

# EARTO INNOVATION AWARDS 2018



European Association  
of Research and Technology Organisations

[www.ear.to.eu](http://www.ear.to.eu)



## **EARTO – European Association of Research and Technology Organisations**

Founded in 1999, EARTO promotes Research and Technology Organisations and represents their interest in Europe. EARTO network counts over 350 RTOs in more than 20 countries. EARTO members represent 150,000 highly-skilled researchers and engineers managing a wide range of innovation infrastructures.

**CONTRIBUTE**  
**EU RD&I PROGRAMMES**  
**GLOBAL CHALLENGES**  
**EUROPE'S**  
**INDUSTRIAL COMPETITIVENESS**  
**INNOVATION UNION**  
**EUROPEAN RESEARCH AREA**

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# FOREWORD

We are in a pivotal period in Europe, facing complex challenges that will determine the future of our continent and our community. To name but a few: Brexit, demographic change, trade conflicts, environmental pollution, and the debate on new technologies and their impact on society are all issues that the European Commission will have to address with renewed energy from 2019 onwards.

We need to join efforts to make the Europe of the future even more attractive for our citizens than it is today, a place with which they can identify themselves. European Research and Technology Organisations (RTOs) have an invaluable role to play here: they develop and transfer research and technology to industry, which will market new products and services with decisive impact for society in areas such as resource efficiency, renewable energies, circular economy, de-carbonisation, digitalisation, production technologies, and health.

Although the European Innovation Scoreboard of 2018 shows that in recent years Europe's innovation performance growth rate is catching up with the United States and Canada, China is progressing at three times the EU's rate. Europe continues to lag behind in terms of R&D-to-GDP-ratio, which is still at the level of 2%, whereas China has recently overtaken Europe with 2.1%. And the World Economic Forum points out that despite the rise of new technologies such as the Internet of Things, artificial intelligence (AI) and big data, Europe's productivity growth remains sluggish due to slow diffusion of innovations.

**“ We need to capitalise on the available resources and potential of European RTOs. For the European Commission and the Horizon Europe research programme, the declared aim must be: we achieve impact through research ! ”**

If Europe wants to keep up with the global competition, it should build on its strengths: today, two-thirds of its economic growth derives from RD&I. Substantial investments, both private and public, should therefore be dedicated in the future to applied research with a concentration on innovation value chains. We need to capitalise on the available resources and potential of European RTOs. For the European Commission and the Horizon Europe research programme, the declared aim must be: we achieve impact through research!

The EARTO Innovation Awards 2018 introduce to you examples of how European RTOs address today's challenges and create impact through their work. From real innovators and their concrete success stories we will learn first-hand about the challenges they had to face and what support they enjoyed to reach their goals.

We wish you an inspiring reading!



Frank Treppe

# EARTO INNOVATION AWARDS 2018

From the lab to your everyday life. RTOs innovate to improve your health and well-being, your safety and security, your mobility and connectivity. Their technologies cover all scientific fields. RTOs are non-profit organisations with public missions to support society. To do so, they closely cooperate with industries, large and small, as well as a wide array of public actors. The innovations presented in this brochure give a flavour of their work. They include real life examples which illustrate RTOs' focus on solving real-world problems and addressing today's challenges! The EARTO Innovation Awards celebrate this year their tenth edition.



## EARTO INNOVATION AWARDS



## Impact Delivered Category

For this category, the rewarded innovations (product or services) have social and/or economic relevance, innovative originality, are today on the market and have proven their impact.

## Impact Expected Category

For this category, the rewarded innovations (product or services) have social and/or economic relevance, innovative originality, are not yet on the market as a final product/service but promise to have a great impact.

## The award competition is adjudicated by an independent jury

**Peter Dröll**

Director,  
DG Research & Innovation,  
European Commission



**Simon Edmonds**

Director,  
Manufacturing,  
Materials & Mobility,  
Innovate UK



**Christian Ehler**

Member of the  
European Parliament



**Carlos Härtel**

CTO & Chief Innovation Officer,  
GE Europe



**Jana Kolar**

Member of the Governing Board,  
EIT



**Francisco Marín**

General Director,  
CDTI



**Unni Merete Steinsmo**

Corporate Advisor,  
SINTEF



# IMPACT DELIVERED

Discover  
innovations  
from RTOs'



**IMPACT  
DELIVERED**

## **SURFACES COME TO LIFE VTT**



**IMSE TECHNOLOGY  
REDUCES ASSEMBLY COSTS  
BY MORE THAN  
30%**  
COMPARED TO TRADITIONAL  
MANUFACTURING METHODS



**IMSE STRUCTURES ARE  
50-75%  
LIGHTER  
AND TAKE UP  
25%  
LESS SPACE  
THAN CONVENTIONAL  
ELECTRONIC ASSEMBLIES**



**THE TIME  
TAKEN TO CHANGE  
PRODUCT FUNCTIONALITIES  
AND APPEARANCE  
IS REDUCED BY  
40%**  
WITH IMSE MANUFACTURING

VTT Technical Research Centre of Finland Ltd is among the major research and technology organisations in Europe. Our research and innovation services give our partners, both private and public, all over the world, a competitive edge.

