researchers from the Materials & Environment Lab (MEL) at VŠB-TUO, has developed an innovative catalyst capable of efficiently transforming chemically stable amides into valuable amines; essential compounds widely utilized in the production of pharmaceuticals, agrochemicals, and advanced functional materials. The findings were published in Nature Communications, where the study was recognized as one of the journal's most noteworthy contributions in the field.

"For the first time, we have introduced a 'green tool' for the reduction of primary amides to functionally and structurally diverse primary amines using molecular hydrogen as an accessible and environmentally friendly reducing agent," said one of the study's authors, Rajenahally V. Jagadeesh, who is affiliated with MEL of the Center for Energy and Environmental Technologies and the Leibniz Institute for Catalysis in Rostock.

A crucial element of the breakthrough was the design of a novel catalyst that both accelerates and controls the reaction pathway. The newly engineered ruthenium complex enables highly efficient and selective hydrogenation under substantially milder conditions than conventional approaches. The process achieves high conversion rates and excellent yields of the desired amines while operating at lower temperatures and pressures. As a result, the technology has the potential to significantly reduce energy consumption and lower the production costs of a

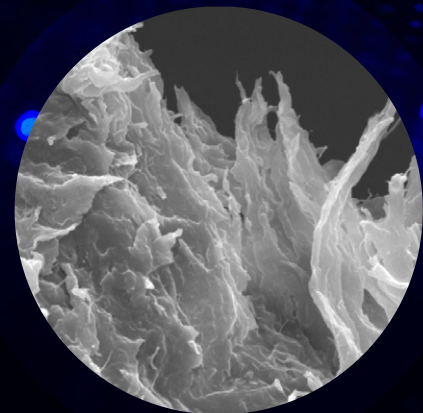
broad range of chemical and pharmaceutical products. The catalytic system is applicable to the synthesis of amine-containing compounds used in pharmaceuticals, polymer, and agrochemical industries, as well as to the valorization of amide-based plastic waste.

Researchers detect polymer-derived particles and additives in atherosclerotic plaques

A study involving researchers from VŠB-TUO, the Faculty of Medicine of the University of Ostrava, and the University Hospital in Ostrava has revealed the presence of solid particles originating from synthetic polymers within the human vascular system. The researchers describe the findings as concerning, as traces of plastics and associated chemical additives were detected in atherosclerotic plaques.

In one plaque specimen, the team detected the plasticizer DEHA together with caprolactam, the monomer used in the production of the widely employed polymer nylon. Additional samples contained fragments of common plastics, including PP, PET, and PVC, as well as chlorinated organic compounds. "The results of this pilot study represent a significant challenge in terms of methodological optimization and the development of new protocols for sample preparation and analysis that will enable us to obtain reliable and robust data," explained Zuzana Šimonová from the Center for Advanced Innovation Technologies at VŠB-TUO.

International studies indicate that the accumulation of polymer particles in atherosclerotic plaques may be associated with an elevated risk of myocardial infarction, ischemic stroke, and cardiovascular mortality. These particles may also influence inflammatory and degenerative processes occurring within plaque tissue. Despite its potential





clinical significance, the topic remains insufficiently investigated due to its inherent complexity and the highly heterogeneous composition of atherosclerotic plaques. Building on these initial findings, the Ostrava research team intends to continue this line of investigation through a project proposed for the 2027–2030 period under this year's call of the Czech Health Research Agency.

Smart material enables efficient plastic recycling and low-cost drug production

A versatile material based on iron and carbon atoms can not only convert waste plastics into useful products but also reduce the cost of producing important chemicals and pharmaceuticals. An international team of researchers, including representatives from MEL at VŠB-TUO, focused on its application, particularly in the valorization of polystyrene, a widely used plastic with a global annual production exceeding 20 million tons, of which only a negligible amount is recycled. The discovery was published in the prestigious journal Nature Catalysis.

