40 stories 40 years

EU Research & Innovation

40 stories for 40 years of EU Research and Innovation

European Commission
Directorate-General for Research and Innovation
Directorate I - Internal Support Services & Communication
Unit I.4 — Communication

Email RTD-PUBLICATIONS@ec.europa.eu

European Commission
B-1049 Brussels

Manuscript completed in September 2024.
First edition.

PDF	ISBN 978-92-68-14848-8	doi:10.2777/31188	KI-06-24-078-EN-N
BOOK	ISBN 978-92-68-14849-5	doi:10.2777/471645	KI-06-24-078-EN-C

Luxembourg: Publications Office of the European Union, 2024

40 stories
40 years

EU Research & Innovation

2024 Directorate-General for Research and Innovation

Index

Introduction

2024 marks 40 years since the launch of the EU's first funding programme dedicated to science, research and innovation.

The EU has set aside over €280 billion for science, research and innovation through successive framework programmes. To date, it has signed over 120 000 grants with some 75 000 beneficiaries. More than 30 top EU-funded researchers went on to win Nobel Prizes, including seven in just the last four years.

Over the last four decades, **scientists, researchers and innovators have helped the EU maintain its competitive edge in the global economy.** They have delivered new knowledge and solutions to challenges in areas that matter to Europeans and global citizens alike. EU R&I funding has created quality jobs, supported innovative companies of all sizes, enhanced the EU's sustainable competitiveness and technological sovereignty. It also achieved remarkable progress in terms of integrating the gender dimension in its projects and in terms of working towards gender balance among researchers and research organisations. **R&I means caring for our planet and natural resources, working for healthy and inclusive societies, protecting democracy and European values.**

This booklet presents a symbolic 40 stories to illustrate the breadth of R&I made possible through EU R&I funding and some of the results achieved over the last 40 years. It covers industrial innovation, health, transport, energy, society, the environment, food, digitalisation, international cooperation, security, and space.

Of course, these 40 stories are just a fraction of the many projects that have received support from the EU's R&I framework programmes. **If you have a story about how EU-funded research has made a difference, we would love to hear from you!** Share your experiences using the hashtag **#ResearchImpactEU** or **#EU40YearsRI** on social media.

Digitalisation

To connect and transform

SETTING THE POWER OF SCIENCE FREE FOR EVERYONE'S BENEFIT

The easier knowledge can be spread, the faster science can move forward. The OpenAIRE initiative has been spearheading this vision with the goal of setting European science free.

Open science is an approach that makes the outputs of scientific research freely available using digital and collaborative technology.

To support this mission, a major e-infrastructure project has been underway since 2008 to create OpenAIRE, an open science platform for Europe. Now, the team behind OpenAIRE have taken things a step further through the OpenAIRE-Advance project. As well as democratising the scientific process in publicly funded areas, they support the EU objective of making open access to research the default option for the whole of Europe.

They have created an Open Research Graph, which collects research data along with its related information and links in a huge database for people to consult.

The resource can be used by everyone from funders and research organisations to citizen scientists exploring topics they care about.

Another innovation is National Open Access Desks (NOADs), which have been set up in every participating country. These NOADs can develop long-term working relationships with institutions carrying out research across the nation.

They can also act as hubs for researchers and policymakers to come together and collaborate. NOADs have been making an impact all over Europe. For example, in Finland, the NOAD is deeply involved in the nation's open science working groups, while in Türkiye, the group has put an open science roadmap on the national agenda.

Besides these activities,

the researchers – from 50 partners from European research institutions – have also been promoting open science through national workshops, training events and learning materials.

Moreover, they have extended their reach globally, connecting with open science networks in South America, Canada and Africa. They are working in partnership with the United Nations to add open access content to the UN's 2030 Connect platform, established as a gateway to science, technology and innovation resources.

Read more about the **OpenAIRE-Advance** project

facts & figures

The database has a **de-duplication system** to avoid repeating information

The project contributed to the **European Open Science Cloud**

Digitalisation

LATEST SMART TECHNOLOGY IS HELPING DRIVE A REVOLUTION IN HOW BUSINESSES OPERATE

Cyber-physical systems that blend the digital and real worlds are driving the development of smart factories, transport networks, electricity grids and even cities. Researchers have been exploring the opportunities and risks presented by the expansion of big data and connected devices.

Their work is driving innovation in a range of concepts, from autonomous cars and robotic surgery to intelligent buildings and implanted medical devices.

From 2016 to 2018, four leading research institutes in Hungary, Germany, Belgium, and the United Kingdom

worked together to share and build knowledge about the impact of digitalisation on production and logistics networks.

The research team set out to bridge the gap between research and industry.

They wanted to help those working in production and logistics use the research's results to innovate, develop smart environments, and ultimately increase productivity, efficiency and sustainability.

The work is built on the concept of the fourth revolution – or so-called Industry 4.0 – in which technology continues to transform the way we live and work and enables the creation of cyber-physical systems that monitor, analyse and automate business processes.

The team focused on research combining cyber-physical systems with innovations in areas such as the way humans interact with technologies. Among other areas, they also analysed the use of the Internet of Things, in which services can be provided through embedded sensors, software and other technologies used to connect devices and exchange data.

Specific projects included developing a concept for the recycling, reuse and remanufacturing of waste electronics using a cloud-based information system.

Through a programme of conferences, training activities, and staff secondments, the researchers have helped those in industry to strengthen their knowledge about different advancements in cyber-physical systems and also to help managers develop complementary skills, such as hands-on experience contributing to software tools.

Joint publications have also highlighted challenges that the scientific community and industry experts can tackle together.

Read more about the **EXCELL** project

facts & figures

The team ran

17

staff visits and

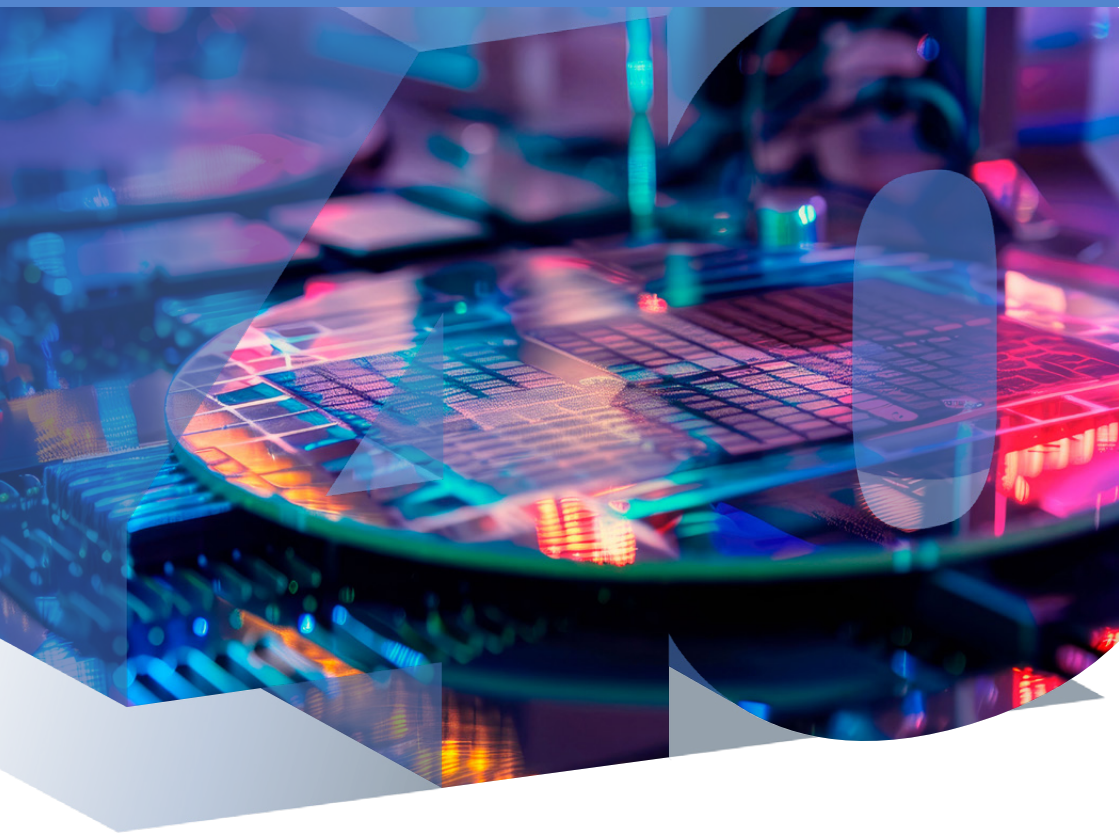
8

scientific and complementary **skills training sessions**

.

10

comprehensive scientific papers have been produced



INNOVATIVE CHIPS FOR LESS POWER-HUNGRY SMARTPHONES

Chips, also known as semiconductors, though largely go unseen, are at the heart of all the digital products that surround us — from smartphones and computers to home appliances, life-saving equipment, communication and energy.

To get better-performing devices, we need smaller chips. Researchers have developed and produced a new chip that has enabled the launch of a new generation of high-performance smartphones.

They used state-of-the-art extreme ultraviolet (EUV) lithography and new material processes to make smaller semiconductors become a commercial reality.

The smaller the semiconductor, the more of them you can fit into electronic devices – and the more high-performing and energy-efficient that electronic is.

In this sense, semiconductors have come a long way. In 1968, they measured 20 thousandths of a millimetre, or 20 000 nanometres (nm). Today's mass-produced semiconductors can be just 10 and 14nm – but researchers are continually striving to make them even smaller.

This revolution in size is what fuels Moore's Law, which predicts that the number of transistors on a microchip will double approximately every two years. This has been happening for decades, and it means our smart devices get more and more powerful with each generation.

Although the technology to make ever smaller semiconductors exists, producing them in a cost-effective fashion that can be streamlined for mass production is a very different challenge.

For the new chip, the researchers developed a system that used EUV's extremely short wavelengths of ultraviolet light to transfer a pattern from an opaque template onto a light-sensitive material on the semiconductor.

This guides the printing of the integrated circuit. The work involved finessing both the lithography technique as well as the materials used in the patterning.

The successful integration of EUV technology has led to more powerful, efficient, and cost-effective electronics.

The progression in semiconductors is essential for the continued advancement of electronic devices and modern society's economic stability.