We pave the way for the future by developing new smart technologies, profitable solutions and innovation services.

We create technology for business – for the benefit of society.



[www.vtt.fi](http://www.vtt.fi)

# Transforming the way electronics are integrated into everyday life

Electronics have an ever-increasing role in product content, features and value in many markets. The need to incorporate electronics into everything from stylish control panels to washable wearable devices has challenged the industry to find alternatives to the 100-year old components-in-a-box approach. VTT sets out to find a way of manufacturing the lightweight, thin and durable electronics global industries are now seeking. Its solution, Injection Molded Structural Electronics

(IMSE), integrates printed circuitry and electronics components within three-dimensional injection molded structures to create one seamless part. Bringing functionality to shapes and places impractical or impossible for traditional electronics, IMSE has been commercialised by VTT spin-off TactoTek and is giving product engineers unparalleled freedom to deliver the electronic functions users want and companies the opportunity to differentiate their products in the marketplace.



IMSE technology transforms injection-molded plastics into smart structures encapsulating sophisticated electronic functionality while being light, thin and durable.

## Reimagining the manufacturing process

Conventional multi-part assemblies made up of separate surfaces and electronic components limit possibilities in terms of functionality and form. Critically, alongside their weight and volume, they aren't flexible or rugged enough for today's applications. Applications such as Internet of Things and wearable devices and switches and lights for car interiors and appliances. These require electronics to be slim and uniquely shaped to enable elegant human-machine interfaces. In many cases, the electronics must also be protected from moisture, vibration and extreme temperatures. A new approach to manufacturing was needed to enable electronics and surfaces to be integrated into a single part.

## Enabling innovative electronic designs

EARTO member VTT developed just such a solution by bringing together a mixture of well-known production technologies. Its IMSE technology enables electronic functions to be integrated inside injection-molded plastic to create smart structures with innovative contours. Easily configured for mass production, IMSE reduces manufacturing costs, bulk and weight – and increases performance and possibilities. The integrated electronics are inherently protected from the outside environment, for example, and, being closer to the surface, more sensitive to touch. They can also be combined with surfaces such as wood and leather to create beautiful fully-functional surfaces.

## Inspiring new customised products

VTT spin-off TactoTek was named winner of the 2017 Global Technology Innovation Award by Frost & Sullivan and its impact supports this endorsement. The company adapts customer designs into IMSE solutions and develops prototypes for mass production in-house or by a licensed manufacturer. It has 12 projects ongoing with major brands and 100 in the pipeline. These include creating a natural wood trim with touch and lighting functions for car interiors and a smart connector capable of withstanding harsh environments for motion sensing solutions integrated into clothes and shoes. The market's response to IMSE enabled TactoTek to secure \$23m funding and predict a doubling of its workforce to 150 in 2018.

**IMPACT  
DELIVERED**

## A DIGITAL NOSE FOR SUCCESS CEA



NEOSE CAN DETECT  
**MORE THAN  
700**  
DIFFERENT ODOURS  
AND DELIVER RESULTS WITHIN  
**30 seconds**



IN THE SIX MONTHS  
AFTER ITS LAUNCH  
**50**  
NEOSE DEVICES  
COSTING  
**€ 10,000**  
EACH WERE ORDERED BY 10  
OF THE WORLD'S LEADING  
FRAGRANCE COMPANIES



IT IS ESTIMATED THAT THE  
**DIGITAL OLFACTION MARKET**  
WILL BE WORTH  
**€ 1 billion**  
A YEAR  
BY 2025

The CEA – Alternative Energies and Atomic Energy Commission – is a French government-funded RTO and a prominent player in the ERA. The CEA is active in four main areas: low-carbon energies, defence & security, information technologies and health technologies. The CEA maintains a cross-disciplinary culture of engineers and researchers, building on the synergies between fundamental and technological research.

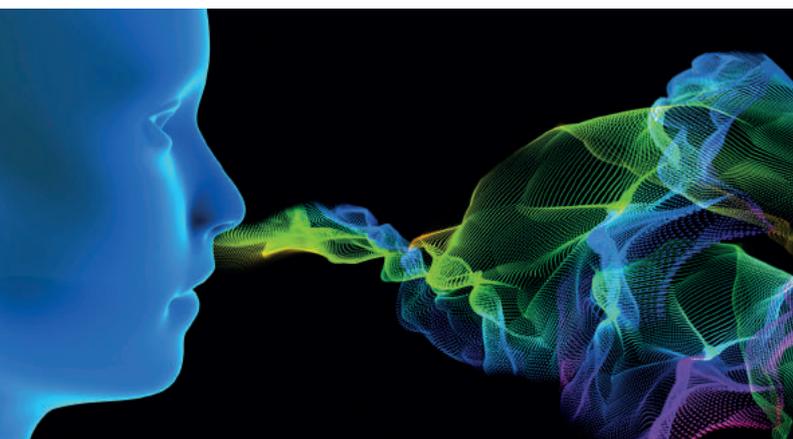


[www.cea.fr](http://www.cea.fr)