Current approaches to polystyrene recycling are often inefficient, technologically demanding, or environmentally unfriendly. "To address these limitations, we developed a sustainable low-temperature process that employs oxygen and ammonia to convert polystyrene into benzonitrile. This highly valuable chemical serves as a key precursor

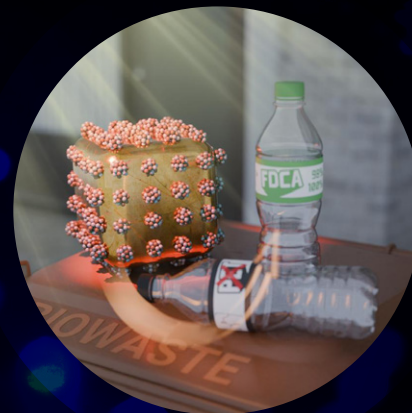
in the production of pharmaceuticals, fertilizers, and numerous industrial chemicals. The key to success was developing an effective catalyst capable of lowering reaction temperatures while substantially increasing the yield of the desired product," explained one of the study's lead authors and Scientific Director of MEL, Radek Zbořil.

The catalyst is based on iron atoms dispersed in a carbon matrix and stabilized nitrogen and boron atoms. This chemical environment surrounding the iron atoms, along with the porous structure of the support, is essential for achieving low-temperature and efficient polystyrene conversion. The material can be easily produced on a large scale, and after the chemical process is complete, it can be recycled and reused. It is precisely this versatility, simple production, lower energy consumption, and significant cost reduction for a range of chemical processes that promise rapid practical application of the material. The researchers therefore plan to scale up production to a pilot-scale level.

Researchers develop a novel solar-driven catalyst for converting biomass into raw materials for bioplastic production

Researchers from MEL at VŠB-TUO contributed to the development of a new type of plasmonic photocatalyst capable of efficiently and selectively converting biomass into key raw materials for bioplastic production using solar energy. The findings were published in the prestigious journal Nature Catalysis.

The research focused on the 5-hydroxymethylfurfural molecule, which is produced from sugars in plant biomass and is considered one of the key intermediates in modern biorefineries. Through its controlled oxidation, 2,5-furan dicarboxylic acid can be obtained, a compound usable as a basic building block for biopolymers, such as PEF plastic, which is an eco-friendly alternative to commonly used PET.





“The newly developed catalyst is based on a combination of nanostructured titanium nitride and extremely small nanoparticles of a ruthenium-platinum alloy. Titanium nitride serves as a material that absorbs light effectively, particularly its infrared component, and converts it into high-energy electrons and localized heat. These effects subsequently promote the activation of molecular oxygen on the surface of the catalytically active nanoparticles, where the actual chemical reaction takes place,” said one of the corresponding authors, Štěpán Kment from MEL. Thanks to the perfect cooperation of the catalyst components, the oxidation of 5-hydroxymethylfurfural can be precisely controlled, achieving nearly complete conversion to the target product without the use of strong chemical additives or extreme reaction conditions. Compared to existing technologies, the process is significantly more selective, more energy-efficient, and produces substantially less waste.

Researchers present a system for testing vehicle communication using headlights

Researchers from VŠB-TUO, involved in REFRESH’s Industry 4.0 & Automotive Lab, have achieved a significant scientific breakthrough in the field of visible light communication (VLC). In the prestigious international journal IEEE Transactions on Intelligent Transportation Systems, they presented a novel technology that enables the testing of vehicle-to-vehicle communication using automotive headlights.

“The study introduces an innovative software-defined radio (SDR) platform for measuring data transmission error rates under real-world dynamic conditions of direct vehicle-to-vehicle communication. Unlike earlier studies that relied solely on simulations, we validated the technology directly in real-world traffic conditions for both stationary and moving vehicles. Using standard automotive headlights and the OFDM method, we experimentally demonstrated stable communication over distances of up to 10 meters with a very low error rate,” said one of the publication’s authors, René Jaroš from the Faculty of Electrical Engineering and Computer Science.

Vehicle-to-vehicle communication based on light has a wide range of practical applications, particularly in traffic safety, autonomous mobility, and intelligent transportation systems.

Industrial culture. A driver or a barrier to the development of small towns?