Read more about the **SeNaTe** project

facts & figures

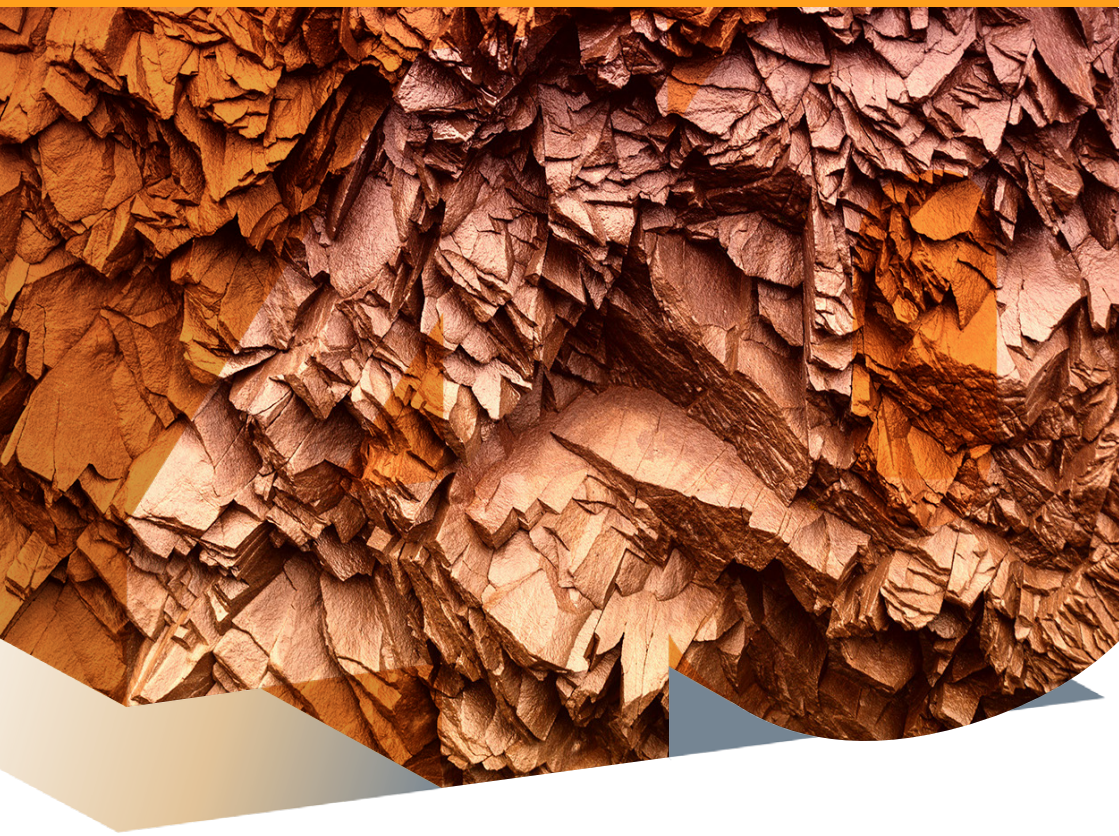
The **first semiconductors** used for electronics measured **20 000 nm**

The project drew on the expertise of **40 partner companies** and **research institutes** worldwide

From **2020** to **2023**, the world suffered a **serious semiconductor shortage**

Energy

To power and sustain



TURNING CO_2 FROM THE ATMOSPHERE INTO STONE UNDERGROUND

Industrial activities, from electricity generation to cement production, are responsible for emitting huge amounts of greenhouse gases, including carbon dioxide (CO_2). What can we do about these ever-increasing levels of carbon dioxide in the world, especially those emissions produced by industry? How about injecting it into the ground, where it turns to stone and is stored forever? That sounds far-fetched but it is actually a natural process that already happens on earth.

Researchers have pioneered a groundbreaking technology to remove CO_2 at the source, such as from a factory chimney, dissolve it in water and then inject it into deep lava layers where it reacts with minerals and turns into rock, preventing it from escaping back into the atmosphere.

The project was centred at the giant Hellisheiði Geothermal Power Plant in Iceland, one of the largest in the world. The plant harnesses volcanic heat to generate electricity and provide hot water for much of the country's population. Continuous capture of CO_2 emissions from the steam emitted by the plant has been ongoing since 2014. A company was founded shortly after the project was completed, in order to bring the technology to market.

The project featured in 'Down to Earth', a Netflix travel show exploring healthy and sustainable ways to live, and has also been featured on the BBC, HBO, National Geographic and more.

Starting in 2025, CO_2 captured at industrial sites in northern Europe will be shipped to a cross-border carbon transport and storage hub in Iceland before being injected into the ground.

Reducing the amount of greenhouse gases in the atmosphere is vital for Europe to become climate-neutral by 2050.

This technology could lead to more climate-friendly industries and help meet climate targets.

Read more about the **CarbFix2** project.

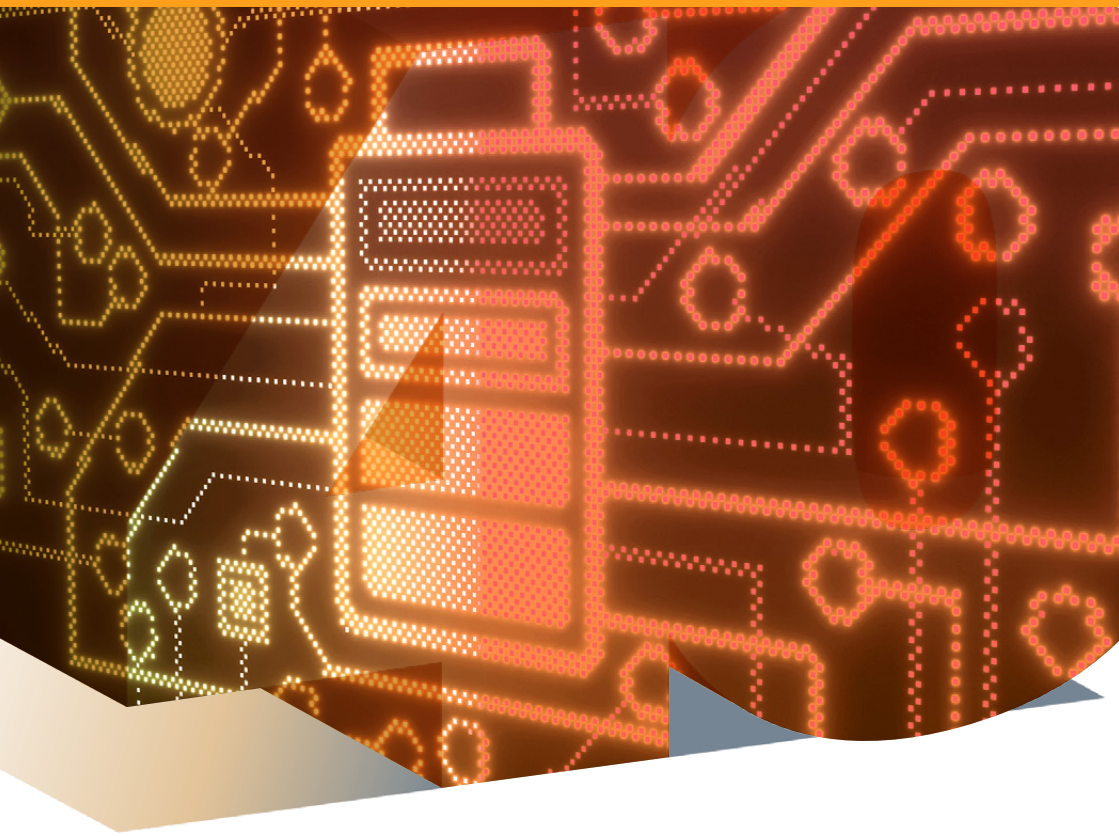
facts & figures

Around

102 393

metric tonnes of CO_2 has been injected underground since 2014

By beating nature in speed and mitigating the risk of leakage, this is a **rock-solid solution for storing CO_2**



TWO-DIMENSIONAL NANO-FLAKES COULD BE KEY TO TOMORROW'S ENERGY STORAGE

Led by Prof. Valeria Nicolosi at Trinity College in Dublin, Ireland, scientists are developing next-generation batteries that could provide more efficient ways of storing and delivering energy, allowing electric cars, laptops and smartphones to charge faster and operate for longer periods.

The new technology also allows batteries to become much smaller while delivering the same power. To achieve this goal, the scientists developed a novel 'supercapacitor' using extremely thin materials such as graphene and the means to produce it through inkjet printing. This process uses slightly modified inkjet printers, similar to those found in offices.

This supercapacitor combines the strengths of batteries and capacitors by holding relatively higher storage capacity while efficiently delivering a high level of power.

It is estimated that the method can increase a battery's lifetime 5 000 times more than the technology in 2016, when the project completed its work.

Capacitors and batteries differ in the ways they are used based in part on their ability to hold energy and deliver it when needed. Batteries can hold more energy but provide lower power relative to scale compared to capacitors, which are used to provide high bursts of power for devices such as camera flashes. Nanotechnology combines science and engineering to develop tiny structures at dimensions of around 100 millionth of a millimetre and below.

The scientists used nanotechnology techniques in a process called 'exfoliation', which strips layers off materials to create super-thin electrodes, a key component for energy storage and delivery.

The thinner an electrode is, the more energy can be stored by a battery.

And these two-dimensional nanolayers are some of the thinnest around.

The scientists tested the process by combining different metals and minerals, including graphene. Made up of a carbon layer just one atom thick, graphene is incredibly light, stronger than steel and can conduct electricity better than copper.

The research attracted industry partnerships, indicating its real-world impact.

Read more about the **2DNanoCaps** project.

facts & figures

Graphene comes from **graphite**, as found in lead pencils

▪

Exfoliated layers can also be used **to improve device touchscreens**

▪

The project resulted in **> 45 publications,** with one paper cited by other scientists **> 1 200 times**

BRIGHTENING THE FUTURE OF SOLAR ENERGY IN CYPRUS

Sun-drenched Cyprus imports most of its energy, but this is unnecessary: Cyprus has the highest solar power potential in the European Union. Local engineers and researchers, together with energy experts from Austria and Denmark, have worked to develop the use of this natural resource on the island.

The research promoted the development of Cyprus as a hub for solar power innovation.

The initiative harnessed expertise on all aspects of the solar energy cycle. This includes the solar cells that harvest the sun's energy, the storage systems required to exploit a variable resource that is unavailable at night, and the smart power grids needed to distribute and manage the flow of electricity.

Early successes in the initiative included a novel method to tackle harmful leakages of electrical power in solar energy systems, which can degrade the long-term performance of solar cells.

The improved cells were designed for use in a new solar park at the University of Cyprus, meeting all the university's electricity needs.

The efforts of the local and international consortium have also led to many new proposals for future research that build on the initial results.

The work is helping to train the next generation of solar energy researchers and engineers.

They are needed to sustain progress and promote further advances. Specific training sessions have focused on photovoltaic performance and monitoring, degradation, fault detection, power forecasting, grid integration and battery storage. The results of this training were presented at two international conferences.

Additional work with Cypriot industrial partners will continue to strengthen collaboration between industry and academia, benefiting the solar power industry in Cyprus, throughout Europe and beyond.

Outside of Europe, the work has enhanced the links between the EU partners and countries in the Middle East and North Africa, which also have vast solar energy potential.

Read more about the **TwinPV** project.

facts & figures

Cyprus has more than **3 300 hours of sunlight** per year

By **2022,** Cyprus was generating almost **12%** of **its energy from solar power**

FROM OLD TO GOLD: DEEP RENOVATION AND ENERGY SAVINGS FOR AGEING BUILDINGS

Private investment to fund the renovation of buildings in line with Europe's energy efficiency goals can be difficult to find. A financing scheme in Latvia has shown how energy service companies could be supported in funding the renovation of such buildings.

This EU-funded initiative stimulated more than €20 million of investments to renovate over 100 000 m^2 of public and multi-family residential buildings in Latvia dating from the Soviet era.

Energy savings of between 30% and 60% were achieved and, in total, an annual energy saving of 8.6 GWh was made.

Energy service companies are a relatively new breed in the market. In addition to providing traditional consultancy and equipment services, they may also finance and implement energy efficiency projects.

They can contractually guarantee energy savings. Such savings guarantees, referred to as energy performing contracts, can be used to convince lenders to finance the extensive renovation work required for older buildings.

However, in emerging energy performance contracting markets like Latvia, banks are hesitant to get on board. To initiate the market in Latvia, the initiative helped set up the Latvian Baltic Energy Efficiency Facility to help small- and medium-sized municipalities get their major renovation projects financed.

The facility helps minimise the capital investment and risk, and ensures operation and maintenance of the renovation contract, including decreased energy consumption, for the entire contract duration – potentially up to 20 years.

The lessons learnt in Latvia on financing energy efficiency investments and the platform developed could be adjusted for use by other countries, allowing for scaling up across Europe. It is one of several EU-funded initiatives to encourage the private financing of deep renovations to achieve energy efficiency savings for older buildings.

