NATIONAL INSTITUTE OF CHEMISTRY

Strategy of the National Institute of Chemistry 2024–2027

*For a **green** and **healthy** future*

NATIONAL INSTITUTE OF CHEMISTRY

Strategy of the National Institute of Chemistry 2024–2027

01

Foreword by the Director

The National Institute of Chemistry, which will celebrate its 80^{th} anniversary in 2026, has gradually grown from humble beginnings to become one of the largest and most pioneering scientific research institutions in Slovenia. It has a long-standing and strong international network of related institutions and close links with industry. The importance of science to human progress has always been great, and with all the challenges we face, it seems to be growing. And with it comes a responsibility to society. With its staff, expertise and research infrastructure, the National Institute of Chemistry aims to make an active contribution to meeting these challenges. The future is challenging, but it is also inviting. It encourages us to think about how we can unlock the mystery of the world as we know it and as it is not yet known but looms on the horizon.

Scientific excellence remains a fundamental pillar of our research activities. The quality of our work is confirmed by publications in the most prestigious scientific journals and by funding from the European Research Council (ERC), which represents the highest level of achievement in the scientific world. Carrying out international reviews and collaborating with renowned experts to verify the quality of our work and disseminate knowledge plays a very important role in the reputation of our institution. Linking with industry is key to the transfer of knowledge to society, so increasing the level of technological development and promoting innovative entrepreneurship are also of paramount importance to our Institute. The same applies to staff training, providing them with support and the promotion of their professional and personal development. We aim to create an environment of scientific research and innovation in which the careers of all our staff can flourish.

Recognising our role in society, and with a vision and values to which we are committed, we have developed a clear strategy for our future. As well as continuing to pursue the above objectives, we set out below our strategy for 2024-2027, in which investment in new facilities and research capabilities will play a central role. These will help solve our spatial challenges and provide the right conditions for our colleagues to conduct cutting-edge research on the most pressing societal challenges.

For a green and healthy future!

Prof. Dr. Gregor Anderluh, Director of the National Institute of Chemistry

02

Long- and Medium-Term Objectives

01 Ensuring scientific excellence

Scientific excellence remains key to the visibility and quality of our research. Publications in **top scientific journals (*Science, Nature*)** are a key indicator of the value of our research contributions. The citation rate of our research in the scientific community is an indication of its impact and relevance in a given field.

Projects funded by the **European Research Council (ERC)** also represent some of the highest achievements in the scientific world. These projects contribute to cutting-edge and ground-breaking advances in various scientific disciplines. We will continue to encourage and support researchers to apply.

At the National Institute of Chemistry, we will regularly carry out **international reviews** (independent International Scientific Advisory Committee, EARTO, etc.) and promote cooperation.

We will continue to develop state-of-the-art research equipment and infrastructure. Access to advanced equipment and infrastructure allows us to perform complex experiments and ensure the high quality and relevance of our work.

02 Addressing spatial challenges

Addressing spatial challenges is critical to the development of the National Institute of Chemistry. We need more laboratory, office and common areas, so we are making new investments to ensure efficient working conditions. **We are building new centres** that will help balance the spatial challenges until 2027 and stimulate the development of knowledge, innovation and their transfer to the economy. **We are planning a new core for the Institute in Ljubljana** and the renovation of the existing premises.

03 Rational work scheduling and digitalisation

Rational work scheduling, both in shared services and in individual departments, is essential to the continued success of the National Institute of Chemistry. When it comes to streamlining processes and procedures, we aim to simplify and optimise workflows.

04 Collaboration with industry and knowledge transfer

Through research in the new centres and collaboration with companies, we aim to take cutting-edge technologies and knowledge from the laboratory to the field.

We are placing particular emphasis on the development of the NICKI initiative, an internal fund of the National Institute of Chemistry that promotes innovation. This initiative enables us **to build on our research achievements and create innovative products and new business opportunities**. At the same time, we are focusing on licensing and selling patents resulting from our research to provide companies with access to innovative solutions.

By 2027, we will also develop the **Entrepreneurship Programme** at the National Institute of Chemistry to help researchers turn ideas into successful business projects. We encourage innovative entrepreneurship and the development of deep-tech start-ups through mentoring, financial support and networking with investors.

05 Human resources development

Human resources development is an extremely important part of our work. **Through continuous training, we enable our employees to acquire new skills** and encourage innovation and creativity. We pay particular attention to the development of early-career researchers. By 2027, we will have established at least two junior research groups to give early-career researchers valuable experience and stimulate their creative potential.

We also **launched internal initiatives** such as the Family Friendly Company and Health at Work programmes, conduct employee satisfaction surveys and regularly follow up on employee suggestions. We will put in place mechanisms to strengthen and develop the National Institute of Chemistry's top-class scientists.

03

Vision, Mission and Values

Vision

With our cutting-edge research, we are pushing the boundaries of science. With modern and innovative solutions, we help shape the economy of the future. Through the transfer of knowledge to young researchers and the pursuit of good interpersonal relations, we are enabling career development. Committed to positive values and science, we want to serve society and be among the best in the world.

The vision of the organisation and functioning of the National Institute of Chemistry in 2024–2027 is based on the consolidation of the Institute's leading role as a top scientific research institution in Slovenia, the wider region and the world. Our basic guideline is to establish scientific excellence in the Institute's key research areas by demonstrating globally comparable indicators of scientific excellence. While ensuring the highest possible level of research activity, the Institute will continue to work intensively on the transfer of knowledge to the Slovenian and foreign economy and society, especially by participating in the development of new technologies and products, establishing spin-out companies and training staff with the latest knowledge and experience.

Mission

The National Institute of Chemistry is a renowned scientific research institution whose research contributes to global challenges such as health, sustainable energy, climate change, the circular economy and safe food. We aim high, create new value and successfully transfer knowledge to industry to support societal development. We connect to international research networks and collaborate with leading global institutions and groups. We strive to provide a stimulating environment for young researchers to develop their curiosity and creativity, contributing to future generations of scientists.

We offer our staff an inspiring working environment where relationships are valued and we are committed to openness, connectedness and equality. We work to attract excellent Slovenian scientists back to their home country, thereby contributing to the well-being of Slovenian society and building trust in science as a driving force for progress.

Values

Integrity

We are committed to moral and ethical standards, transparency and governance as a necessary basis for trust in our institution.

Community (research community, family)

Community is the foundation that shapes values and relationships, the transfer of skills and knowledge. We are united by a research culture and a shared past and future. We care for each other and are a source of support in times of crisis.

In the Employee Satisfaction with the Working Conditions, Organisation and Motivation at the National Institute of Chemistry 2023 survey, which was conducted in September 2023, employees were also given the opportunity to express their views on values. These values were ranked highest in the survey.

Responsibility

Responsibility is the key to personal and societal progress, so we create better conditions for development, cooperation and prosperity. We take responsibility and care for our actions, decisions and attitudes. Our guiding principles are to be reliable, ethical and moral, to respect work rules and duties, and to respect our colleagues.