Experts from the University of Ostrava sought to answer this question, highly relevant to the transformation of industrial regions, including the Moravian-Silesian Region, through research conducted within the Social Lab of REFRESH. In an article published in GeoJournal, the authors examined the role of industrial culture in the development trajectories of two small towns in the peripheral areas of the Moravian-Silesian Region.

The researchers focused on the period from 1945 to 2024 and analysed the towns through the perspective of evolutionary economic geography. This approach makes it possible to explore how historical decisions and local conditions shape contemporary economic development.

“The comparative study demonstrates that industrial culture can help stabilize local economies, preserve industrial continuity, and sustain employment. At the same time, however, it may impede necessary restructuring processes and reinforce dependence on traditional industries that often offer limited prospects for





future growth,” said the study’s lead author, Lukáš Chwistek.

The findings suggest that the successful transformation of old industrial regions requires more than investment in infrastructure and the preservation of tangible industrial heritage. Equally important is the ability to reinterpret existing knowledge and regional identity in ways that foster innovation and new development paths. At the same time, sustained investment in education, economic diversification, and the gradual modernisation of peripheral economies remains essential.

Research on hydrogen separation from gaseous mixtures using multi-stage polymer membranes

Researchers from REFRESH’s Energy Lab are developing and testing advanced multistage polymer membrane systems for the efficient separation of hydrogen from gaseous mixtures, including syngas, biogas, and industrial process gases. The research aims to advance innovative technologies for the production of high-purity low-carbon and green hydrogen, thereby supporting the energy transition and reduction of greenhouse gas emissions in industry.

“The research focuses on investigating the properties of polymer membranes, including their permeability, selectivity, chemical stability, and long-term operational durability under a range of pressure and temperature conditions. It also encompasses the design of multistage separation configurations, the optimization of operating parameters, and the experimental evaluation of membrane modules to increase hydrogen purity and recovery,” said Ján Vereš from the Energy Research Centre (ERC) at the Centre for Energy and Environmental Technologies.

The researchers have published several of their findings in leading journals, including *Fuel Processing Technology* and *Energy Conversion and Management*. In the study *H₂ Separation of Synthetic Multicomponent Gas Mixtures Using Single-Stage and Multistage Hollow Fiber Membrane Systems: An Experimental and Theoretical Study*, Ján Vereš from ERC, together with his Italian colleagues from CNR-ITM, investigated the potential of membrane separation for producing high-purity hydrogen from industrial gas streams.

The authors designed, experimentally validated, and subsequently modelled a multistage membrane system intended to improve hydrogen separation and recovery compared with a conventional single-stage configuration. Numerical simulations further demonstrated that the proposed system can effectively recover other valuable components of the gas mixture, particularly methane, with recovery rates approaching 100 per cent. The results confirm the potential of multistage hollow-fibre membrane systems for efficient hydrogen purification and the utilization of energy-rich by-product gases in industrial applications.

Experiment helps advance fire safety of timber buildings

The fire behavior of timber structures was investigated in a large-scale fire test conducted in May by experts from the Faculty of Safety Engineering at VŠB-TUO and the REFRESH’s Energy Lab at the DIAMO experimental facility in Chlebovice. The study focused primarily on structures made of CLT panels, which are increasingly used in modern timber buildings.





The researchers simulated an interior fire to examine how the structures respond under fire conditions, how rapidly the wood chars, how heat propagates, and under what circumstances the fire may self-extinguish or, conversely, reignite. The collected data revealed that CLT structures exhibit distinctive fire behavior, which has important implications for the safe design of multi-story timber buildings.

“In conventional structures, fire intensity gradually declines once the fire load has been consumed. In exposed CLT panels, however, high temperatures may cause the adhesive between individual wood layers to deteriorate, resulting in the charred layer detaching and exposing fresh, uncharred wood. This can trigger reignition and extend the overall burning period,” said experiment leader Eva Šopíková. The results of the experiment will therefore help refine fire safety design methodologies, validate the computational models used in design practice, and contribute to the safer use of wood in construction.