# Mimicking humans' sense of smell to improve product quality and quality of life

There has long been a strong demand to digitise humans' sense of smell, as has been achieved for our sense of hearing with the microphone and our sense of sight with cameras. While there has been some progress in creating 'electronic noses' capable of identifying small numbers of similar liquids or gases, universal odour detection technology remained an aspiration. CEA and spin-off Aryballe Technologies have now developed the first device capable of detecting hundreds of simple and complex smells. Combining chemical

sensors and an optical detection system in a miniaturised package, the NeOse device digitises detected odours and compares them to a reference database for rapid identification. This speed, together with its portability and flexibility, enables the device to open up opportunities in a wide variety of industries. As well as its ability to ensure the olfactory characteristics and conformity of products, NeOse also has a role in healthcare, safety, R&D and environmental monitoring.



The NeOse device sucks odours via a pump and uses chemical sensors and an optical system to identify different scent molecules which are sent to a database of known smells for analysis and identification.

## Opening up new horizons for industry

Hundreds of prototypes have been developed over the years in a bid to mimic human olfaction. It is, however, such a complex process that the only workable solutions have been simple – able to detect just one type of odour. The problem is that smells are not energy and easily 'sensed' like light and sound but mass, a very different kind of signal. This means that each smell requires a different type of sensor – and that any multi-odour device would be unfeasibly bulky. The absence of a universal odour detector has been keenly felt for over a decade by industries faced with ever-growing needs to monitor and control product, air and water quality and to improve detection of hazardous leaks and diseases like cancer.

## Outperforming the human nose

To create a cost-effective, easy-to-use commercial solution, EARTO member CEA turned to its patented technique for distinguishing different odours: surface plasmon resonance imaging (SPRI). In collaboration with spin-off Aryballe, it developed the components for a miniaturised system incorporating 100 biosensors providing a universal recognition spectrum. The NeOse device, commercialised by Aryballe, enables industries like farming, food and fragrance to control the quality of raw and finished products with higher reliability and reproducibility than a human nose. It can also be used in factory risk assessment, microbial pathogen detection and olfactory pollution monitoring.

## Meeting commercial and consumer needs

Within months of their launch, NeOse systems were sold to 10 customers from leading fragrance companies. Other early adopter industries include automotive, food, packaging, cosmetics, biomedical and analytical chemistry. A consumer version of the device will be launched next. This will help people monitor and control things like food freshness, oven cooking and kitchen ventilation. It can also act as an aide for people with no sense of smell and a diagnostic tool for 'sniffing out' certain diseases. This version will be turned into turnkey solutions for the car and appliance markets by value-added resellers, an arrangement Aryballe predicts will help it achieve a turnover of €20 million in 2021.

**IMPACT  
DELIVERED**

**3**

## AROUND THE WORLD IN A DAY TNO



TNO HAS SUPPLIED  
A COMPLETE TELESCOPE  
SUB-SYSTEM  
VALUED AT  
**€ 10 million**  
FOR EUROPE'S  
SEVEN-YEAR SENTINEL  
5P AIR QUALITY  
MONITORING MISSION



THE INNOVATIVE  
SPACE TELESCOPE  
IS BEING USED  
TO MONITOR  
AIR POLLUTION IN THE TROPOSPHERE,  
WHICH EXTENDS FROM THE  
EARTH'S SURFACE  
TO A HEIGHT OF UP TO  
**10 km**



THANKS TO ITS UNIQUELY  
WIDE VIEWING ANGLE,  
THE TELESCOPE  
CAN IMAGE THE ATMOSPHERE  
AROUND THE GLOBE  
EVERY DAY WITH A  
GROUND PIXEL RESOLUTION OF  
**3.5 x 7 km<sup>2</sup>**

TNO, an independent RTO from the Netherlands, has over 3,000 professionals who put their knowledge and experience to work in creating smart solutions to complex issues. These innovations help to sustainably strengthen industrial competitiveness and social wellbeing. TNO has some 3,000 industrial partners around the world, including SMEs.

TNO focuses on 5 domains:  
healthy living, defence, safety and security, industry, energy, and urbanisation.