Collaboration and cooperation

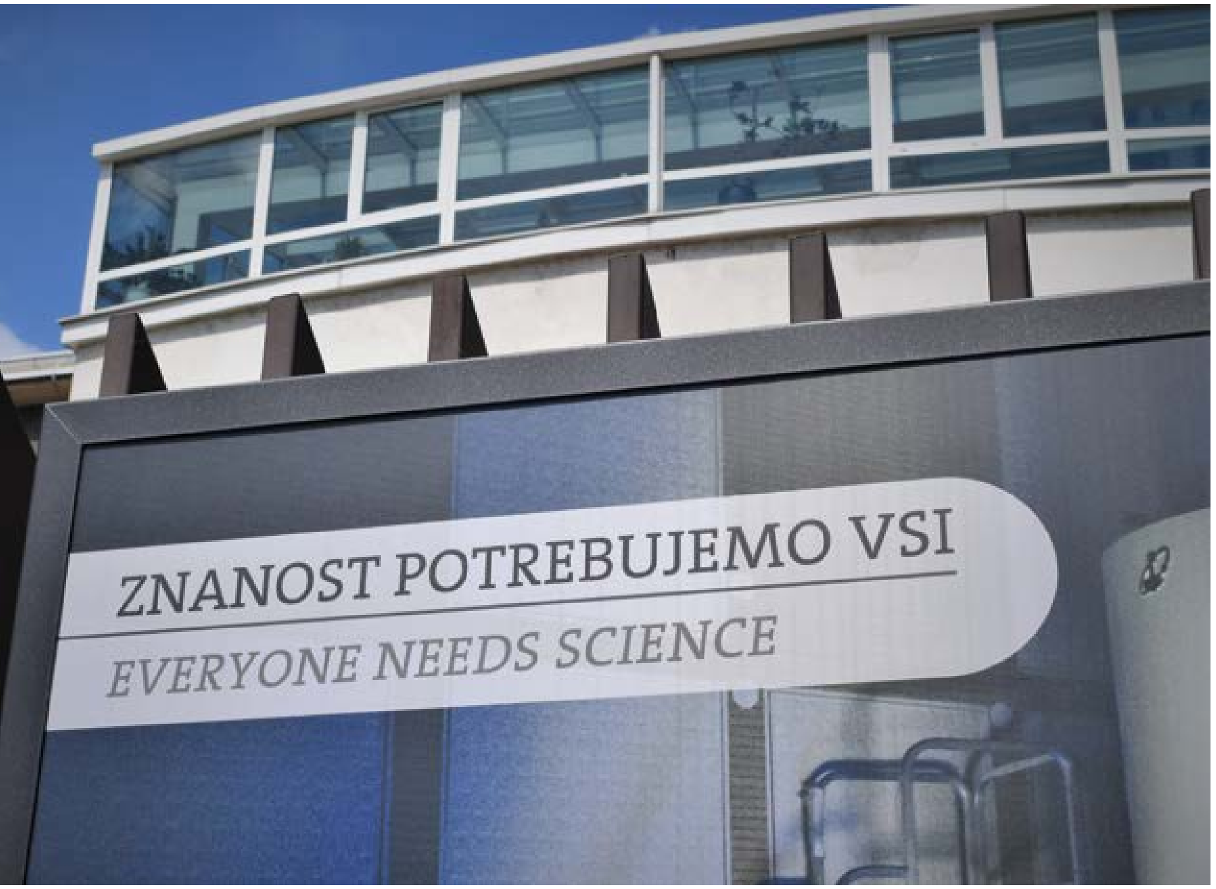
Collaboration and cooperation are key values for us to effectively achieve our common goals and integrate diverse ideas, opinions and talents. We seek solutions that benefit all stakeholders. We enable learning and growth. We participate in discovery, innovation and the development of new products and services. We encourage dialogue and international cooperation

Trust

Evidence-based science and scientific integrity are our guiding principles for building successful relationships and a society based on honesty and mutual respect.

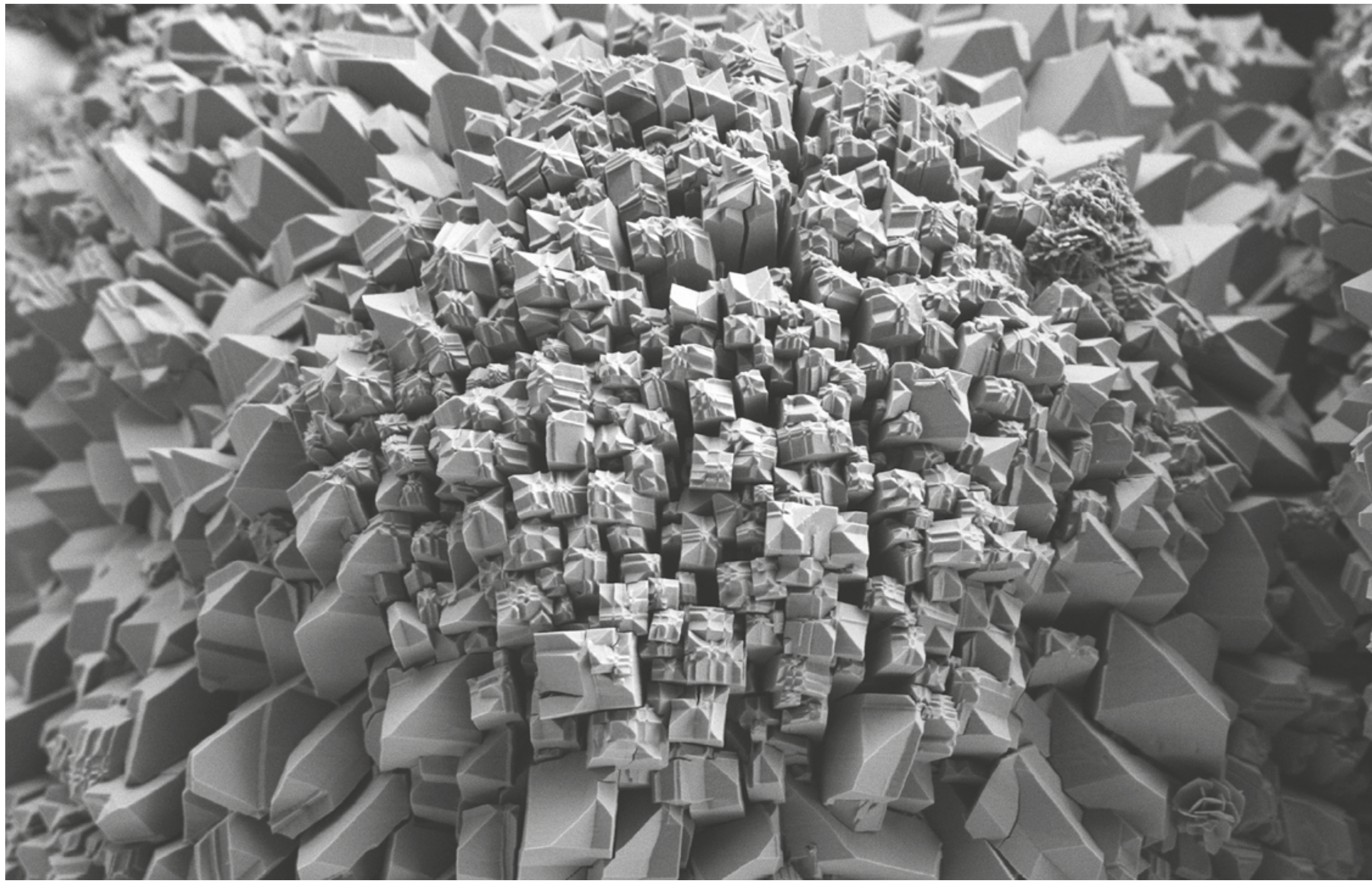
Excellence

With a wealth of knowledge, experience and state-of-the-art equipment, we explore the unknown and push the boundaries of what's possible.