An estimated 220 million buildings, representing 85 out of 100 buildings in the EU, were built before 2001. Most are not energy-efficient, have poor insulation, rely on fossil fuels for heating and cooling, and use older, wasteful technologies.

Standard renovation can achieve energy savings of 20 to 30%. A major renovation using state-of-the-art technologies can slash a building's energy use by more than 75% and extend its life by 30 years or more.

Read more about the **Accelerate SUNShINE** project.

facts & figures

Over

120

energy audits

and over

45

project development plans were completed

9 000

people

directly **benefited** from the renovation projects

75 356

m² of multi-family residential buildings were involved

Environment

To preserve and protect

POLLINATORS ARE BEING PROTECTED BY 3D-PRINTED BEEHIVES MADE OF FUNGUS

Honeybee populations are under increasing pressure, with these important pollinators in decline across the globe. Researchers have come up with a revolutionary, futuristic concept to protect them.

Nearly three-quarters of food crops depend on pollinators to some extent, so ensuring the wellbeing of these insects as they confront pressure from all sides - climate change, habitat loss, pesticides and invasive alien species - will be central to ensuring, healthy functioning ecosystems and enough food.

facts & figures

Scientists working in Belgium, Bulgaria, Germany, Latvia and Switzerland collaborated on a series of hives containing digital technologies to help monitor and manage honeybee populations.

The technologies could help support precision agriculture.

One innovation is a digital honeybee comb, consisting of many individual robots on the honeycomb, which is itself embedded with a range of sensors. It gathers data on the honeybees and responds with vibration patterns or changes in temperature to control and move the bee colony in specific ways.

Bees use a 'waggle dance' to communicate with each other about pollen sources, and researchers created a dancing robot to actively recruit bees to specific locations.

The team developed a series of hives to embed the various technologies inside. One of the hives developed by the team was made by 3D-printing an artificial hollow tree trunk using fungi, a natural material that boosts the environmental benefits of the system.

Read more about the **HIVEOPOLIS** project.

Insect populations are in **decline** across the globe

About **70%** of the main crop species are **animal pollinated, primarily by bees**

FINDING TREASURE IN TRASH BY TURNING DIRTY DIAPERS INTO VALUABLE MATERIALS

The convenience of disposable nappies, or diapers, comes at a shocking environmental cost. Every year, 8.5 million tonnes of absorbent hygienic products (AHP), which include disposable diapers, end up in Europe's landfills or incinerators. AHP makes up around 3 to 4% of household waste.

In response,

scientists have developed an innovative system to convert previously non-recyclable used nappies, sanitary pads and adult incontinence products into high-value new materials.

AHP are mainly made from cellulose, plastics and superabsorbent polymers. These valuable materials are in demand for many products, from packaging and bottle caps to organic fertiliser and new AHP, such as absorbent mats for medical treatment.

The nappy conversion system was successfully tested at a full-scale demonstration plant in Treviso, Italy. The fully automated process separated used nappies and other AHP into their component parts.

The first stage opens up the products and sterilises them using steam in a rotating vessel called an autoclave. The sterilised waste is then gently dried. In the final stage, mechanical and optical separators turn the waste into components ready for recycling.

The project demonstrated the pre-treatment of up to 1 500 tonnes of AHP waste every year. It converted the recovered cellulose-based materials into sugars that were then used to make biodegradable and compostable bioplastics.

By-products are used to produce biogas and high-quality compost for soil improvement and regeneration.

As the separate collection of AHP waste was central to the success of this model, the project also developed smart bins for dedicated municipal nappy collection.

An accompanying phone app located and opened the nearest bin, which otherwise remained locked to keep the nappies and smells inside. A trial of 12 bins in two densely populated districts in Amsterdam was a success, as were other trials in Paris and Verona.

Read more about the **EMBRACED** project.

facts & figures

Europe's babies use

36

million disposable nappies every year

Annual **AHP waste** in Europe is equivalent to

30

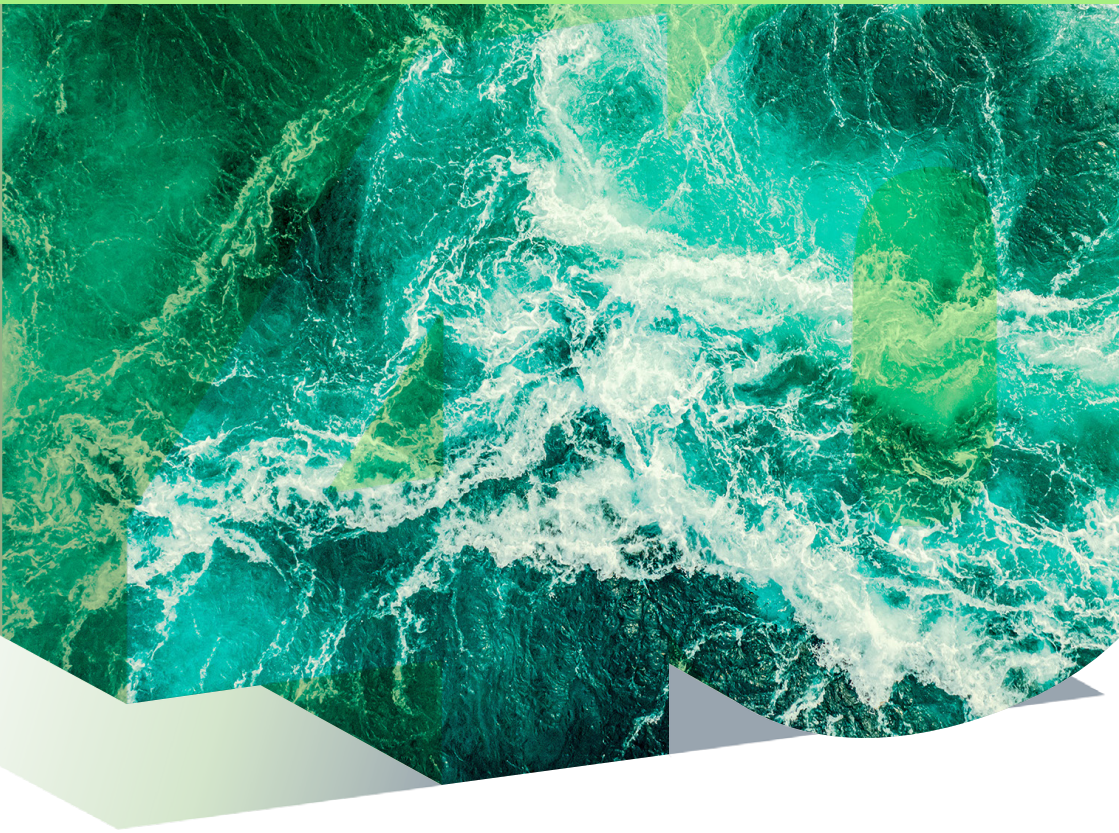
landfills a year

The demonstration plant created

153

new jobs

in the logistic, waste management and product development sectors



ALL AT SEA: DEVELOPING A EUROPEAN-WIDE OCEAN MONITORING SYSTEM

Oil spills, red tides, coastal floods and toxic algal blooms often hit the headlines, even though a wide range of treaties, conventions, and organisations monitor and protect the marine environment in Europe.

Understanding what's happening in Europe's oceans is important to maintaining the balance between economic and social benefits on one hand and minimising environmental impact on the other. However, the systems predicting ocean-based events across Europe were fragmented, incomplete and inconsistent across regions.

facts & figures

From 2003 to mid-2004, a novel project took the first steps towards Europe's current integrated ocean monitoring system.

Operational oceanography combines data from river- and ocean-based monitoring systems with satellite observations and ocean models, allowing us to describe the current state of the oceans, forecast future conditions, and assemble long-term data sets showing trends and changes.

For 18 months researchers assessed and demonstrated the capacity of four existing monitoring and forecasting systems across the North Atlantic and the Mediterranean.

To do this, they integrated satellite observations with data from different monitoring technologies, including tide gauges, moored buoys, tagged sea animals and dedicated research vessels.

The researchers also reviewed high-resolution models for inspecting specific issues, such as harmful algal bloom and oil spill monitoring in the Baltic, North Sea, Irish Sea, Iberian coastal shelf seas and the Aegean Sea.

The project highlighted challenges and shortcomings for future work and planned a practical, unified approach to conducting observations across Europe by consulting model developers and those reviewing the existing and planned availability of satellite and in situ ocean monitoring systems.

The project was part of a larger global monitoring programme to provide accurate, timely and easily accessible information to improve the management of the environment, understand and mitigate the effects of climate change and ensure civil security.

Read more about the **MERSEA-STRAND 1** project.

The researchers studied the data for the **North Atlantic** and the **Mediterranean**

IT'S A PIRATE'S LIFE FOR KIDS, ON A MISSION TO REDUCE PLASTIC POLLUTION

A large portion of plastic litter is transferred from the land to marine areas via rivers. While there is a fair understanding of the origins of plastic litter in a few of Europe's regions and river systems, the research is largely incomplete.

To help fill the knowledge gap, school children across Europe aged 10 to 16 joined the Plastic Pirates – Go Europe! initiative on an important mission: collecting plastic pollution from coastlines and waterways to shed light on the amounts of plastic flowing into our ocean.

Citizen science is an approach to involve the public in research providing professional scientists with

more data than they could have gathered otherwise. This contribution can lead to better and more accurate results.

Plastic Pirates – Go Europe! empowered children to take action against plastic pollution.

By engaging young people as citizen scientists it also contributed valuable data for scientific analysis.

Since 2022, over 16 000 children from 13 European countries have participated in the programme to find and categorise 93 718 plastic items recovered at more than 350 rivers, waterways, and coastal areas.

They followed a scientific approach developed by the project. Their findings were then validated and analysed by researchers.

The initiative is part of the EU Mission Restore our Ocean and Waters by 2030.

It contributes to the Mission's objectives by empowering young Europeans to take action against plastic pollution and supplying data aimed at reducing macro- and microplastics in our waterways and seas by 2030.

Countries achieving notable success with this programme, such as Germany, use a whole-of-society approach to get schools, teachers, and kids involved. Free teaching materials and the Plastic Pirates Action Booklet give citizens a hands-on protocol for collecting scientifically valuable data and increasing their knowledge of the ocean environment. This includes information on responsible consumer behaviour and the risks of plastic pollution to our waterways.

Plastic Pirates – Go Europe! intends to serve as a guiding light for engaging people in other citizen science initiatives across Europe.

Read more about the **PlasticPiratesEU** project.

facts & figures

13
million tonnes
of plastic litter are washed into the ocean from land each year

Of this, rivers contribute up to

2.8
million tonnes

Food

To enrich and nourish

SCIENTISTS BOOST CROPS THAT ARE BETTER FOR CLIMATE AND HEALTH

Einkorn, emmer and spelt, and even oats or rye may not be the first grains that spring to mind when thinking about cereals. Yet researchers from 10 different countries have rekindled interest in these traditional crops for the benefit of our environment and health.

These cereals require far less fertilisers, pesticides, and energy, compared to the dominant grain crops: wheat, maize, and barley.

Growing a wider variety of crops is a useful strategy in terms of potential exposure to droughts and diseases.

Relying on only one crop increases vulnerability, as was the case during the Irish potato famine in the mid-19th century. Disease wiped out the country's potato crop, leading to widespread starvation.

Optimising cultivation methods was one of the researchers' priorities, as was the refinement of processing techniques. The researchers also interacted with millers, bakers, and other partners to generate momentum, address practical matters, and explore the market potential.

Field experiments were carried out in Estonia, the United Kingdom, Czechia, and Crete.

With partners, researchers planted, studied and cross-bred many hundreds of genotypes – sets of genes in a plant's DNA.