Researchers contribute to the development of a secure communication platform for security forces

Experts from the Faculty of Electrical Engineering and Computer Science (FEECS) at VŠB-TUO are participating in the development of the next generation of the secure communication platform CHIMERA 2.0. The project responds to increasing cyber threats and the growing need for sovereign, fully controlled communication solutions for the Czech Police, the Czech Armed Forces, and other key state institutions. In addition to robust encryption, the platform will incorporate artificial intelligence capabilities and operate independently of external service providers.

Most widely used communication platforms are operated by companies headquartered outside the European Union and depend on foreign data centers. For government security organizations, this may present significant risks, particularly regarding the protection of sensitive information and limited control over communication infrastructure. CHIMERA addresses these concerns by offering a solution that can be deployed and operated independently of external services.

“By taking this approach, we eliminate the risks associated with transmitting data through third parties. Organizations retain full control over all sensitive information, which is a fundamental requirement in the defense and security sector that conventional commercial applications cannot guarantee,” said Ivan Zelinka from FEECS, who leads the university’s research team involved in the project. The platform will employ advanced end-to-end encryption, ensuring that message content remains accessible only to the sender and the intended recipient. In addition, the development process includes the integration of applied artificial intelligence algorithms that will introduce advanced functionalities for threat detection and communication optimization.

University of Ostrava takes the baton

The national conference VIZ: 3E - Economically, Environmentally, Effectively, or The Countryside Supports Innovation will be hosted by the University of Ostrava on 1 April next year. Organized by the Ministry of Regional Development, the event will come to Ostrava after representatives of REFRESH’s Social Lab received the symbolic baton this year from colleagues at the University of South Bohemia.



The conference brings together academics, local government representatives, entrepreneurs, and students, creating a platform for sharing practical experience and discussing current challenges related to regional and municipal development. The next edition will take place at the City Campus of the University of Ostrava.

As REFRESH is a flagship initiative supporting the transformation of the Moravian-Silesian Region towards a sustainable and innovation-driven future, the conference programme will highlight the project's research outcomes to the public, local businesses, and students. The event will also showcase the results of other major projects, including LERCO, which advances excellent research in medicine, biotechnology, and population health, and STENEO, which examines the social dimensions of the energy transition and explores ways to align modern energy systems with improvements in residents' quality of life.



Humanoid robot opens new directions for research and education

Thanks to REFRESH, VŠB-TUO has acquired its first humanoid robot, valued at approximately CZK1.5 million. This technological assistant will not only support cutting-edge research but also contribute to the development of a new university course and significantly strengthen interdisciplinary and interfaculty collaboration.

Researchers from the Faculty of Safety Engineering, the Faculty of Electrical Engineering and Computer Science (FEECS), the Faculty of Mechanical Engineering, and the Faculty of Economics will work together to explore potential applications of humanoid robotics while also addressing security challenges.

“Our research will focus on topics such as safe human-robot collaboration, the integration of humanoid robots into industrial environments, and cybersecurity. At the same time, the growing presence of humanoid robots raises broader questions that cannot be overlooked, including the future of human labor and the evolving relationship between humans and machines. Cybersecurity and sustainability are also key areas of interest. In this context, strengthening the independence of the European market is essential, particularly in relation to technologies originating from China, which currently dominates the field of humanoid robotics and largely shapes its future development,” said Radim Hercik from FEECS.

Researchers have already submitted several project proposals involving the humanoid robot. These include establishing a competence center for humanoid robotics, a project focused on integrating a humanoid robot into metalworking production processes, and a range of other innovation activities.

Hyundai Motor representatives explored the future of hydrogen energy at CEET

In early June, a delegation from Hyundai Motor Group visited the Center for Energy and Environmental Technologies (CEET). During the visit, the guests were introduced to the CEETe H2 research initiative and toured research facilities dedicated to thermochemical conversion processes and hydrogen technologies.