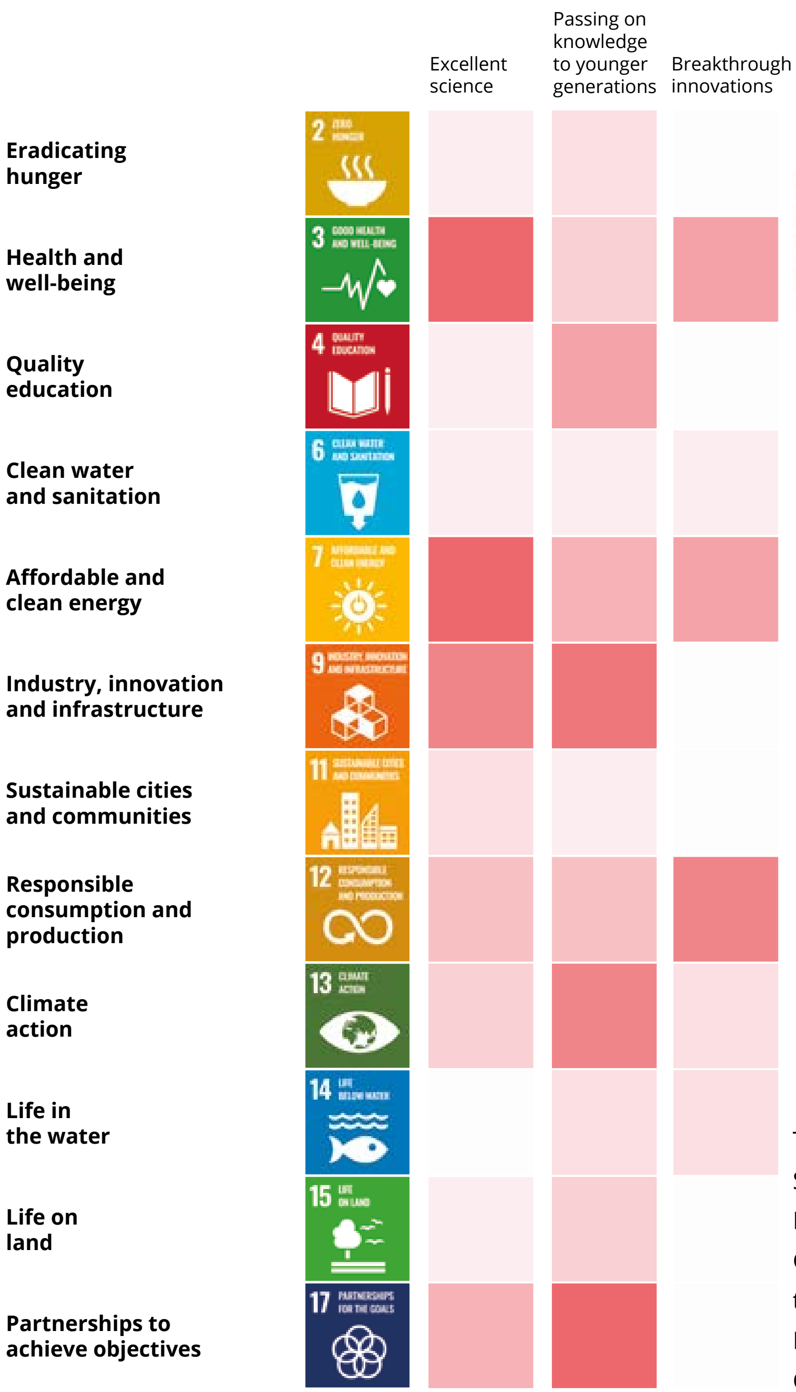
04

Main Areas of Activity and Scientific Research Focus



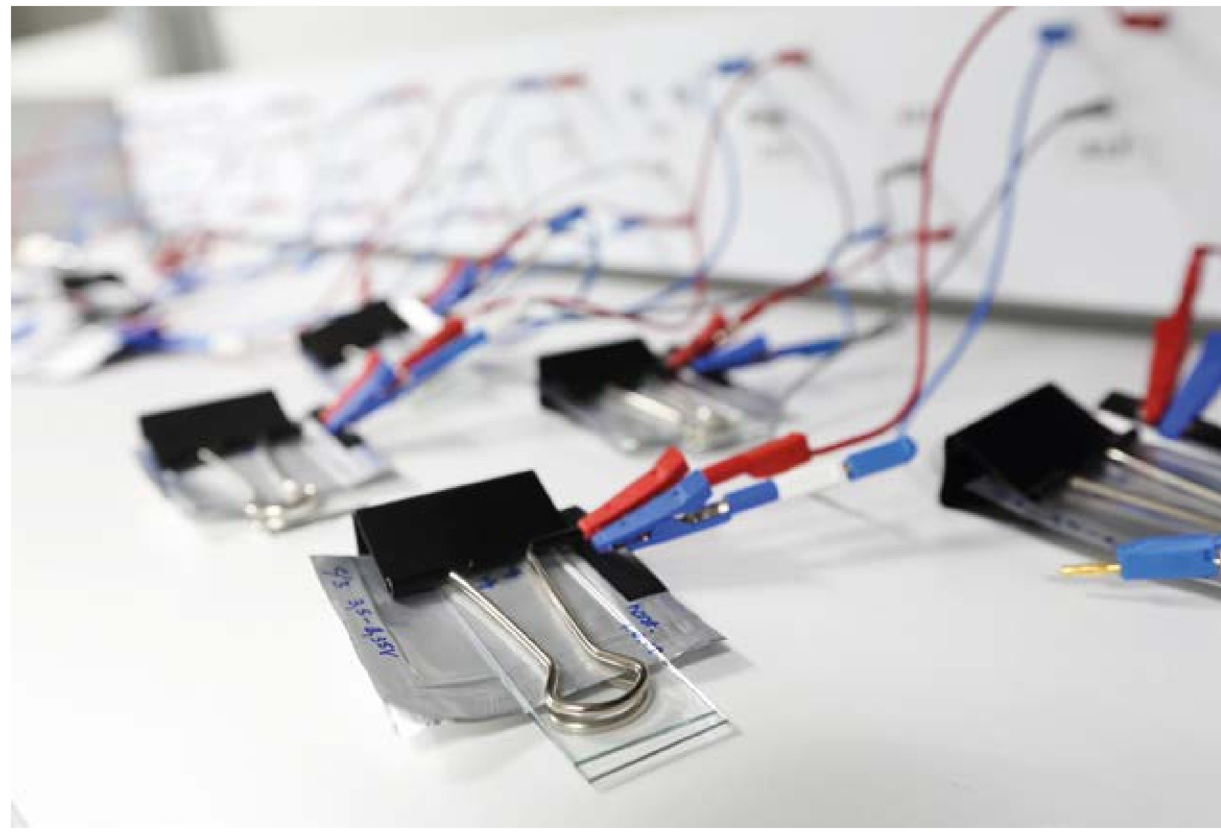
The research directions are in line with the **Slovenian Scientific Research and Innovation Strategy 2021–2030**, **the Slovenian Smart Specialisation Strategy, the EU Framework Programme Horizon 2020** and **the new EU Framework Programme (2021–2027)**. In these societal/research areas and themes, the Institute's state-of-the-art infrastructure, its involvement in international multidisciplinary research networks and its internationally renowned researchers enable it to achieve scientific excellence at the level of the world's best institutions and to compete in calls for proposals under all the pillars of the European and international Framework Programmes.