They selected varieties with promising qualities, such as higher yields, greater resistance to fungal infections and particular suitability for processing, while also looking into potential health benefits.

While rye bread or porridge oats may not be everyone's first choice for breakfast, a broadened taste in cereals can boost health and help protect the future of Europe's farming.

Read more about the **HealthyMinorCereals** project.

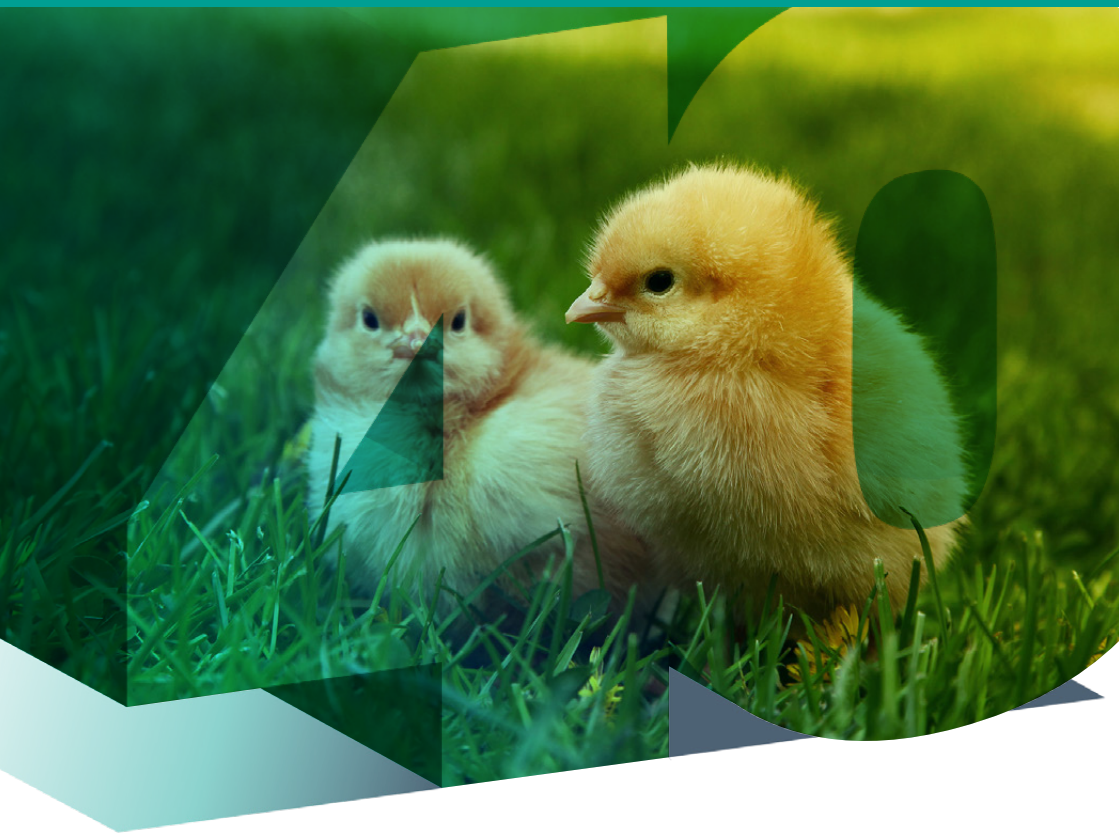
facts & figures

Wheat, barley and **maize** account for more than

85%

of the cereals currently grown and produced on a global scale

Rye, oat, spelt, emmer and **einkorn** are classified as **minor cereals**



A REVOLUTIONARY EGG FARMING TECHNOLOGY COULD END MALE CHICK CULLING

Each year, the egg industry kills 6.5 billion male chicks, but can we prevent this practice? Scientists have found a way to reduce this mass culling through new technology.

Leading the charge is the Netherlands-based company In Ovo, a spinoff from the University of Leiden, whose automated technology determines the sex of chicks during egg incubation, leading to improved animal welfare and a more sustainable poultry industry.

Day-old male chicks are usually considered a byproduct when farmers breed layers for eggs. Current practice sees egg farmers checking the sex of each chick manually after hatching. These chicks cannot be raised and sold as poultry meat, as meat-poultry chickens are a specialised breed that differs from egg-laying chickens. Male chick breeds for laying will not get big enough to sell as meat.

Despite being one of the largest and oldest problems in the poultry industry, this issue has received little attention until recently. But now, consumers, supermarkets and policymakers are putting pressure on the poultry industry to find a solution. Germany, for example, issued a ban on the slaughtering of male chicks in 2022.

One solution? Remove male eggs from incubators before hatching.

The technology automatically identifies male eggs on day nine of incubation using a single sex-linked biomarker discovered in 2016.

Within a few seconds, the machine drills a tiny hole in the shell and harmlessly takes out a small drop of fluid. The hole is then closed. Mass spectroscopy screens the samples for the biomarker to determine the sex of the chicken.

The technology, which has operated at a commercial hatchery in the Netherlands since 2022, can also reduce the environmental impact of the poultry industry in cases where male chicks are not killed immediately after hatching. Some factories rear males for meat, but as egg-laying chickens take longer to grow, this demands more feed and creates more waste than rearing chickens bred for their meat.

Read more about the **InOvotive** project.

facts & figures

Seven billion
egg-laying hens are hatched every year

One egg-sorting machine prevents **CO_2 emissions** equivalent to those produced by

2 000
Dutch households
annually

SAFE AND SUSTAINABLE SEAFOOD TO LAND ON PLATES ACROSS EUROPE

As a source of high-quality protein and naturally rich in valuable nutrients, seafood is one of Europe's most important food commodities. But as the population grows, how can we meet demand while making seafood more socially, economically and environmentally sustainable?

In 2017, researchers set out to develop new, eco-innovative and transparent seafood production and processing methods.

Over three and a half years, they generated research, tools, and solutions to tackle sustainability, safety,

quality and transparency along the whole supply chain of the European seafood industry.

The project especially focused on the nutritional needs of pregnant women, older adults and children – all of whom will also benefit from tailor-made seafood products thanks to the project's efforts.

For example, researchers formulated novel aquaculture feeds using sustainable natural ingredients to replace traditional fish feed sources. The aim was to produce farmed fish fillets fortified with essential nutrients. They supported improved seafood production by developing technologies to reduce energy and water consumption.

Another innovation related to production is a shortlist of formulas that can be used by producers of smoked salmon and salmon pâté to reduce the amount of sodium in end products while maintaining taste and microbiological safety.

The project tested and validated faster, more effective methods to detect, remove or reduce contaminants.

To encourage consumers to be more aware of the seafood they are eating, the researchers launched a new version of FishChoice, an online tool that provides detailed information on the sustainability, nutrients and potential pollutants of seafood.

In parallel, a cooking competition was held to create dishes using less popular but sustainable species, such as chub, horse mackerel and gilthead seabream.

The project's work helps boost the popularity of high-quality, sustainable seafood. This could lead to the creation of more scalable markets and an increase in the availability of healthier seafood to improve consumer diets and health.

Read more about the **SEAFOODTOMORROW** project.

facts & figures

3
billion people rely on **seafood** as a **primary source of protein**

Seafood is naturally rich in **vitamins** (A, D3, B12), **minerals** (iodine, selenium) and **fatty acids**

The **FishChoice** tool is available in
25
languages

Health

To cure and care

FROM SCAN TO SURGERY: 3D PRINTING MODELS THAT HELP SURGEONS BETTER PREPARE

If you are about to have surgery, especially a complicated one, you want the surgeon to have as much information as possible. Simple imaging techniques, like X-rays, are a good starting point, but they are not always sufficient.

For complex procedures, physical 3D models can make a big difference in helping surgeons prepare. These models enable surgeons to visualise and rehearse procedures on patient-specific replicas, improving precision and reducing risks during actual surgeries, benefiting patients.

Back in the 1990s,

researchers developed a method that results in highly accurate 3D

medical models based on images generated from CT and MRI scans.

They showed that it is possible to produce accurate medical models based on medical image data.

They also developed a selective colouring of medical models so that all relevant information from the images can be transferred to the surgeon.

The models are built using laser photopolymerisation, a 3D printing technology that creates precise, solid objects layer by layer. It uses a laser to cure and harden liquid photopolymer resin. The resin is low-toxicity and can even be used in the theatre room. The entire process from scan to print can take just a few hours.

The application is not too dissimilar to other 3D printing techniques. However, when you are 3D printing something, you input the model you want. In the medical scenario, you must work with imperfect and incomplete information. Part of the challenge with this type of research was interpolating the existing data into a coherent, plausible structure.

Smart algorithms developed in the project and submillimetre accuracy ensured the models capture critical anatomical details.

Safe, colourable resins could be integrated into the models to highlight different areas of interest to the surgeon.

Surgeons from a range of specialities were asked to test out the models with their patients. This survey showed that 40% of surgeons found the models ‘very useful’, 33% found them ‘useful’, and 21% found them ‘essential’.

The series of projects has made significant strides in medical imaging and model production, leading to better surgical planning and improved patient outcomes.

Read more about the PHIDIAS projects **here** and **here**

facts figures

25
surgeons validated the models

94%
of surgeons found the tools useful, very useful, or essential

Submillimetre accuracy can be obtained for **finer details** of the body

A GROUNDBREAKING CORONAVIRUS VACCINE

Right after the pandemic started, the EU rapidly implemented several measures to respond to COVID-19. One notable action was providing funding and a guarantee through the European Investment Bank (EIB) to help BioNTech in developing a safe and effective vaccine. Additionally, international data-sharing portals and information tools were established, and collaborative research and innovation projects promoted.

As early as January 2020, the European Commission launched its first emergency call on coronavirus research, awarding €48.2 million to 18 research projects.

Safe and effective Pfizer/BioNTech's coronavirus vaccine set a record – the fastest one created in

medical history and the first mRNA vaccine to receive market approval.

But this success did not come from nowhere. Supported by European funding, BioNTech co-founders Dr Özlem Türeci and Dr Uğur Şahin showcased the advantages of mRNA vaccines and paved the way for new applications in treating other illnesses.

For the new coronavirus vaccine, the scientists used a molecule called 'messenger RNA' (mRNA), a carrier of genetic information, rather than part of an actual bacteria or virus.

Before the pandemic, BioNTech had coordinated a project to develop treatments for triple-negative breast cancer (TNBC), a highly aggressive form of the disease. Between 2013 and 2017, BioNTech, together with several European academic and clinical research centres, developed a novel and highly personalised RNA vaccine-based immunotherapy.

mRNA vaccines can target tumours by teaching the body's immune system to recognise and attack cancer cells. Once scientists have identified which antigen proteins are present on the surface of a patient's cancer cells, they can tailor the vaccine accordingly.

Early clinical trials with 10 patients indicated that such vaccines were well-tolerated by the patients and they appeared to induce a strong immune response.

This research marked a leap forward in personalised medicine and vaccine development.

And it set the scene for the development of the COVID-19 vaccine.

Horizon Europe, the EU research and innovation programme, continues to fund projects related to COVID-19 to improve our understanding of pandemics and enhance preparedness for future outbreaks.

Read more about the **development of the Pfizer/BioNTech vaccine**

facts & figures

> 100
COVID-19 R&I projects have been supported with **over €200 million**

BioNTech received EU funding for the MERIT project & a

€100 million EIB loan

Uğur Şahin received funding from the EU's **European Research Council**

BENEFITS OF PAYING LESS ATTENTION TO PAIN

Our attention to pain is highly variable and can influence how bad it feels. Research suggests that improved psychological approaches could help lessen suffering for the millions of people around the world who experience chronic pain.