“Hydrogen technologies are a crucial component of the transition toward low-carbon industry and transportation, while also serving as a natural link between centralized and decentralized energy systems. The fact that global technology leaders such as Hyundai are interested in the outcomes of our research confirms the high professional standards and the correct strategic direction of CEET. We strongly value open cooperation, knowledge exchange, and the integration of leading research and industrial teams, as these accelerate the transfer of research findings into industrial applications. Partnerships of this kind play a vital role in fostering innovation and strengthening the competitiveness of European industry,” said Stanislav Mišák, Director of CEET and Scientific Director of Energy Lab.

The unique Fraunhofer Innovation Platform at VŠB-TUO continues

The Fraunhofer Innovation Platform at VŠB-TUO (FIP-AI@VŠB-TUO), established to advance innovations for more efficient and sustainable industrial production, entered a new five-year period at the beginning of June. VŠB-Technical University of Ostrava and Fraunhofer-Gesellschaft, one of Europe’s foremost applied research organizations, have agreed to extend their collaboration. Closely connected with REFRESH, the platform combines expertise in materials science, applied artificial intelligence, forming technologies, and energy systems.

“During its initial phase, the Fraunhofer Innovation Platform at VŠB-TUO



successfully established effective collaboration frameworks, initiated promising research activities, and involved industrial stakeholders. The decision to support the second phase reflects confidence in the platform’s progress and recognition of its strategic significance,” said Frauke Mickler, Program Manager for International Research Cooperation at the Fraunhofer-Gesellschaft. The collaboration brings together several faculties and research institutes of VŠB-TUO, alongside the Fraunhofer Institute for Chemical Technology and the Fraunhofer Institute for Machine Tools and Forming Technology.

MEL hosted the management of Třinecké železářny

In May, researchers from the Materials & Environment Lab (MEL) met with representatives of Třinecké železářny, led by CEO Roman Heid, to discuss potential cooperation in areas that currently represent major challenges for the metallurgical sector. The discussions focused primarily on circular economy strategies, the valorization of secondary material streams, and the reduction of environmental impacts. Participants also explored oppor-

tunities for advanced material characterization, analysis of operational dusts and industrial residues, and laboratory-scale validation of emerging technological solutions.

"I believe the meeting was highly valuable for both parties. Trinecké železářny is a major industrial partner in the region, and our colleagues showed great interest in the technical infrastructure of our laboratory as well as the expertise of our researchers. We quickly identified several specific opportunities for joint research activities that we intend to pursue further," said MEL Scientific Director Radek Zbořil.



CEETe II will strengthen VŠB-TUO's research infrastructure and support regional transformation

The ceremonial launch of the renovation of the former Building N on 20 May marked the beginning of the next stage in the development of CEETe's research infrastructure. The new Nanotechnology Center will substantially enhance research in advanced materials for sustainable energy systems and circular economy technologies while further expanding collaboration

with industrial partners, where these topics closely align with the scientific activities of the Energy Lab of REFRESH. The facility will house laboratories equipped with cutting-edge instrumentation for battery safety and hydrogen technology research, as well as shared innovation spaces such as the Industry Partnership Laboratory Platform. The project is also closely connected to the newly established CEETe testing facility dedicated to evaluating modern energy technologies. Through both the renovation of research spaces and the acquisition of state-of-the-art equipment, REFRESH is making a significant contribution to the development of the CEETe II building, creating conditions for further growth of excellent research and the effective transfer of results into industrial applications.



Industry 4.0 Open House debuted in Ostrava

More than 150 representatives from industry, academia, public administration, and innovation organizations attended the United by Innovation - Industry 4.0 Open House conference held in mid-May at CPIT TL3, Faculty of Electrical Engineering and Computer Science. Organized jointly by the

National Centre for Industry 4.0 and VŠB-TUO, the event took place in Ostrava for the first time and also showcased information about REFRESH.

The presented outcomes and discussions highlighted that successful cooperation between research institutions and industry develops not within isolated regions but across a connected innovation ecosystem spanning the entire Czech Republic. An important role in shaping this environment is played by the National Centre for Industry 4.0, together with the network of testbeds linking RICAIP Testbed Prague, RICAIP Testbed Brno, and the CPIT TL3 testbed in Ostrava. This interconnected research infrastructure provides Czech companies with opportunities to test emerging technologies under real operating conditions and supports the faster adoption of innovation across the industry.