The main areas of the Institute's work will focus on the following five strands: **advanced materials**, **life sciences**, **analytical chemistry**, **computational modelling** and **chemical engineering**. Through cutting-edge research, we will add fundamental discoveries to the world's store of knowledge and help address some of society's most pressing issues, such as **health, sustainable energy, climate change, the circular economy, environmental protection, food security** and **human resource training.**



The United Nations Sustainable Development Goals fulfilled by the research of the National Institute of Chemistry.

The activities of the National Institute of Chemistry are of key importance for Slovenian industry, especially in the fields of **biotechnology, synthetic biology** and **functional materials.** Cooperation with international industrial partners is expanding, particularly in the fields of **battery system development, coatings, pharmaceuticals** and **bionanotechnology.** Our future direction is to work even more closely with global market leaders and to further improve the treatment of rare genetic diseases and carbon-free technologies.



05

Employees

permanent position
32%

temporary position
68 %

Women		Men
53%	**437** employees	47%
54 %	from Slovenia **84 %**	46 %
52 %	from other countries **16 %**	48 %
51 %	PhD students **152**	49 %
41 %	after the PhD **178** 0–7 : **71** < 7 and > 12: **36** < 12: **71** years after the PhD	59 %
36,9	average > 30 years: **32%** 30-40 years: **36%** 40-50 years: **18%** 50-60 years: **10%** < 60 years: **4 %**	37,4

06

6. ERC Projects

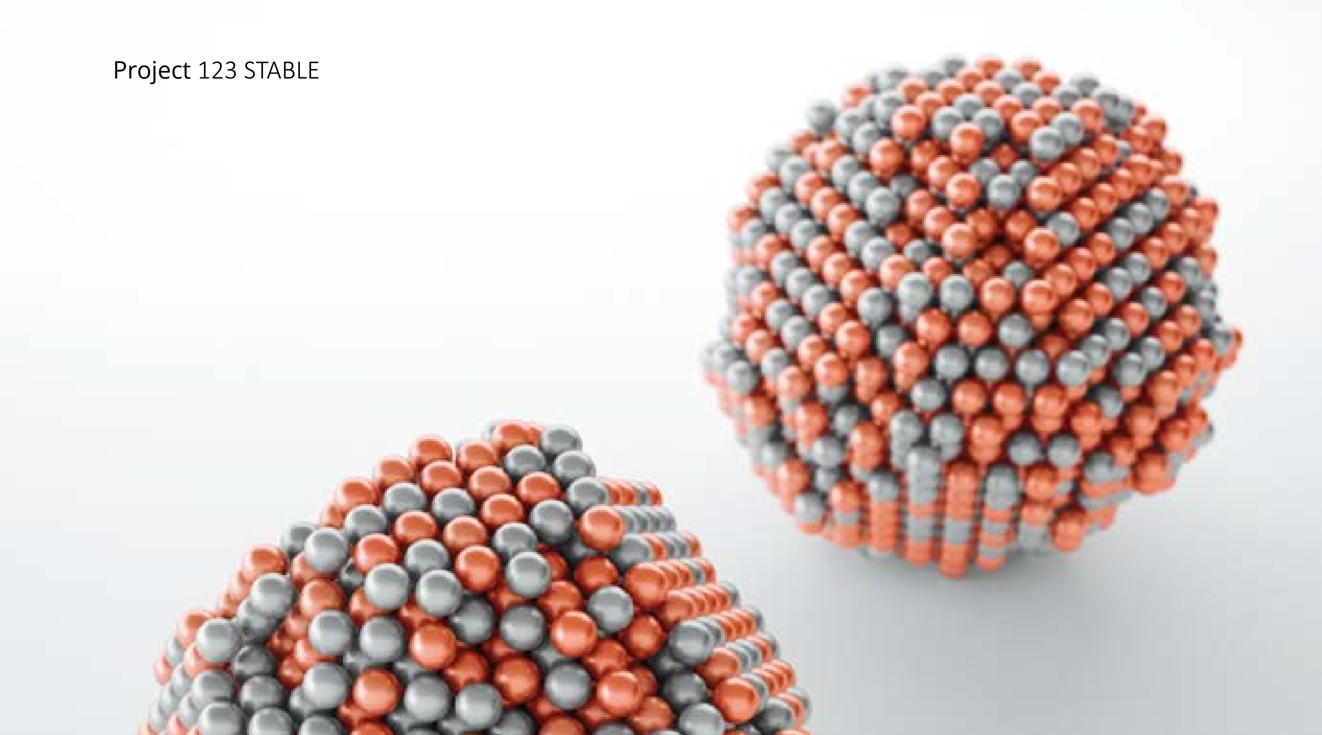
123 STABLE
(Lead Researcher: **Prof. Dr. Nejc Hodnik**)

Hydrogen and fuel cell technologies could accelerate the transition to a clean, low-carbon energy system. Water electrolysis is an environmentally friendly method of producing hydrogen. The efficiency and competitiveness of this process depend on the use of highly stable electrocatalysts. The low stability of electrocatalysts, combined with their low abundance and uneven geographical distribution, acts as a barrier to a more sustainable way of storing and generating electricity. The 123 STABLE project aims to improve the understanding of the structure-stability relationship of catalysts involved in electrochemical reactions. Highly sensitive approaches down to the picogram level, combined with subatomic scale microscopy, promise insights into the corrosion and reconstruction of noble metals in electrochemical environments at the atomic level.

ERC PoC: StableCat

The ERC-funded StableCat project has identified key weaknesses in commercial platinum-based catalysts and gained new structural understanding at the atomic level. In doing so, researchers have devised a new synthesis strategy that allows them to combine three key pillars within the same catalyst material - platinum high surface area, catalytic activity, and durability.