Between 10 to 20% of people in Europe live with some form of chronic pain. It is a growing problem that significantly reduces quality of life, often leads to early retirement, and places an economic burden on individuals and society.

Drug options for chronic pain are limited and their long-term use can cause serious side effects.

Psychological approaches to coping with pain could offer a safer alternative.

Research into how we process pain in everyday life, coordinated by researchers at the University of Luxembourg, set out to challenge the conventional assumption that our tendency to pay attention to pain is stable and consistent. Its findings suggest this feature, known as 'attentional bias for pain information', varies widely depending on the attention devoted to other activities.

Previous studies of the effect of attention on pain have been conducted in laboratory settings, which can fail to catch how the complexities and ever-changing nature of everyday life affect how we experience pain.

This project moved research out of the lab and into the real world.

The researchers asked volunteers to over-exercise so that they felt stiffness and discomfort. Then, they applied vibrating pads of varying intensity to the painful and non-painful areas as the volunteers went about their day.

The investigation probed the link between what people were doing and how painful they found the vibrations to reveal when people felt most attuned to the sensations.

The key conclusion was that the attention participants gave to pain depended on what other aspects of daily life they were paying attention to. It suggests that focusing on urgent needs, such as collecting children from school or preparing for an exam, significantly reduces the attention we give pain.

Psychological approaches for controlling the attention we give to everyday activities could therefore be used to better manage our experience of chronic pain, without relying on drugs.

Read more about the **PainDynamics** project.

facts figures

Between **10** to **20%** of people in Europe live with some form of **chronic pain**

MAPPING THE HUMAN BRAIN ONE NEURON AT A TIME

With over 100 billion neurons and 100 trillion synaptic connections, our human brain is enormously complex. Now, a collaborative, multidisciplinary effort is set to revolutionise brain research and treatment.

Brain research has changed enormously in the past few years. High-resolution imaging techniques, such as MRI and PET scans, allow scientists to observe brain structures and activities in real time, individual neural connections can be mapped, and new computational models and artificial intelligence has helped scientists to simulate brain activity and predict outcomes.

Researchers now want to use all this information to create a detailed map of the brain.

This complex map could open the way to the development of more effective treatments and drugs for neuro-psychiatric disorders.

In creating such a practical aid, you need to map the roads and other features and work out the navigation. You also have to fill in the details like what time the shops are open and what kind of restaurants are around. It is the same when you do a map of the brain – you need all sorts of different information.

From computational models that simulate and attempt to predict brain function, to neuroscience approaches that bridge basic research with clinical applications, everything must be included for a comprehensive atlas of the brain.

The scientists' objectives include developing new standards for brain atlases and integrating multi-level data of healthy and pathological brains.

The creation of digital twins – continuously updated, computer-based brain models – will help develop personalised brain maps for more targeted diagnostics and therapy for neurosurgery and the treatment of conditions such as epilepsy.

This research could lead to innovative solutions for neuro-inspired computing and cognitive technologies such as neurorobotics and artificial intelligence.

This brain atlas will serve as a hub for neuroscience data, provide supercomputing power for further groundbreaking research, outline a scientific roadmap for future research, and train users from academia, industry and SMEs on the use of new, innovative technologies.

Read more about the **EBRAINS** project.

facts figures

The scientists have **access** to the most powerful **European supercomputers**

The EU's **Human Brain Project** involved more than

500

researchers from

19 countries

who developed **more than**

160

digital tools

BETTER INSIGHTS INTO PREDICTING AND PREVENTING BREAST CANCER

Every year, over 2 million people globally are diagnosed with breast cancer, 99% of whom are women. Thanks to EU-funded research we now have better insights into predicting and preventing breast cancer – saving lives.

Breast cancer is not a single disease; it has several subtypes that need to be understood separately. Furthermore, no two patients and no two tumours are the same. Doctors have got much better at treating breast cancer, but most patients have no clear risk factors other than age and gender.

The researchers analysed data from over 20 000 breast tumours, along with clinical and lifestyle information from 100 000 breast cancer patients.

They also developed tools to assess breast cancer risk, empowering patients and doctors.

These tools are available online now and are providing healthcare providers with critical information that enables tailored prevention and treatment strategies. This model has been translated into several languages and is already helping clinicians to classify patients according to the danger posed by type of cancer.

Doctors are then able to offer high-risk patients further diagnostics such as MRI scans.

Another challenge is understanding the genetic and lifestyle determinants of risk. By studying almost 250 000 women with and without the disease, this work has found nine new genes associated with breast cancer.

These were assessed as the most useful for inclusion on breast cancer prediction models.

The research has led to a comprehensive risk model. In time, it could form the basis of genetic tests to identify women who are more likely to develop the disease.

Several other types of data were analysed. For instance, some breast cancers can be prevented by reducing alcohol consumption and following a healthy lifestyle.

By combining genetic, lifestyle, and clinical data, these tools offer a holistic approach to breast cancer risk management, aiming to reduce incidence and improve outcomes for patients worldwide.

Armed with this model, healthcare providers can offer better prevention guidelines, tailored for individuals.

Read more about the **B-CAST** and **BRIDGES** projects.

facts & figures

Over

350 000

women in the EU are **diagnosed** with **breast cancer** every year

Nine genes

are **key** to **assessing** individual patient **risk**

A CLEARER VIEW INTO THE EYES

Modelling studies have uncovered a surprising simplicity behind the development of the lens in mouse eyes, revealing insights that could help prevent and treat cataracts in humans. A lack of flexibility in the human eye lens, which can lead to cataracts, affects almost everyone over the age of 50.

The eye's lens is our window on the world. It can effortlessly produce sharp images of objects at varying distances. However, how biological growth processes achieve this impressive optical precision remains as a big challenge for science.

In response, back in 2014,

researchers based in Croatia and the United States drew on existing knowledge of the well-studied mouse eye to create mathematical simulations.

These modelled the behaviour of individual cells to show the lens grows and changes throughout an animal's life. Their research shows that as cells multiply along the edges of the eye, they 'push' other recently formed cells inwards.

Surprisingly, their simulations predicted that lens growth depends on only two variables: the area in the lens occupied by each cell and the different rates of cell division in each of the four zones in the outer skin of the lens.

This simple two-variable model is the first to fully replicate lens growth over the entire lifespan of a mouse. It also helps explain how an essentially random process of cell division can produce a lens with the correct shape with an extremely high degree of accuracy.

The simulations also suggest how cataracts form in the lens during ageing.

They now believe that exposure to ultraviolet radiation in sunlight can cause mutations in lens cells, leading to the clouding associated with cataracts.

The model already explains how lenses become stiffer as we approach middle age, an issue that underlies most older peoples' need for reading glasses as it is more difficult for them to adjust focus.

The researchers say this is historically the first ever mathematical model of the growth process of the eye lens. If some of their hypotheses about cataract development also prove to be correct for human lenses, then this may lead to methods to reduce cataracts, which in some underdeveloped countries is still the main cause of blindness.

Read more about the **MOLEGRO** project.

facts figures

The lens in a human eye **grows throughout life**

It reaches some

7 million cells

in a **60-year-old human**

IMAGING YOUR BRAIN ACTIVITY AS YOU MOVE COULD PREDICT NEUROLOGICAL DISEASES

For a pioneering study, scientists have captured in real time the brain's activity during everyday movements. The technology could one day be used to diagnose diseases like Parkinson's before symptoms appear.

Millions worldwide grapple with the physical and cognitive challenges of Parkinson's disease. Its early detection could pave the way towards treatments that significantly slow its progression and improve the quality of many lives. But how can we predict something we still do not fully understand?

Until now, scientists could only study brain activity by getting people to lie still inside MRI or PET imaging machines.

However, these methods barely scratch the surface of understanding how the brain works in everyday life.

Even in the simplest daily tasks, our brain and body must work together in close coordination. Take a trip to the supermarket, for example – you need spatial orientation, memory, and balance to plan, navigate the aisles and complete your shopping.

While these activities are effortless for young, healthy individuals, they become more challenging as we age or develop diseases.

Mobile brain/body imaging (MoBI) technology could now help explain why.

By combining mobile electroencephalography (EEG) with motion capture, the technology explores how movement and thinking interact in everyday situations.

MoBI records brain electrical activity alongside the firing patterns of muscle groups, while a 3D avatar replicates the exact movements of the body in real time. Scientists can then link sensory, cognitive, and motor events to specific brain responses.

When used on individuals with specific diseases, this technology unlocks exciting clinical applications. Preliminary results have already uncovered striking differences in the brain activity patterns of healthy individuals and those with early-stage Parkinson's.

Efforts are underway to bring MoBI technology out of the lab into everyday use for personalised early diagnosis and treatment of neurological diseases.

Since 2021, the Slovenian Mobile Brain/Body Imaging Laboratory has been working to reach this goal. As a central hub for MoBI research, the centre promotes knowledge transfer across partner countries and beyond.

Read more about the **TwinBrain** project.

facts & figures

Globally, the prevalence of Parkinson's has **doubled** in the past 25 years

Estimates showed that over **8.5 million** people suffered from the disease in 2019

The project partnered neuro-muscular researchers in **Slovenia** with others in **Germany, Italy** and **Switzerland**

A PERSONALISED VACCINE THAT TURNS IMMUNE CELLS AGAINST CANCER

Researchers in Europe, led by Dr. Uğur Şahin at the University Medical Center of the Johannes Gutenberg University, Mainz, Germany, have created a remarkable new vaccine that helps the human body fight cancer using its own immune defences.

The vaccine is a form of immunotherapy, meaning a treatment that harnesses the power of the immune system. In this case, the treatment causes our immune cells to attack and destroy cancer mutations – the changes cancer makes to a person's DNA.

The vaccine is part of a new wave of medications that use mRNA, a molecule that is a carrier of genetic information and that can change how the immune system behaves and even redirect it towards a specific target.

Although the drug's healing power comes from the body's own immunity, it relies on technology to apply that power in the right way.

The treatments are personalised, targeting a patient's specific mutations.

The cancerous mutations are detected using computational algorithms, and the treatments can then be tailored to act on those most likely to be vulnerable to immune cell attack.

Even more exciting, the drug is universal – it is equally effective across different types of cancer. This is because mutations happen in every kind of tumour, so they all share the same vulnerability to this new technology.

The research team has treated many hundreds of patients during trials. The work to bring the finished cancer vaccine to clinicians and their patients is still ongoing, but so far, the results have been remarkable.

Trials in humans show the immune system attacking tumour cells in every vaccinated patient.

Researchers are excited about the amazing potential of the vaccine, which could change the face of healthcare as we know it. For now though, their task is to refine their discovery and make sure any weaknesses are fixed.

The team is working with clinical and industrial partners to make this futuristic-sounding drug a reality for cancer patients.

Read more about the **SUMMIT** project.

facts & figures

Immunotherapy is expected to **change the face** of cancer treatment

mRNA technology was also used in **COVID-19 vaccines**

The team previously **studied mRNA** for **over two decades**

BETTER CANCER CARE FOR YOUNG PATIENTS IN LITHUANIA

For paediatric oncology researchers in Lithuania, the rest of the continent can feel very far away. There are few opportunities to train and research overseas, and a lack of investment in the country's oncology infrastructure means its cancer care capability is lagging. A cross-border skills exchange aimed to turn things around.

The data on child cancer outcomes brings the problem sharply into focus.

Paediatric cancer survival rates can reach 80% in high income countries, but for Lithuanian children facing the disease, these figures are as much as 10% lower. And because there are so few paediatric cancer patients – around 80 per year – clinicians often do not get the experience required to grow their expertise.

To address this problem, 32 Lithuanian cancer specialists were twinned with nine research partners in other countries who focused on childhood cancer – a golden opportunity to gain knowledge, skills and experience in this crucial area.