REFRESH results foster new collaboration in Slovakia

The Slovak technology company DiusAi is expanding its activities in autonomous mobility. Within the DIUS LAB project focused on autonomous mobility, artificial intelligence, and intelligent transportation systems, the company has signed a cooperation agreement with autinno. The partnership aims to develop a Level 4 autonomous driving platform integrated directly into a vehicle architecture. The initiative builds on technologies developed at VŠB-TUO within REFRESH and subsequently commercialized by autinno as a university spin-off.

Representatives of VŠB-TUO and Valeo around the same table

Presenting recent research achievements and defining opportunities for collaboration in the coming months were the main objectives of a visit by Ralf Schneider, a leading specialist in advanced automotive systems development from Valeo Germany, to the Mobility Lab at the Faculty of Electrical Engineering and Computer Science, VŠB-TUO. Cooperation with this



major supplier of technologies for global automotive manufacturers continues to expand through REFRESH, particularly within the activities of the Industry 4.0 & Automotive Lab.

The Ostrava research team has been collaborating with Valeo since 2019. What began as joint activities with research and development departments in the Czech Republic has gradually expanded to cooperation with teams in Germany, Japan, and Ireland, where researchers also provide technological solutions. To date, Valeo has invested approximately CZK 25 million in joint research activities.

Czech AI Factory officially launched

The Czech AI Factory (CZAI) project was officially launched on 12 May during a meeting in Ostrava that brought together leading experts in artificial intelligence alongside representatives of government institutions, public administration, and industry. The initiative is coordinated by VŠB-TUO and its IT4Innovations National Supercomputing Center, which operates the Czech supercomputing infrastructure and has extensive experience participating in major European EuroHPC JU projects, including the LUMI AI Factory.

The CZAI project brings together six leading Czech institutions specializing in supercomputing, artificial intelligence, and digital innovation. As part of the pan-European EuroHPC JU initiative, it is creating a Czech node of the European AI Factories network. CZAI integrates high-performance computing resources, data infrastructure, expert support, and application-oriented know-how within a unified ecosystem of AI services available to companies, startups, public institutions, and research organizations. The project aims to significantly strengthen the Czech Republic's position within the European artificial intelligence landscape.

Evenings with REFRESH debate examined the poverty trade



The poverty trade as a systemic social issue was the central topic of another discussion in the Evenings with REFRESH series, held in April. The debate featured criminologists Václav Walach and Petr Kupka from the Faculty of Social Studies at the University of Ostrava, who have long focused on research into the exploitation of low-income households in the housing mar-

ket. One of the key objectives of the event was to demonstrate how academic research can contribute to addressing a complex problem faced by many Czech towns and cities. During the discussion, the researchers also highlighted the practical challenges associated with investigating the poverty trade, including direct interference by operators of accommodation facilities. Despite these obstacles, they have produced a number of studies examining the phenomenon from different analytical perspectives. According to the researchers, however, the level of interest shown by the public sector in tackling the issue remains relatively limited.

Czech-German meeting of researchers and companies addressed topics shaping today's industry

Smart sustainable manufacturing together with advanced energy solutions, including hydrogen technologies, were among the main topics of the third annual Czech-German networking meeting held on 18 March at VŠB-TUO. Organized by the Fraunhofer Innovation Platform FIP-AI@VŠB-TUO, a unique initiative within the Czech Republic, the event brought together innovators from academia and industry not only from the Czech Republic and Germany, but also from Hungary, Poland, France, and Italy. The meeting aimed to facilitate new professional connections and create opportunities for future collaboration in strategically important technological fields.

"We have consistently emphasized applied research and the practical utilization of research outcomes. We are therefore pleased that this international networking event brings together representatives of companies, research organizations, clusters, and universities to create new opportunities for innovation, collaborative research, and cross-border partnerships," said Jan Platoš, Vice Rector for Science, Research and Doctoral Studies at VŠB-TUO and Director of FIP-AI@VŠB-TUO.

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