Prof. Dr. Nejc Hodnik

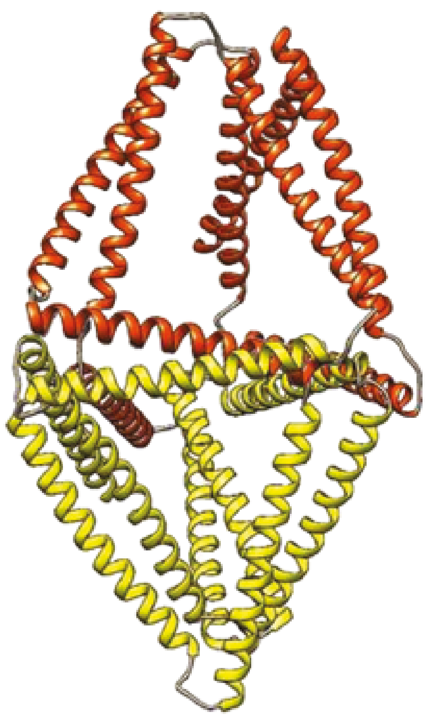

Project 123 STABLE

MaCChines
(Lead Researcher: **Prof. Dr. Roman Jerala**)

The aim of the project is to accelerate research into modular proteins based on coiled-coil protein origami (CCPO) building blocks and to exploit the unique properties of this platform. CCPOs are newly designed proteins consisting of a sequence of coiled-coil (CC) building blocks and flexible linkers that form polyhedral cages based on pairs of CC interactions. These molecules promise efficient recognition, delivery and catalysis and are suitable tools for medicine, biotechnology and other applications. The MaCChines project aims to lay the foundations for a new branch of protein design science and develop technologies for drug delivery, materials engineering, sensors and the design of new therapies.

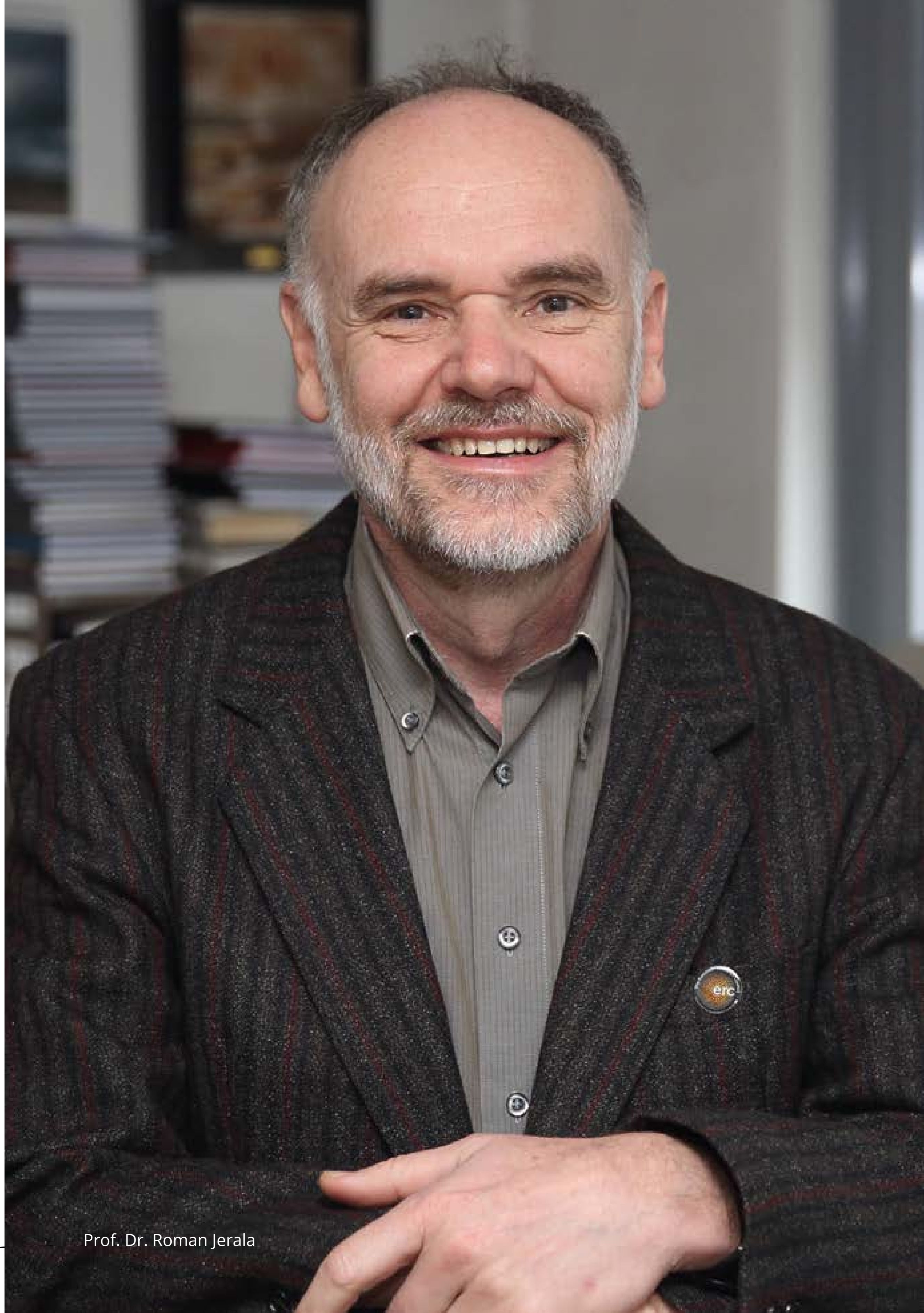
ERC PoC: CC-LEGO

The CC-LEGO project aims to increase the success rate of designing large protein assemblies using coiled-coils (CC) at the interface. CCs are among the best understood protein motifs and can be designed with a high success rate (> 50%). A set of well-defined building blocks (CC-LEGO) will be created by a rigid concatenation of CC bundles and natural oligomerisation domains.



MaCChines

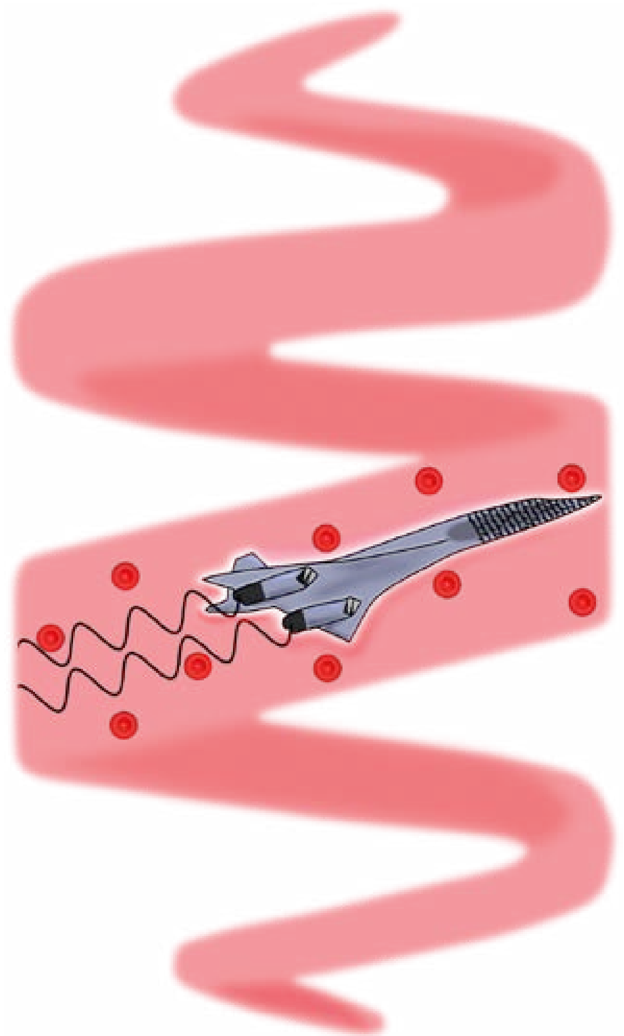
erc
European Research Council
Established by the European Commission



Prof. Dr. Roman Jerala

MULTraSonicA
(Lead Researcher: **Assoc. Prof. Dr. Matej Praprotnik**)

Ultrasound-guided drug and gene delivery (USDG) enables precise drug delivery to cancer tumours via microbubbles (MB) and gas vesicles (GV), reducing toxicity. However, optimisation requires extensive experimentation. The proposed virtual environment aims to optimise USDG by quantifying the MBs and GVs that are critical to success. Current USDG systems rely on empirically set parameters, which limit clinical use. A computational framework for testing and optimising USDG parameters is proposed. New mesoscopic models will accurately capture drug behaviour and overcome the limitations of existing models. Multi-step methods will integrate macro to microscopic levels for accurate modelling. This framework will complement experimental efforts and improve USDG in biomedical applications.