Lithuania's young cancer patients are already seeing the benefits of the programme.

So far, over 30 children have received individual treatment recommendations based on the new learning.

The project focused on solid tumour cancers, specifically the kinds that are most common in children. These cancers, which affect the brain, kidneys and newly growing nerve cells, among other areas, require a variety of sampling and analysis techniques for their diagnosis and treatment.

The Lithuanian researchers and their partners across Europe worked to embed knowledge, raising the standard of care. They covered a wide range of areas, from drug therapies to diagnostic evaluation of patients and their families.

Another aspect of the project was developing genetic sequencing capabilities within Lithuania.

Being able to sequence a patient's DNA allows clinicians to pick up rare genetic anomalies that can signal higher levels of risk. This information helps them intervene earlier in future cases so children have a better chance at a long and healthy life.

Read more about the **TREL** project.

facts & figures

According to the WHO, around

400 000

children and adolescents

develop cancer every year

Classifying tumour types helps doctors select the **best treatment**

The project has picked up **rare genetic variations** among patients

TOP-NOTCH PRENATAL TESTS BRING HOPE TO ESTONIAN COUPLES FACING INFERTILITY

Thanks to knowledge exchange between universities and research centres across Estonia, Belgium and the United Kingdom, more would-be parents can access cutting-edge, non-invasive techniques to help ensure successful pregnancies and healthy babies.

In 2015, the Katholieke Universiteit (KU) Leuven in Belgium and the University of Oxford in the United Kingdom joined forces with the University of Tartu in Estonia to establish a pioneering prenatal screening laboratory in the country.

By 2018, hospitals in Estonia were offering non-invasive tests to identify chromosomal abnormalities in unborn babies using a blood sample from the mother.

Before this project, Estonian women had limited options for non-invasive prenatal testing.

Samples from high-risk patients had to be analysed abroad. The only affordable alternative was amniocentesis, an invasive procedure to check if a baby has a genetic or chromosomal condition. The procedure carries a risk of miscarriage.

The project has also revolutionised pre-implantation genetic testing for couples undergoing in vitro fertilisation (IVF). Non-invasive single-cell analysis combined with advanced software can now predict the chances of an embryo successfully implanting and developing within the mother's uterus, increasing the likelihood of a successful pregnancy.

Infertility is a global issue. While conditions like endometriosis contribute to 20% of poor health among women worldwide, other causes remain elusive. In Europe and Western countries, the trend of delaying parenthood also exacerbates infertility challenges because reproductive diseases become less treatable with age.

To tackle these challenges, the project leveraged the power of international collaboration and knowledge sharing by organising training events, workshops and summer schools.

This work led to the new research laboratory for reproductive medicine in Estonia and expanded the scientific capacity of the country's research community.

Together, the researchers continue to explore the links between female metabolic health and infertility, advancing infertility treatments and prenatal diagnostics.

Read more about the **WIDENLIFE** project.

facts figures

The project involved **three** leading reproductive research centres in **Estonia, Belgium** and the **United Kingdom**

The **twinning scheme** links **emerging** research institutions with **established** ones

Industrial innovation

To transform and lead

ENHANCING THE QUALITY AND EFFICIENCY OF 3D PRINTING IN INDUSTRIAL PRODUCTION

3D printing is booming in the aeronautics, biomedical and automotive sectors. To capitalise on this, five universities across Europe worked together to advance knowledge about industrial 3D printing, also known as additive manufacturing. The legacy of their work is inspiring the next generation of 3D printing experts.

Leading universities in research and innovation from Italy and Norway teamed up with emerging research centres in Czechia, Romania and Serbia to better understand how 3D printing ink affects the final components' ability to bear loads – a knowledge gap that was limiting how fully the technology could be embraced.

Their work developed ways of evaluating the structural properties of 3D printed parts to make them safer and more reliable.

At the same time, the collaboration raised the profile of the partners taking part, helping to establish their regions as centres of excellence for industrial 3D printing.

Over three years, the Norwegian University of Science and Technology (Norway) and the University of Parma (Italy) cooperated in a knowledge-sharing partnership with the University of Belgrade (Serbia), the Institute of Physics of Materials, Academy of Sciences (Czechia) and the Polytechnical University of Timisoara (Romania). The project took shape through staff exchange programmes, training, workshops and seminars.

Benefiting the most were early-stage researchers able to use the programme as a springboard for their careers in additive manufacturing.

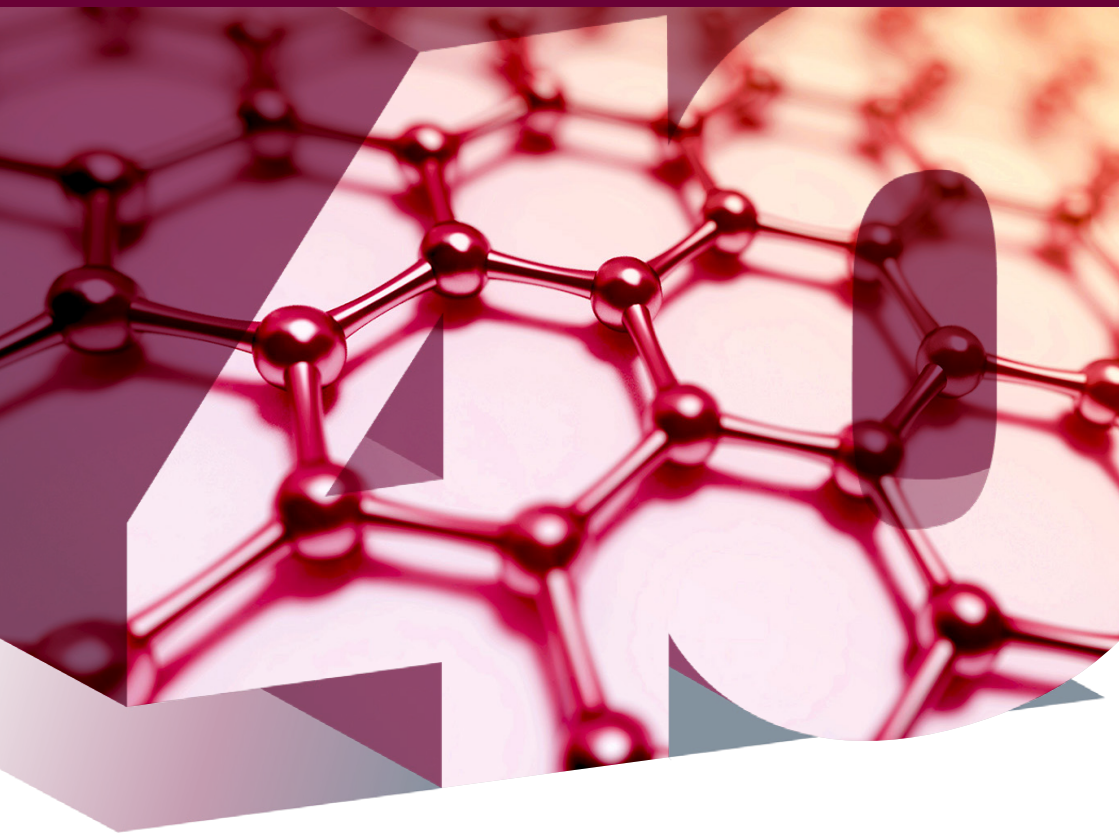
After the programme, a master's course in industrial 3D printing was set up at the Polytechnical University of Timisoara to maintain the knowledge-sharing momentum. The course's popularity has inspired similar courses in Serbia and Czechia.

Read more about the **SIRAMM** project.

facts figures

56
peer-reviewed articles published so far as a result of the collaboration

11
PhD student exchanges between partner universities



EUROPE'S GRAPHENE SUCCESS STORY: LEADING THE CHARGE IN THE NANOMATERIAL REVOLUTION

Nanomaterials like graphene could revolutionise every aspect of our lives, from medicine to computing. The Graphene Flagship initiative has achieved substantial outcomes, including the creation of new companies and novel graphene-based products ranging from lubricating oils to advanced cameras.

Made up of a carbon layer just one atom thick, graphene is incredibly light, stronger than diamond and good at conducting electricity and heat. No wonder scientists and engineers have been busy at work developing graphene into a wide range of faster, thinner, stronger and more flexible products.

To capitalise on this potential, the Graphene Flagship was launched in 2013 as a decade-long initiative. It involves over 178 academic and industrial research partners from 23 countries in multiple projects.

The initiative places Europe at the forefront of graphene nanotechnology,

a branch of science and engineering devoted to tiny structures at dimensions of around 100 millionth of a millimetre.

Notable applications developed by the partners include high-speed photonic switches for 5G communications, de-icing components for airplanes, and a lubricating oil that reduces friction, heat and wear in engine parts. In the medical sector, artificial retina implants could help restore vision to blind patients. Graphene-based products for monitoring and stimulating brain activity could help treat severe chronic diseases.

Experiments with the European Space Agency tested graphene under zero-gravity conditions. This research demonstrated its potential for the propulsion of spacecraft and satellites and to manage onboard temperatures. The partners are moving to develop a working pilot line which will produce 2D materials and have contributed to the proposal to form a public-private partnership to advance the use of advanced materials such as graphene.

The Graphene Flagship will have contributed €3.8 billion in Europe's GDP from 2014 to 2030 and helped to create 38 400 jobs

according to an impact report by the independent WifOR Institute. The Graphene Flagship continues its journey in a new form under Horizon Europe.

Read more about the **Graphene Flagship** project.

facts & figures

16
new companies have been launched

30
graphene-related products have been brought to market

Work on graphene earned EU-funded researchers the **Nobel Prize in Physics in 2010**

International cooperation

To unite and collaborate

A DIGITAL INNOVATION CENTRE IS EMPOWERING ENTREPRENEURS IN AFRICA AND BEYOND

Connecting researchers, innovators and businesses with global markets is vital to ensure that the fruits of research benefit all of society. The ENRICH in Africa (EiA) Centre developed a sustainable network of innovation incubators and accelerators connecting Europe and Africa.

Launched in 2022 in Cape Town, South Africa, the EiA Centre runs soft-landing programmes to support start-ups actively looking to grow in a new market – linking them with already-established partners.

Start-ups, investors and support organisations across Africa can connect with others and get access to EiA services, including bootcamp training courses, a virtual academy, mentoring support and twinning opportunities.

One initiative led to 10 start-ups from 6 African countries travelling to France for 3 months to find opportunities in the health, food, retail, finance, logistics, cleantech and digital sectors.

All have kick-started projects thanks to the EiA Centre.

Another example is the EiA's EuroQuity Community, which provides members with a trustworthy infrastructure to network and co-create together. Another programme, supported by the African Development Bank and the Global Center on Adaptation, aims to expand investment and economic opportunities for youth and women in Africa.

The partners behind the EiA Centre include participants from both Europe and Africa,

such as the South Africa-based start-up accelerator Startupbootcamp AfriTech and international innovation group Methys.

In planning the Centre, researchers analysed the innovation landscape in Africa, resulting in a report outlining the African ecosystem, including policy structures, public and private investments, the start-up landscape and data for evaluating key factors for the Centre's success.

The partners have co-created a model that will ensure a sustainable basis for the EiA Centre going forward, including a strong group of around 50 'champions' who act as ambassadors for the initiative.

The EU established ENRICH centres in Brazil, China, and the United States prior to the EiA Centre in South Africa to deliver such support.