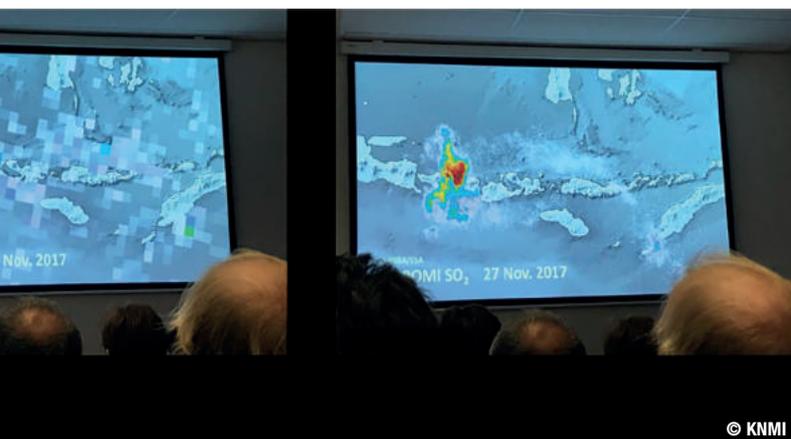
**TNO** innovation  
for life

[www.tno.nl](http://www.tno.nl)

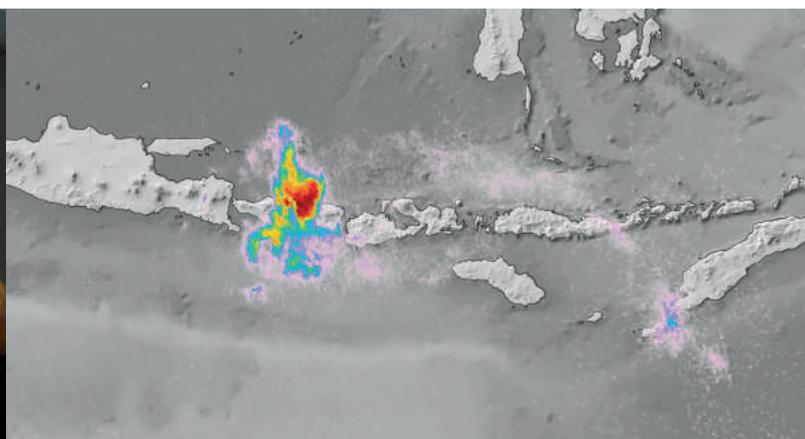
# Providing the most accurate daily picture ever achieved of global air quality

Air pollution is a major environmental challenge, with trace gases and dust contributing to climate change and a variety of health problems affecting millions of people. Reliable global data relating to the full spectrum of pollutants, collected daily over a long period of time, is vital to understand what exactly is changing in the earth's atmosphere, with what consequences for mankind and how we should intervene. A telescope developed by TNO, whose two free-form mirrors enable unprecedentedly high optical quality and wide field of view, is the first

to fulfil all these performance requirements. The telescope has already been deployed in TROPOMI (TROPOspheric Monitoring Instrument), the sole payload of Europe's Sentinel 5P satellite whose seven-year mission will gather and share global air quality data. It can also be modified for use on small satellites where compactness and low cost are paramount. By taking pollution monitoring to the next level, TNO's innovation will play a role in creating opportunities to improve health and living standards around the world.



© KNMI



The superior image quality and wide field of view of TNO's novel telescope enables the meticulous daily mapping of air pollution around the globe down to the neighbourhood level.

## Mapping the future of air monitoring

Existing space telescopes for pollution monitoring have performance limitations which are restricting the use and value of the data they generate. They are limited in terms of what they can detect, when there's a need to measure all the main pollutants and two major climate gases as well as aerosols which play a role in pollution in the troposphere – up to 10 km above the earth. And there is no telescope capable of covering the entire Earth in a day and giving scientists, regulators, urban planners and policymakers the data frequency and 'big picture' view their work calls for.

## Enabling superior performance

EARTO member TNO worked with Netherlands space industry to develop a new kind of telescope whose performance surpasses existing models through the combination of their best features and a fundamentally new design. Using just two free-form mirrors without rotational symmetry means that excellent image quality can be maintained over the entire viewing angle. This design makes it possible to meticulously monitor air quality to the level of a few square kilometres, and in the future to smaller than 1 km<sup>2</sup>. The data generated by the telescope can be used to provide critical information to services and decision makers, guide pollution reduction measures, identify areas of non-compliance with international climate agreements and create healthier environments.

## Advancing space optical systems

The TNO telescope was launched in October 2017 aboard the Sentinel 5P satellite funded by the European Space Agency and the Netherlands Space Office as part of the European Commission Copernicus program. The mission's global coverage and open data policy guarantee its worldwide impact. TNO has used a similar two-mirror design in the TROPOLITE/SPECTROLITE instruments it has designed for small and cube satellites. The telescope is also suitable for a wide range of remote sensing, space-based Earth observation instruments. TNO has made use of the knowledge it has gained in free-form optics to create software tools which companies can use for the design and development of space optical systems and for advanced industrial instrumentation such as lithography.



© Junko Kimura / Fraunhofer

## Making liver surgery safer

The gold standard for curative treatment of liver cancer, one of the most common cancers worldwide, is surgical removal of the tumour. However, the liver is one of the most demanding organs for surgeons, who have to take into account its four interwoven vascular systems, the tumour position and residual liver function when deciding whether, and exactly how, to operate. This complexity makes the surgery planning demanding.