MULTraSonicA

European Research Council
Established by the European Commission

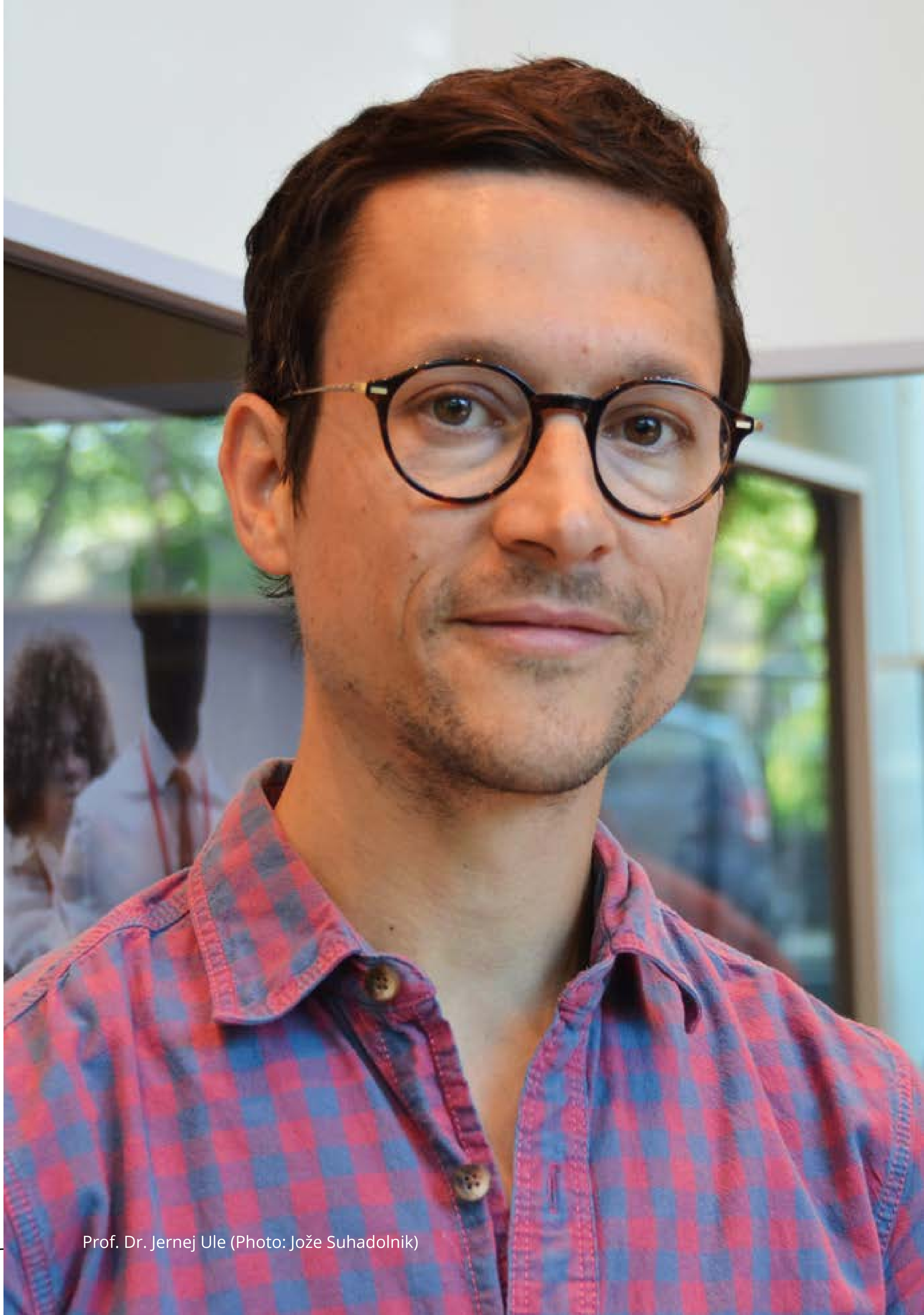
Assoc. Prof. Dr. Matej Praprotnik

RNPdynamics
(Lead Researcher: **Prof. Dr. Jernej Ule**)

Ribonucleoprotein (RNP) complexes regulate development, while mutations in RNA-binding proteins (RBPs) are associated with diseases such as cancer and ALS, often affecting intrinsically disordered regions (IDRs). Multivalent interactions within IDRs drive RNP dynamics, leading to liquid-liquid phase separation. Understanding these dynamics is key to understanding the mechanisms of the disease.The RNPdynamics project aims to investigate these interactions using experimental and computational methods. As part of the project, a research team led by Prof. Dr. Ule is investigating how RBPs affect cell state transitions during neuronal differentiation and developing tools to manipulate RNP assembly. Based on these findings, they will fine-tune RNP assembly in ALS mutant RBPs to reduce toxicity. This approach offers promising opportunities for understanding and potentially treating neurodegenerative diseases.

RNPdynamics

European Research Council
Established by the European Commission



Prof. Dr. Jernej Ule (Photo: Jože Suhadolnik)

07

Young Researchers at the National Institute of Chemistry

Dr. Sara Drvarič Talian

When I was pursuing my doctorate at the National Institute of Chemistry, I was always in contact with outstanding European researchers. This resulted in high-quality publications and awards for my doctoral thesis (the Maks Samec Award 2019, Pregl Award 2020 and IJS Golden Emblem 2021). After my doctorate, I started a family and received support and understanding from the Institute. I am now leading my own research projects and mentoring doctoral students, who I believe will find a job at the National Institute of Chemistry to be a great stepping stone for their future.

Vojtěch Škopek

I came to Slovenia from the Czech Republic embarking on my PhD journey as part of the Scientist4Future program. I'm thrilled for this opportunity because the program supports my development in the field of chemistry in every aspect. The working environment is fantastic and I receive plenty of support, so I feel right at home.