Read more about the **EiA** project

facts & figures

There are
12 partners
behind the EiA Centre

▪

Five partners hail from **European countries** (Belgium, Germany, France, Austria and Portugal)

▪

Four partners are based in **African countries** (Kenya, Nigeria, South Africa and Tanzania)

Security

To protect and innovate

SHARED SEA SURVEILLANCE SYSTEM SPREADS A SECURE NET ACROSS EUROPE'S WATERS

Monitoring what happens at sea helps life run smoothly, both on land and in the water. Marine surveillance can monitor and maintain both the environmental health of our oceans and the security of Europe's citizens. It can counter threats like accidents, piracy, illegal fishing, ecological disasters and terrorism.

Several agencies have created marine surveillance systems, but there has not been a simple way for EU countries to share this information with one another, leading to duplicated efforts and missed opportunities to access invaluable data.

To make things more efficient, researchers helped develop a Common Information Sharing Environment (CISE) so that authorities can exchange maritime information automatically and securely.

Maritime CISE is a voluntary collaborative process that connects existing information sharing systems. EU member states volunteer to share their data and CISE selects the best information to help surveillance authorities plan and react more effectively. This way, CISE aims to reduce threats to European interests, as well as the costs and efforts involved in doing so.

CISE started in 2009, and the system's development accelerated when a group of researchers came together for the EU CISE 2020 project that ran from 2014 to 2018.

They were asked to create a political, organisational and legal environment to enable information sharing across seven maritime sectors – transport, environmental protection, fisheries control, border control, general law enforcement, customs and defence.

The team created a test bed of surveillance platforms and thoroughly road-tested everything the programme needed to work effectively and enable co-ordination on threats, from technical feasibility, to collaboration, to performance indicators.

The work is considered a crucial milestone in the roadmap of CISE implementation, enabling developing and testing its network, based on existing surveillance systems/networks.

The project has inspired other initiatives. For example, a similar shared surveillance approach is being used to enhance security of the Arctic. The 'Artificial Intelligence based Virtual Control Room for the Arctic' (AI-ARC) project will help coast guards and other seafarers use AI to boost safety.

Read more about the **EU CISE 2020** project

facts & figures

EU CISE 2020 involved

40

partners

from

16

coastal countries

The network incorporated data gathered by the EU's **Copernicus** satellites

Society

To empower and unite

A NOBEL PURSUIT

The Nobel Prize is the most prestigious scientific award in the world, and winning one is the ultimate accolade.

Did you know that more than 30 Nobel Prizes have been won by EU-funded researchers, including seven in just the last four years?

The Royal Swedish Academy of Sciences and the Nobel Assembly of the Karolinksa Institutet award the Nobel Prizes to “those who, during the preceding year, have conferred the greatest benefit to humankind.”

It takes place every year and there are five categories: physics, chemistry, physiology

or medicine, literature and peace, and the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel.

Most recently, Anne L'Huillier and Ferenc Krausz, two researchers who the EU has backed substantially for the past 15 years, were awarded the Nobel Prize in Physics in 2023.

There are many different tools in our funding programmes that help potential Nobel Prize winners to emerge.

The European Research Council (ERC) provides grants for researchers to work on cutting-edge science. It provides long-term grants where researchers are free to deviate, explore and take risks. Since its launch in 2007, 14 ERC grantees have won a Nobel Prize.

Additionally, the Marie Skłodowska Curie Actions (MSCA) support excellent researchers at all stages of their career. Whether they are doctoral candidates or highly experienced researchers, they get the opportunity to receive training and engage in innovative transnational, inter-sectoral and interdisciplinary research. The programme is named after the double Nobel Prize winner Marie Skłodowska-Curie to honour and promote the values she stood for. Several researchers directly involved in the MSCA followed her footsteps. Since 2013, 18 researchers involved in MSCA have been awarded a Nobel Prize.

Both Anne L'Hullier and Ferenc Krausz received ERC grants and are directly connected to the MSCA.

Providing funding that results in Nobel Prizes is Europe working at its best.

Read more about **Nobel Prizes won by ERC grantees**

Read more about **Nobel Prizes won by MSCA fellows**, scientists and supervisors

facts & figures

33

Nobel Prize winners supported by **EU research and innovation programmes**

The **European Union** won the **Nobel Peace Prize** in 2012

RESEARCHERS HAVE FOUND A WAY TO USE MUSIC AS MEDICINE

Have you ever noticed how the richly resonant timbre of the cello resembles a human voice? Or how the drumbeat in a film can start your blood pumping? Music can mimic the emotional human voice. The notes can sound like a sad voice, an angry voice or a reassuring one.

We know that different sounds trigger different emotions, but how? Researchers' work has now given us a better understanding of what happens in the body and how sound affects the neuronal pathways in the brain.

With this knowledge, researchers found a way to crack the emotional code of music: which music signals produce which emotional effects, and unlocked the therapeutic potential of musical emotions.

They did this by engineering musical stimuli to activate specific emotions, and therefore manipulate mood, building a 'bank' of sounds that activate specific neuronal pathways in the brain.

This opens up the possibility for people with anxiety or depression swapping meds for music. Personalised sound prescriptions could be designed to diagnose, or even treat, individual psychological or neurological conditions.

Music could even become a cognitive technology, with algorithms able to engineer it to mobilise one neuronal pathway or another, non-intrusively and non-pharmacologically.

The tools researchers developed are open-source and already being used in real-life applications in several French hospitals, especially to alleviate stress and soothe anxiety.

Musical therapy could be used even more widely, to help people with autism or to start rehabilitating people who have suffered a stroke.

Read more about the **CREAM** project.

facts & figures

The research included

over 600 participants across **four countries**

It combined skills in **information technology** (audio signal processing) and **cognitive neuroscience**

All tools are made available as free, open-source software for the scientific community

WHAT IF YOU COULD WALK AROUND HISTORICAL SITES IN EUROPE AND PEEL AWAY THE LAYERS OF HISTORY ON YOUR PHONE?

Researchers are using virtual and augmented reality to reconstruct cultural sites in 3D and make visiting them even more exciting. Like travelling back in a virtual time machine, this new tech can reveal buildings' hidden secrets: how they were used in the past and how they evolved over centuries.

Museums, churches and cultural heritage sites can all be brought to life for visitors, just by pointing

their phone at specific points to learn more.

For example, at the Istituto degli Innocenti Florence, Italy, by pointing their phone at one of its nine semicircular arches, users can learn not only about its terracotta designs (by Andrea della Robbia), but also about the building's original function as an orphanage, alluded to in the relief design.

Researchers used advanced Building Information Modelling (BIM) techniques to create next-generation 3D models of artefacts and environments.

The models were enriched with a system that connects contextual technical and historical information like text, images, audio and video, so they can work together seamlessly.

As well as Italy, the tech has been trialled in eight different sites in Europe: the historic church of Obergum in The Netherlands, Castillo de Torrelobaton in Spain, Old Stone Villages in Dalmatia and the Technical Museum Nikola Tesla in Croatia, Church Panayia Phorviotissa in Cyprus, and in Greece the Akropolis of Erimokastro in Rhodes, Villa Klonaridi in Athens and the HAMH Museum in Hydra.

Enhancing people's views of their surroundings in this way opens up countless possibilities for design studios, archaeologists and even the construction industry.

Read more about the **INCEPTION** project.

facts & figures

8 in 10
Europeans
think cultural heritage is important to them personally, as well as to their community, region, country and the EU as a whole

RESEARCHERS ARE TESTING HOW OPERA CAN MAKE OUR SOCIETIES MORE INCLUSIVE

Opera is the theatre of emotion. It can speak to audiences across societies, continents and even centuries because the core themes and struggles of the human condition remain the same.

Opera has always spoken to both elites and people, expressed both authority and revolution. But in recent decades, this art has too often lost sight of its popular roots and radical edge.

Researchers sought to put opera back at the heart of living culture,

giving some of society's most-marginalised groups – young offenders, migrants and the rural poor shared ownership of the culture that expresses European values.

People at risk of social exclusion co-created opera performances with professional artists, telling stories that are important to them, and reconnecting the form with its socially progressive potential. Community opera trials used a special stage to connect locations and people in real-time, allowing participants in different places to perform together.

11 opera performances involved more than 1 300 non-professional artists and community members. The operas were enjoyed in person by more than 8 000 people, and over 766 000 remotely.

Performances included a community opera with and for the young inmates of Leiria Youth Prison, Portugal, an opera about life in Raval featuring amateur choirs from the neighbourhood in Barcelona, and the world's first virtual reality-based opera, co-created with teenagers in remote areas in Ireland.

The arts are central to how societies talk to themselves, researchers say. They can be used to include those left behind in wider prosperity, and build societies in which all members belong.

Read more about the **TRACTION** project.

facts & figures

95.3
million people
are at risk of poverty or social exclusion in the EU – that's nearly a quarter of the population

PREVENTIVE ARCHAEOLOGY SAVES HIDDEN TREASURES FROM BEING LOST TO HISTORY

Europe is a treasure-trove of archaeological sites, but many of them are under threat. From development projects to illegal excavations and climate change, these sites and their fragile relics seem to face danger on all sides.

To protect them, a new practice has emerged – preventive archaeology. This approach uses methods that protect sites as much as possible. But some countries have been slow to adopt it, leaving their archaeological heritage at greater risk than that of their neighbours.

In response, researchers connected businesses and

universities in Slovakia, Czechia, Slovenia and Serbia in a knowledge transfer programme.

As a result, preventive archaeology capabilities have sprung up across the region, with better access to software and training materials.

Thanks to the researchers, preventive archaeology courses are now offered at universities in Bosnia-Herzegovina, Croatia, North Macedonia and Serbia, and smaller archaeological businesses are better connected with the wider industry, increasing their potential for development.

For example, the University of Ljubljana and the University of Belgrade are offering a joint Master of Arts in professional archaeology. Master of Arts programmes are also offered by universities in Sarajevo, Bosnia-Herzegovina, in Zagreb, Croatia, in Skopje, North Macedonia and in Novi Sad, Serbia.

To encourage such courses, the researchers trained students and entrepreneurs in preventive archaeological research skills and recording using the latest digital technologies, including 3D modelling, remote sensing and other forms of virtual archaeology.

As well as protecting European heritage, the preventive approach benefits the public.

Researchers and students used 3D laser scanning and 3D photogrammetry to build high-quality models of sites such as Bratislava Castle in Slovakia, a medieval church in Jasenica, Slovakia, the Duvno basin in Bosnia and the coastline of the northern Adriatic.

The results were exhibited to the public and documented for local authorities.

Read more about the **CONPRA** project.

facts & figures

90 %
of European archaeology is now preventive

Bratislava Castle
was one of the sites modelled

Teams explored a **Neolithic early agricultural** site 10 metres below ground

ENDANGERED LANGUAGES ARE REVITALISED BY COMMUNITY ENGAGEMENT

Like plants and animals, languages are threatened when their native habitats grow too small. In the case of endangered languages, those habitats are the communities of speakers that keep them alive in a world that often does not give them enough recognition.

Researchers in Poland pioneered new approaches and techniques as a way to revitalise and preserve endangered minority languages.

They took a collaborative approach, working in partnership with speakers instead of just studying them.

The researchers' also brought academics and their institutions together with participating communities, benefiting everyone involved.

Their work and the work of researchers following the techniques they have developed also comes with a fast-approaching time limit: once the last speaker is gone, it is difficult to bring a language back from the dead.

The activities included engaging young people with their community's language and cultural history through plays written and performed in endangered languages.

As part of the collaboration, teenagers wrote the plays and young people performed them.

Minoritised languages are often seen as being less legitimate than the languages spoken in official settings like schools and healthcare centres. The project challenged this misconception by running a field school delivered in Nahautl, a Mexican language with Aztec roots that had never before been used in this kind of setting.

Closer to home, the project helped to revive the fortunes of a language specific to a small community in southern Poland: Wymysiöeryś is unique to the town of Wilamowice, where only a small number of speakers remain.