**Innovation:** EARTO member Fraunhofer-Gesellschaft has developed software enabling risk analysis, procedure planning and residual liver function estimation. The MeVis LiverAnalyzer, which was supported by the EUROSTARS programme and the European Development Fund, is based on image-processing algorithms. These enable to quantify the risks of intervention and to generate 3D visualisations of the liver, tumour and vascular systems, helping to evaluate and optimise the surgical plan.

**Impact Delivered:** The innovation is now available to clinical users worldwide thanks to the close collaboration of Fraunhofer MEVIS and Siemens Healthineers. The software is supporting to increase the number of promising surgical interventions, since patients who were previously regarded as non-operable may now be treated. It also makes surgery safer for patients and helps to optimize surgical plans, in particular for complex cases where it changed up to 33 % of initial plans according to clinical studies.



The Fraunhofer-Gesellschaft is a German RTO, which has a clearly defined mission of application-oriented research, with a focus on key technologies of relevance to the future.

[www.fraunhofer.de](http://www.fraunhofer.de)



## A virtual ride down memory lane

Europe's fast-growing ageing population represents a challenge for healthcare systems. New technologies and services are urgently sought to help elderly people exercise both their brains and bodies and maintain a good quality of life. The challenge is to make solutions effective and affordable and to ensure they meet the needs of elderly users rather than the assumptions of researchers.

**Innovation:** EARTO member VITO developed a low-cost solution combining cloud-based software with Google Streetview, a stationary exercise bike and a screen to allow elderly people to take a virtual ride down memory lane. Users can create their own personalised experiences, following familiar routes with emotional value or exploring new locations. Designed with nursing home residents and care professionals, Memoride enables users to exercise in a fun, motivating and safe environment regardless of physical or cognitive restrictions.

**Impact Delivered:** Commercialised by Activ84Health, Memoride has been installed in over 80 nursing homes, rehabilitation centres and hospitals in seven countries, achieving revenue of €300,000 in 28 months. Feedback brings home the innovation's ability to unlock memories and encourage users to tell their stories. Memoride is now ready for global expansion and Activ84Health has set up distributor networks in three countries with plans for four more.



VITO is a Belgium RTO in the areas of cleantech and sustainable development, elaborating solutions for the large societal challenges of today such as climate change, food security, resource scarcity, sustainable energy and health.

[www.vito.be](http://www.vito.be)



## Enabling higher performance jet engines

Jet engine components are exposed to extreme thermal loads, particularly during take-off and landing, and need to be protected by thermal barrier coatings (TBC). These can be damaged by the mechanical stresses of repeated thermal expansion and contraction. One promising idea for enhancing TBC endurance involves tailoring the surface design of components to create a stronger bond with the ceramic top layer.

**Innovation:** In collaboration with Rolls-Royce, EARTO member Fraunhofer developed additive manufactured filigree metallic structures and a process for coating entire curved components. The solution, based on the work of FP6 project TOPPCOAT, increases TBC performance and lifetime, allows for longer service intervals and reduces fuel consumption by 10%, increasing the overall efficiency of jet engines.

**Impact Delivered:** The innovation has been deployed by Rolls-Royce in its XWB 97 model, used on the Airbus A350. This engine is now the fastest selling widebody jet engine ever, with 1,700 engines ordered by 45 customers. Rolls-Royce has invested €100m in its German plant to meet demand. Thanks to the engine's reduced fuel consumption, a saving of around €2.4m per aircraft per year is estimated. For the 160 Airbus A350s on order, this adds up to savings of €420 m.



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[www.fraunhofer.de](http://www.fraunhofer.de)



## A step forward for rubber shoe soles

The vulcanisation process that turns raw rubber into a more durable substance ideal for shoe soles has long hampered productivity improvement. The process, in which rubber is heated in the presence of sulphur to prevent deformation while retaining its elasticity and other valuable characteristics, is very slow. Accelerators can be added to speed up the process, but it has proved difficult to decrease reaction time without degrading some of the rubber's final properties.

**Innovation:** The Footwear Technology Center of La Rioja, EARTO member through FEDIT, has overcome this problem by developing new rubber formulations from novel additives based on nanotechnology. The use of nanoparticles means there is a greater area of contact between particles and vulcanisation occurs more quickly, without any detriment to the rubber's abrasion, flexion and tear resistance, hardness, density and light fastness.

**Impact Delivered:** The new additives reduce manufacturing time by 44% – 13% more than expected – removing the previous production process bottleneck. The project's two industrial partners have started using the formulations and are seeing a rise in sales of 10% – and in their global competitiveness. The innovation could be extended to other European companies and also to other products that use vulcanised rubber such as car tyres and hydraulic hoses.



FEDIT is a Spanish association of RTOs whose main mission is to boost and encourage innovation, technological development and private research.

[www.fedit.com](http://www.fedit.com)



## Creating a new vision for the ophthalmic industry

Consumers' growing interest in products personalised to their needs and preferences is prompting many industries to rethink their business operations. For the ophthalmic industry, personalisation poses a huge challenge, with spectacles mass produced far away in Asia and every customer having a uniquely shaped face. It also, however, presents a great opportunity.