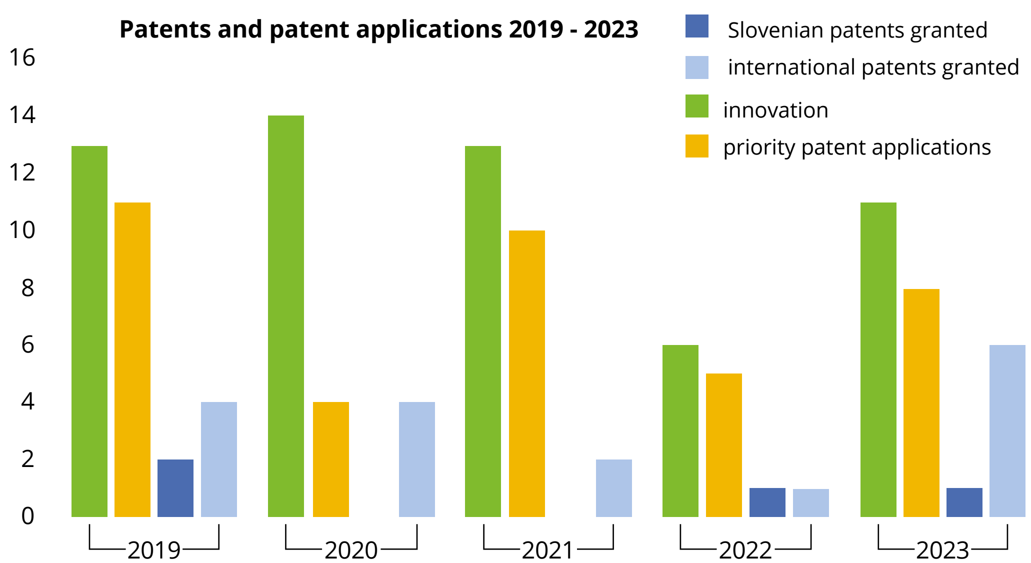
Dr. Ajasja Ljubetić

I love doing research at the National Institute of Chemistry. In 2018, I was awarded a Marie Curie European Fellowship and moved to the USA with my family for three years. I was happy to return to Slovenia in 2022. Our quality of life is much better and I can still do cutting-edge research on protein robots with my team at the National Institute of Chemistry. We have top-notch equipment and excellent colleagues.

08

Knowledge Transfer

Knowledge transfer processes at the National Institute of Chemistry have been systematic from 2019 to 2023. During this time, 57 innovations were made, 38 priority applications and 41 applications were filed with major patent offices around the world (EPO, USA, Japan, South Korea, and China).



Patents protect our intellectual property and provide an opportunity for the commercialisation and marketing of innovative products and services.

In recent years, we have been able to boast new technologies in the development of the new analytical methods needed to comply with REACH legislation and new chemical recycling processes.

We have developed and patented new vaccine delivery methods, new therapeutic and diagnostic procedures, and new compounds for health applications.

In the field of energy efficiency, we have developed new methods for the catalytic conversion of CO_2 and hydrogen, new electrocatalysts, and new processes based on magnetic heating.

NICKI
helping technology to grow

The **NICKI innovation and technological progress incentive enables researchers** to develop their ideas into innovative products, services, and business opportunities. It thus contributes to the development of new technological solutions and the strengthening of innovative entrepreneurship.

Example of good practice of NICKI support

NICKI co-funding has helped to overcome a major bottleneck in the production of the initial M/C (metal nanoparticles on carbon) composite. The improvement has doubled platinum distribution in the final catalyst, thus exceeding the characteristics of the industry reference. This was followed by two scientific publications, with a third still under review, and a simultaneous validation in an industrially relevant environment. The results and validations led to the creation of the spin-out company ReCatalyst, which was awarded the title of Slovenian Start-up of the Year 2023.

National Institute of Chemistry spin-outs

Spin-outs are vehicles for knowledge and innovation, representing excellence in professionalism, dedication, and innovative spirit.

MyCol focuses on the development of advanced **colour technology solutions**. Its products offer sustainable solutions to improve production chains in the food, automotive and other industries.

ReCatalyst develops catalysts for industrial processes and purification technologies. Its products enable **more efficient and environmentally friendly production processes** and help to reduce the environmental impact of industry.

Mebius is continuously developing new and more efficient PEM GC components. The transition to the hydrogen fuel paradigm will require the development of better **proton conducting membranes**, **gas diffusion electrodes** and **membrane electrode assemblies (MEAs)**, which form the core of any hydrogen fuel cell system design and have brought cost effectiveness and energy density to levels that are more than competitive with current, commonly used methods of energy production.

All three spin-out companies are the result of years of research and development at the National Institute of Chemistry and are examples of the successful transfer of knowledge from academia to practical applications in industry. With their innovative solutions and products, they continue the Institute's tradition of excellence and expertise and make an important contribution to the progress and competitiveness of our economy.

MyCol.si

ReCatalyst

mebius

Contribution of the Institute of Chemistry spin-outs

17
new
jobs

EUR 5.7
million in raised funds
(grants and from investors)

09

Collaboration with Industry

The Institute cooperates with more than 100 Slovenian and 20 foreign companies each year. We carry out research and development projects, analyses, and services for companies. We are involved in various Slovenian and European projects with a number of national and international companies.

Steklarna Hrastnik

"The National Institute of Chemistry is an important partner of Steklarna Hrastnik in the field of decarbonisation and the circular economy. In recent years, we have implemented several projects in cooperation with them, which have been well received by our customers. Access to the knowledge and equipment to enable green innovation is a key element in the transformation of the energy-intensive glass industry towards carbon neutrality. This will enable us to maintain our competitive position in global markets for years to come."

Tilen Sever, Steklarna Hrastnik, d. o. o.

10

International involvement

INSTRUCT-ERIC

From July 2023, the National Institute of Chemistry will lead a consortium of Slovenian research organisations in the Instruct-ERIC infrastructure. Instruct-ERIC is the European research infrastructure for structural biology, enabling European researchers to use state-of-the-art technologies and methods. It consists of 16 member countries, including Slovenia. Its aim is to foster innovation in biomedical science through open access to the latest technologies. Structural biology is a key framework for understanding molecular and cellular functions and is at a turning point thanks to advances in various tools.

ILL GRENOBLE

The National Institute of Chemistry has become the Slovenian scientific member of the leading international research centre for neutron scattering, the Max von Laue-Paul Langevin Institute (ILL). This membership brings with it scientific, administrative and financial responsibilities, as well as the coordination of the Slovenian scientific community in this field. The ILL, located in Grenoble, France, is a leading research centre for neutron scattering, providing state-of-the-art research facilities and expertise to visiting scientists. This initiative will provide Slovenian researchers with access to advanced analytical methods in chemistry, materials physics, structural biology and nuclear physics, and increase their opportunities for international collaboration and career development.

CERIC ERIC

CERIC ERIC is a European research infrastructure providing open access to Europe's leading materials, biomaterials and nanotechnology facilities. It connects 8 European countries and is open to researchers from all over the world. The representative of CERIC in Slovenia is the Slovenian NMR Centre, which is part of the National Institute of Chemistry. Participation in CERIC provides international visibility, access and expertise for research on the structure of materials, biomolecules and dynamics, leading to a better understanding of biological functions, structure and dynamics.

instruct ERIC

NEUTRONS FOR SOCIETY

CERIC
Central European
Research Infrastructure
Consortium

11

Investments

The development of the Institute over the last five years has brought us to a point where the space available does not allow us to continue to grow. Lack of space has been identified as a major weakness in the development of the Institute in international assessments. That is why we have prepared ambitious investment plans to address the most pressing spatial challenges by the end of this strategy period, while at the same time enabling research activities to be set up at higher levels of technological sophistication. In addition to the investments shown below, we will also develop a Biomass (Bio)Refining Research Laboratory in Velenje, in cooperation with the Municipality of Velenje.