The project resulted in a new research centre at the University of Warsaw, Poland, where academics are studying how linguistic discrimination and the loss of a language impact health and well-being.

Read more about the **ENGHUM** project.

facts & figures

One language in the project is **Wymysiöeryś,** unique to the Polish town of Wilamowice

There are now over **20** **new speakers** of Wymysiöeryś

Space

To explore and discover

FROM STARBURSTS TO GIANTS: LOOKING BACK IN TIME TO UNDERSTAND HOW ELLIPTICAL GALAXIES FORMED IN THE EARLY UNIVERSE

Galaxies are the basic building blocks of the Universe. Although new stars are continuously forming in our home galaxy, the Milky Way, most stars are found in giant elliptical galaxies. Such galaxies, which have an oval shape, stopped forming stars billions of years ago.

Sune Toft, Professor of Cosmology and Extragalactic Astrophysics at the Niels Bohr Institute in Copenhagen, is revealing how these galaxies formed, evolved and died – crucial to understanding the Universe and everything we see around us.

His research investigated the origin of elliptical galaxies to see whether different types of extreme galaxies are actually phases of a massive galaxy's evolution.

The research team studied starburst galaxies, which have an unusually high rate of star formation and are thought to be the early phase of the giant elliptical galaxies. Over five years, the team observed starburst galaxies at different wavelengths, studied individual galaxies in depth, and analysed statistical studies of millions of galaxies to discover more about the structure, shape, dynamics, star formation properties, gas contents and other characteristics of different galaxy populations.

The results show that the largest elliptical galaxies can be traced back to less than a billion years after the Big Bang, when they formed in enigmatic starbursts and evolved until star formation was quenched.

These findings are now a widely accepted model of the evolution of massive galaxies,

supported by other studies. New generations of astronomical surveys using ALMA – the largest telescope in the world – and the James Webb Space Telescope will further explore the model.

The team also developed a photometric catalogue of their research, which they believe could be a benchmark for galaxy evolution studies over the next decade.

The project has also paved the way for a major centre of excellence called the Cosmic Dawn Center (DAWN) at the Niels Bohr Institute and DTU Space in Denmark. DAWN focuses on uncovering how and when the first galaxies, stars and black holes formed.

Read more about the **ConTExt** project.

facts & figures

ALMA in Chile is an array of

66

radio telescopes

The origin of the **largest elliptical galaxies** can be traced all the way back to **starbursts** formed less than a billion years after the **Big Bang**

SAVE OUR SPACE: THE QUEST TO CLEAN UP SPACE JUNK

Our planet is surrounded by an ever-increasing cloud of obsolete satellites and other waste materials. Even the smallest pieces of debris pose a threat to spacecraft and the satellites the modern world relies on. To continue using space technologies, scientists developed cost-effective ways of cleaning up space.

A consortium of companies and research organisations developed the first low-cost mission to demonstrate, in orbit, key technologies for active debris removal. The experimental satellite they designed was equipped with a net system to capture

and trap debris, a harpoon to capture a specific target, and a drag sail that was used to de-orbit the satellite at the end of the mission.

The space mission included two small satellites – known as 'CubeSats' – as artificial targets.

They were released from the main satellite, and then successfully recaptured using the net and harpoon. Careful monitoring throughout the mission, which launched in June 2018, provided input for further development and fine-tuning of the technology.

The opportunity to test these technologies in a real space environment was invaluable, allowing scientists to better understand the challenges involved and make improvements for the future. The drag sail element, for example, did not deploy exactly as planned. However, with further development and fine-tuning, the technology was improved.

It has since been commercialised and used successfully in real-life missions.

The project also attracted significant media attention, which has helped to raise public awareness of space junk. This attention could help to create momentum towards the delivery of more missions to remove some of the large pieces of debris currently orbiting the Earth.

Cleaning up this problematic space junk is key to ensuring our continued, sustainable, use of space technologies.

Read more about the **REMOVEDEBRIS** project.

facts & figures

170 million
estimated number of **space debris objects**

Of these
29 000
are **larger than 10 cm**

Any of these objects can harm spacecraft

Transport

To connect and advance

SHIPPING GOES GREEN BY HARNESSING THE CLEANEST ENERGY OF ALL – WIND

Researchers are taking ship design back to the future with an ancient concept - sails. But this time there's not a scrap of sailcloth in sight.

In August 2023, a cargo ship set sail on its maiden voyage, making its way across the ocean to Brazil. The result of years of planning and preparation,

it is the world's first cargo ship retrofitted with a game-changing technology called WindWings:

rigid, retractable sails that harness wind power to reduce fuel consumption and carbon emissions.

The crew onboard is alerted when to raise or lower the sails, and they can do so in the push of a button from the bridge.

And that is not all, the ship glides along on a carpet of micro bubbles deployed beneath the hull reducing friction and lowering fuel consumption.

New-build cargo ships with three WindWings installed could use on average 30% less fuel, which could be even higher if used in combination with alternative fuels.

Researchers have also created a hydrogen-powered cruise ship that in combination with a waste heat recovery system, manages to cover the engine needs onboard the ship.

Energy needed to propel the ship through the water is lowered by a new technology that keeps the hull clean using an ultrasound antifouling system, preventing barnacles and other sea life from accumulating on submerged surfaces.

The researchers' ultimate ambition is to slash greenhouse gas emissions by 99% and energy savings by 50%.

Read more about the **CHEK** project.

facts figures

90 %
of the **world's goods** are transported over the waves

Global shipping produces **a billion tons of CO_2** every year

The **shipping industry** is responsible for roughly **3 % of global emissions** – the same as flying

SMARTER PARKING FOR SUSTAINABLE CITIES

Using public space for parking can be fraught. Policymakers need to balance the quality of life of people who live in cities as well as provide adequate, sustainable levels of parking. But good parking management can actually free up public space and make cities more attractive.

Municipal policymakers have tended to address parking issues in a reactive manner. When faced with a lack of parking spaces, for example, many towns and cities have simply increased the number of parking spaces.

Sixteen cities, from Norway to Albania, teamed up to demonstrate the benefits of smartly managed parking and share their findings and benefits.

The cities identified and implemented strategic parking management measures which had an immediate impact.

Best practice included ensuring that revenues from parking fees and fines are invested into sustainable urban mobility. Citizen participation in developing parking management measures also helped in ensuring acceptance of and compliance with new measures.

In general, 88 measures were implemented across the cities, 55 000 parking spots were regulated for the first time and over 3 000 parking spots were scrapped to be used for other purposes, which saved €2.4 million of parking subsidies per year. Reducing subsidies for parking spaces, while charging for existing parking in the form of fees or fines, helped to generate income for municipalities.

The work aimed to free on average 10% of public space currently used for parking and invest at least 10% of parking revenues into sustainable transport.

The work also resulted in the ParkPAD audit tool which allows cities to review, prioritise and update parking policies. 16 audits were carried out as part of the project identifying where new and improved parking measures could be implemented.

The audit tool will outlive the project and guarantees that European cities can benefit from the knowledge of the project through an auditing process.

Read more about the **Park4SUMP** project.

facts figures

Parking management is recognised as one of the **most underdeveloped areas** in **sustainable urban mobility planning** policies

An estimated

15-20%

of **smaller and medium-sized European cities** still have **no regulated parking** in place

INTERNATIONAL DRONE DELIVERIES COMING TO AN AIRSTRIP NEAR YOU SOON!

When we think of global trade, we think of massive container ships, perhaps barges or cargo planes and, of course, huge trucks on our motorways. But what about drones?

You may have seen news articles on drones being developed for the ‘last mile’ delivery of small parcels to your doorstep, but longer-range drone technology is emerging as the next big innovation for global trade. And Europe is playing a leading role in its development.

Cargo drones can provide fuel-efficient, same-day, cross-border and medium- or long-haul cargo delivery.

For these reasons, innovators are looking to operate a fleet of drones from a network of drone ports across Europe. The system will initially serve non-hub, remote, or underserved communities, creating local manufacturing and jobs.

These novel drones were designed and developed in Europe and can carry a 350 kg payload – roughly similar to a small delivery van – for up to 2 500 km.

Significantly, the drones only need 400 metres of runway to take off or land. This means that more than 3 000 airstrips in the EU could host one of the networks of standardised low-cost drone ports that will use automated flight control systems.

The innovators claim that the drones are up to 90% more affordable to produce and run than alternative services, will enable international same-day deliveries at a cost of only €5 or less per kilo, and will reduce CO_2 emissions by up to 60%.

Following initial trials of the service, which took place from a drone port in Bulgaria, the network will be expanded across the EU, with the first ones planned in Greece.

The new drone service, called Dronamics, is licensed to operate in Europe. The cargo drone airline is looking to work with e-commerce, the pharmaceutical sector and other businesses that need to supply urgent shipments at short notice.

The innovators are already partnering with some of the major logistics players in Europe to supply them with thousands of drones and are ready to create a new market for drone-based 'middle-mile' delivery right now.

Read more about the **Dronamics** project.

facts & figures

Cargo drones could **reduce CO_2 emissions** by **up to 60%**

The drones can **carry up to 350 kg** of cargo up to **2 500 km**

Over **3 000 EU airstrips** could host a **drone port**

ISLAND INNOVATION: MALTA PIONEERS CLEAN MOBILITY SOLUTIONS FOR A GREENER FUTURE

Island nations like Malta are at particular risk from the consequences of climate change. They also tend to rely on imported fossil fuels for energy. Due to their isolation and size, they often lack the resources to deliver a lower or zero carbon economy.

Now, scientists are creating hybrid and electric mobility solutions to ramp up the green transition.

Led by the Malta College of Arts, Science and Technology (MCAST), the research covered vehicle technologies, from electric cars to e-scooters, and understanding Maltese driving habits and mobility issues.

Amongst other topics, researchers explored the energy-efficient cooling of electric vehicles, analysed the power quality of charging stations, and modelled the mechanics behind electric bus scheduling to allow time for buses to charge.

The integration of electric vehicles can contribute to a more reliable energy supply by, for example, adjusting their charging schedules to alleviate pressure on the power grid during peak hours.

The research made substantial contributions to these emerging energy topics, with several studies published.

A specific focus was on micro-mobility solutions to improve access to transport for all citizens, including those with limited mobility or limited access to public transport.

Through schools and workshops organised in Malta and partner countries, mentoring activities, and visits and internships between the various partners, MCAST has boosted its energy research profile while building long-term partnerships.

MCAST collaborated with the Alternative Energies and Atomic Energy Commission (CEA) in France, the Austrian Institute of Technology (AIT), and Cyprus' Nicosia Development Agency (ANEL) in investigating the challenges associated with e-mobility.

The college is now working as a regional hub in e-mobility and helping to foster high-tech industries in Malta that can develop technology and energy solutions for local and international applications.

To secure the legacy of the project, the Foundation for Innovation and Research in Malta was established as an independent, non-profit, public-purpose foundation and research and dissemination organisation.

Read more about the **NEEMO** project.

facts & figures

Malta is only
27 km
long

The **average journey** on the island is just
6 km

The island receives the **highest sunshine intensity** in the EU

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you online (**european-union.europa.eu/contact-eu/meet-us_en**).

On the phone or in writing

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

– at the following standard number: +32 22999696,

– via the following form: **european-union.europa.eu/contact-eu/write-us_en**.

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website (**european-union.europa.eu**).

EU Publications

You can view or order EU publications at **op.europa.eu/en/publications**. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (**european-union.europa.eu/contact-eu/meet-us_en**).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (**eur-lex.europa.eu**).

EU open data

The portal **data.europa.eu** provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for freee, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

Publications Office
of the European Union