**Innovation:** EARTO member Eurecat and 10 partners developed a business model and advanced manufacturing techniques for the production of 3D-printed spectacles tailored to the anatomy of each customer and manufactured in mini-factories. Optician2020, which was co-funded by the Framework 7 Factories of the Future PPP, makes the user an integral part of the co-creation process – and fully personalised spectacles available for the first time.

**Impact Delivered:** Optician2020 has the potential to transform the industry's image, offering and customer experience. Not only does it improve the frame fit and optical quality of lenses, it also makes spectacle manufacturing local and more sustainable. By doing away with the transportation logistics involved with overseas manufacture, time-to-market is reduced by 75%, costs by 40% and environmental footprint by 50%. The innovation is now available in Spain and Portugal under the brand name Mimic Eyewear.



Eurecat is the main Technology Centre in Catalonia, Spain. Its multidisciplinary and multinational team of 600 professionals work in more than 160 projects of applied R&D.

[www.eurecat.org](http://www.eurecat.org)



## Simulating surgery for better results

Abnormal dilatation of the aorta (aneurysm), which can lead to rupture, internal bleeding and death, affects 5-10% of men over 65 in the Western world. Endovascular aneurysm repair (EVAR) is a less invasive and more efficient treatment than open surgery. It does, however, require time-consuming pre-planning to customise grafts for the aorta landing zone and precise, right-first-time placement to avoid unanticipated complications and prolonged procedures.

**Innovation:** In cooperation with St Etienne University Hospital, EARTO member ARMINES developed predictive and patient-specific numerical simulations of EVAR and other surgical procedures. Making use of research carried out by the ERC-funded BILOCHANICS project, the solution accelerates and improves personalised stent design and the planning and execution of complex surgery, cutting the preparation phase from two months to one week and making the treatment less hazardous for patients.

**Impact Delivered:** Brought to market by ARMINES spin-off PrediSurge, the software will significantly impact the efficiency and quality of aorta surgery for the 200,000 patients treated each year. It will also help hospitals and medical device manufacturers improve their service and reduce their costs. PrediSurge forecasts 75% penetration of a growing market currently valued at €48 million a year.



ARMINES is a private non-profit research and technological organisation (RTO) funded in 1967 at the instigation of its partner engineering schools, the Ecoles des Mines network.

[www.armines.net](http://www.armines.net)



## Breakthrough in streaming virtual reality

Virtual reality (VR) technology that allows users to feel they're in the middle of the action has an exceptionally bright future. In the meantime, sectors such as entertainment, education, healthcare and advertising, eager to make use of panoramic or 360 degree VR (VR360) video, have had to wait for some basic limitations to be overcome. Limitations such as low screen resolutions, enormous bandwidth requirements and mediocre quality images.

**Innovation:** EARTO member TNO developed a solution based on 'tiled' streaming, where large images are cut into 'tiles' and only those that cover the user's viewport are streamed. Their solution ClearVR increases visual quality by a factor of five and dramatically lowers the bandwidth required as well as the cost of streaming. The result is a significant increase in the number of users who can receive high quality 360 VR video to headsets or tablets over their internet connection.

**Impact Delivered:** ClearVR was launched by spin-off Tiledmedia, in partnership with a VR concert specialist. Trials are underway with leading European and US telecommunications operators, as is a cooperation with China's largest content delivery network. System integration has started with Ericsson Media Services among many others. The market Tiledmedia is finding so receptive is predicted to grow to € 40-60 billion within five years.

**TNO** innovation  
for life

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[www.tno.nl](http://www.tno.nl)



## A new generation solution for business process management

Business Process Management (BPM) has been helping organisations formalise how they do things to optimise performance and productivity for decades. Conventional BPM systems have, however, gained a reputation for being complex, beset by constraints and relevant only for large companies. But firms need a solution that could be easily set up, used and continually adapted without any particular technical knowledge.

**Innovation:** EARTO member ARMINES supported Iterop to achieve this goal with an online software-as-a-service (SaaS) solution that tracks and automates processes and workflows in a few clicks. Implemented seven times faster than predecessors, Iterop provides a central application where all processes, documents and information are brought together, enabling employees to visualise, manage and change processes quickly in real time.

**Impact Delivered:** The Iterop solution provides a way for all organisations, and SMEs in particular, to make a success of their digital transformation. Iterop's 50 customers, who include Airbus and the French Ministry of Defence, report a 30% increase in operational efficiency. Iterop has achieved 60% growth over the last three years and predicts sales from subscriptions for the solution will rise from 50% of all revenue to 80% by 2022.