Ark Arhitektura Krušec d. o. o.

Hajdrihova ulica site

On the basis of the selected architectural solution for the integrated and functional layout of infrastructure on Hajdrihova ulica in Ljubljana, two new wings will be built in the north-eastern part of the Institute. The architectural solution envisages a total gross floor area of approximately 5,500 m^2. The new premises will be located in the middle wing, between the main building and the CTGCT (Centre for the Technologies of Gene and Cell Therapy), and in the inner courtyard, which will act as a connecting building.

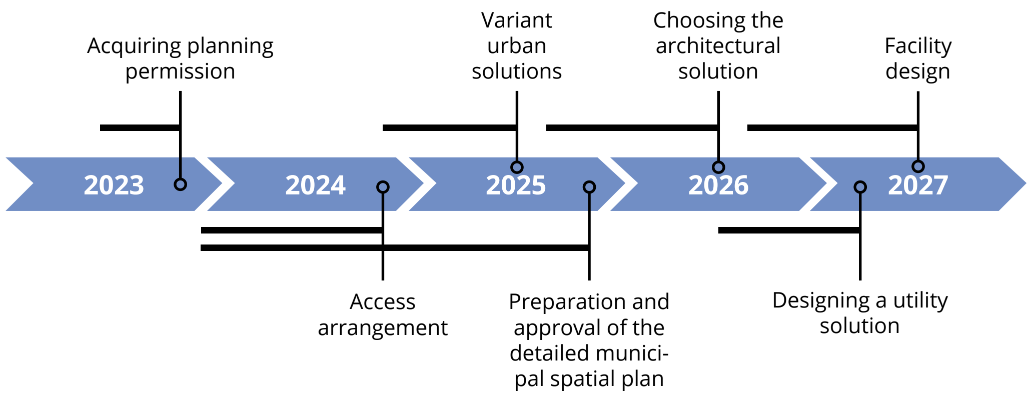
CTGCT Centre

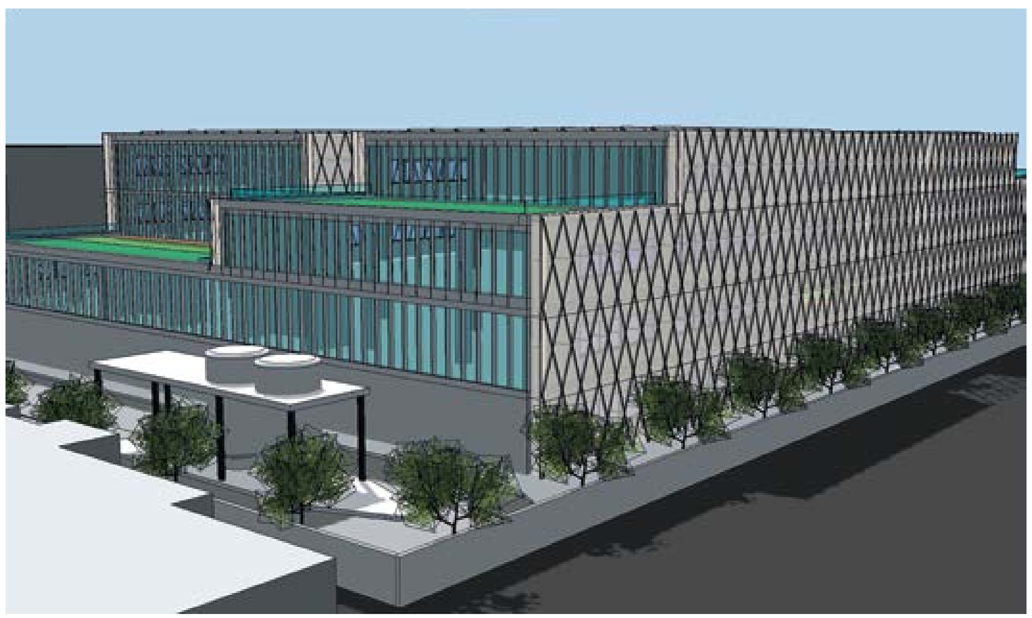
The Centre for Technologies of Gene and Cell Therapy (CTGCT) will be located in a wing at the extreme north-eastern end of the National Institute of Chemistry on Hajdrihova ulica and in the basement of this area. Connections to the rest of the Institute will be provided. Approximately 2,000 m^2 will be dedicated to the CTGCT. In addition to the general laboratories, the Centre will house clean laboratories for work on advanced therapy research (gene and cell therapy).

Ark Arhitektura Krušec d. o. o.

Chemical Institute's Sustainable Technologies Research Centre

The long-term development of the Institute at its current location on Hajdrihova ulica is not possible, despite the planned consolidation of premises and the new building. Therefore, in autumn 2023, the Institute acquired planning permission for a plot of land in its immediate vicinity. It will be used to build and create infrastructure for researching innovative processes and materials, chemical engineering, and sustainable energy.

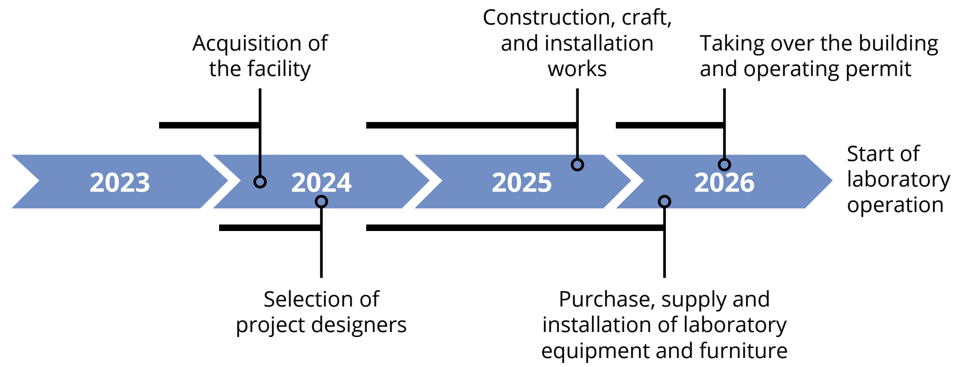




Biro Arcus d. o. o.

Centre for Development, Demonstration, and Training for Carbon-Free Technologies (DUBT Centre)

The DUBT Centre will be located in the Kisovec industrial zone in Zagorje ob Savi. The existing industrial facility will be converted and fitted with laboratory-demonstration equipment for research at higher levels of technological development. The new facilities will provide access to the most advanced equipment for carbon-free technologies in this part of Europe. The ground floor will consist of a hall housing laboratory equipment, while the first floor will be used for laboratories and offices.



I FEEL SLOVENIA

Sofinancira Evropska unija

REPUBLIKA SLOVENIJA
MINISTRSTVO ZA VISOKO ŠOLSTVO, ZNANOST IN INOVACIJE

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