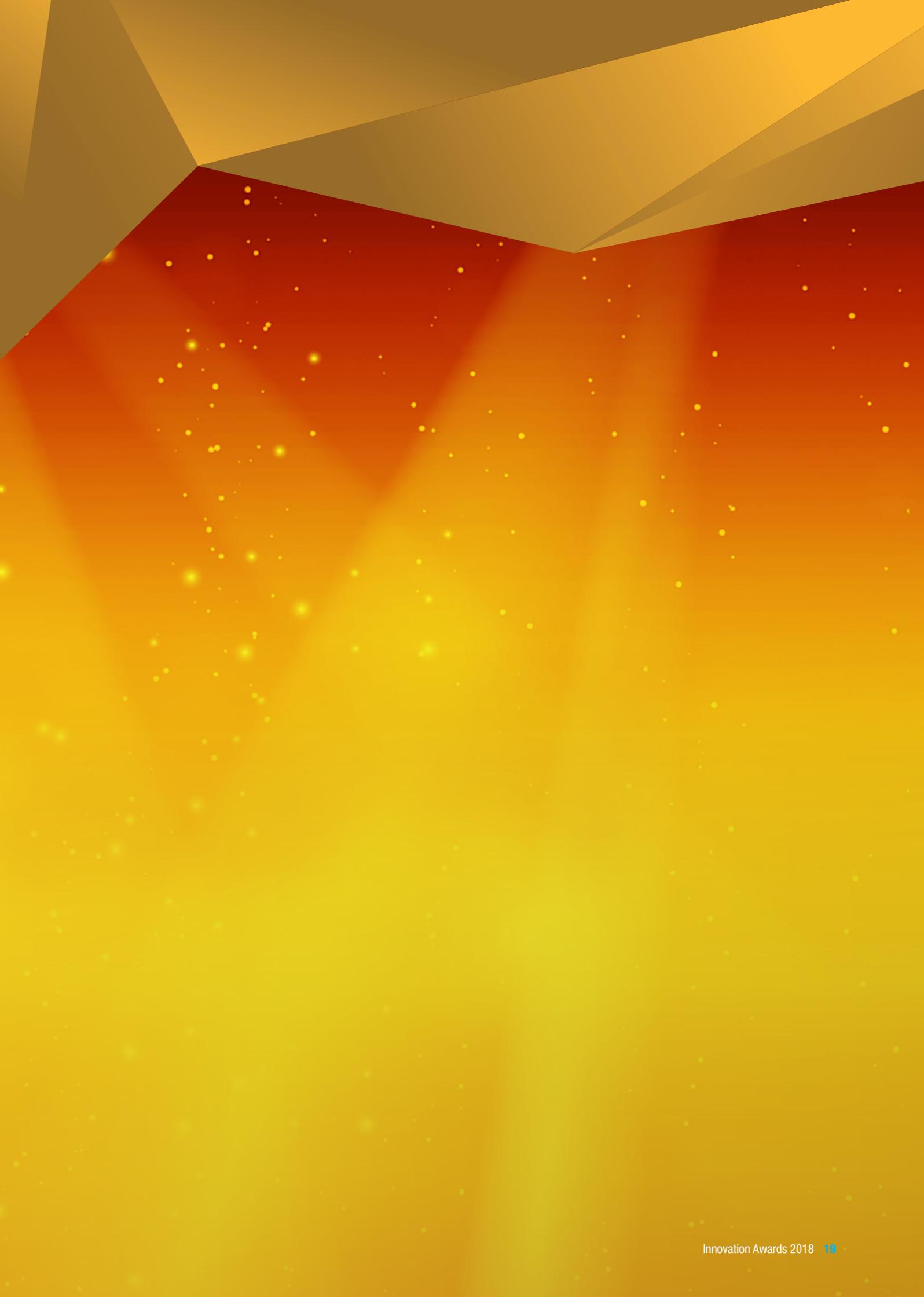
**ARMINES**  **iterop** 

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[www.armines.net](http://www.armines.net)

# IMPACT EXPECTED

Discover  
innovations  
from RTOs'



**IMPACT  
EXPECTED**

## FINDING A NEEDLE IN A HAYSTACK HELMHOLTZ ASSOCIATION



SENSEUP TECHNOLOGY  
ACCELERATES THE  
MICROORGANISM  
SCREENING PROCESS  
BY A FACTOR OF  
**1,000,000**



THE NEW TECHNOLOGY  
ENABLES THE ANALYSIS OF  
UP TO **50,000**  
INDIVIDUAL CELLS PER SECOND  
COMPARED TO THE  
CONVENTIONAL RATE OF  
**30,000**  
A YEAR



HELMHOLTZ SPIN-OFF  
SENSEUP TECHNOLOGY  
SECURED VENTURE  
CAPITAL INVESTMENT AND  
GRANTS TALLING  
**€6.5 million**

Helmholtz Association is Germany's largest scientific organisation. It represents more than 39,000 employees working in 18 research centres across Germany. The Helmholtz Association concentrates its resources within specific programmes where it carries out top-class research in six research fields. These are Energy, Earth and Environment, Health, Aeronautics, Space and Transport, Key Technologies, plus Matter.

Helmholtz transfers scientific knowledge into innovation and on into the market and so contributes to creating the technological basis for a competitive society.

**HELMHOLTZ**  
RESEARCH FOR GRAND CHALLENGES

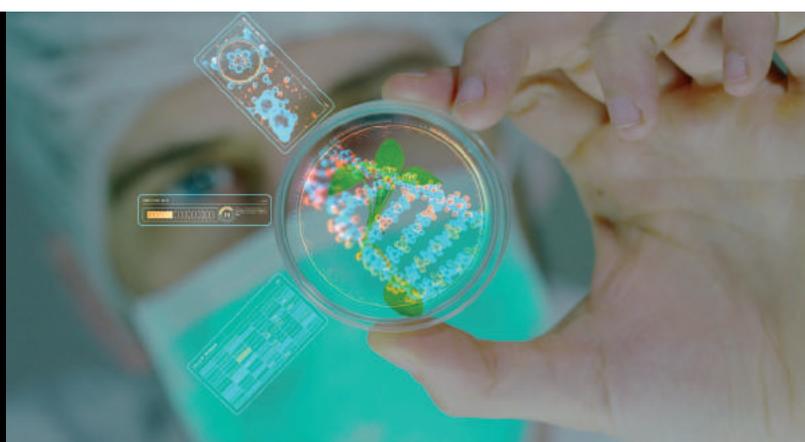
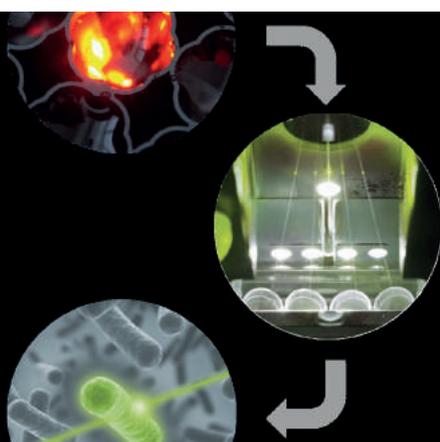
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FORSCHUNGSZENTRUM

[www.helmholtz.de](http://www.helmholtz.de)

# Unlocking nature's potential to drive the new bioeconomy

The global biological economy is rising, bringing with it the promise of novel product opportunities and greater environmental protection. But the move away from a chemical economy to a bioeconomy based on renewable resources and natural catalysts presents enormous challenges. Among the most significant is the need for a flourishing supply of suitable microbial production strains for the vast number of biotechnological production processes change will require. The Helmholtz Association of German Research Centres

has developed a technology that uses genetic sensors, a cell sorter and a laser to screen and isolate the most productive strains out of millions of others in minutes instead of thousands of years. The innovation has been commercialised by Helmholtz spin-off SenseUp Technology which is working with companies around the world to develop tailor-made production strains for novel biotechnological products in the pharmaceutical, food and chemical sectors.



SenseUp technology makes it possible to quickly and efficiently identify highly productive microorganisms capable of producing the basic building blocks for products made from renewable raw materials.

## Speeding the screening process

Microbial production strains are biocatalysts that can transform renewable raw materials into high-value products. The more they produce of the desired substance, the more effective the entire industrial process becomes. Highly productive production strains are in increasing demand as replacements for fossil resources and synthetic catalysts, but supply has been hampered. Identifying the few most productive cells out of millions with classic methods is difficult and time consuming, traditionally taking months, years or even decades. A step change in the screening process has long been needed to ensure industries have access to sufficiently efficient and scalable biotechnological processes.

## Lighting up new opportunities

EARTO member Helmholtz has enabled this change with its SenseUp technology which can screen 50,000 cells a second and identify the most highly productive strains. Individual cells are first injected with a highly specific genetic sensor which quantifies the desired product it contains. The cells are then flushed through an ultra-high throughput fluorescence activated cell sorter and as they pass a laser beam, the brightest – and most productive – cells are highlighted. SenseUp technology has the potential to enhance the productivity and cost-efficiency of biotechnology processes and help companies tap into new markets and get new biotechnological products to market fast.

## Creating highly valuable products

Helmholtz spin-off SenseUp Technology secured funding of €6.5 million from venture capitalists and the Federal Ministry of Education and Research (BMBF) on its launch. It now has a global client base covering Europe, China, Japan, Korea, the USA and Australia and expects significant commercial revenues by 2020. The breadth and progress of initial projects suggest the technology will play a notable role in driving the bioeconomy to a successful future. Outcomes of early projects include evolved or completely new production strains for an amino acid used globally as a food and feed supplement, the large-scale production of peptide-based glues and an antibody successfully used to treat leukaemia.

IMPACT  
EXPECTED

## NEXT GENERATION GENERATOR TECNALIA



GLOBAL DEMAND FOR  
HIGH PURITY HYDROGEN  
AT SMALL AND MEDIUM SCALE  
IN THE HIGHEST-GROWING SECTORS  
IS VALUED AT  
**€7 billion**  
A YEAR



TECNALIA'S ADVANCED  
MEMBRANE REACTOR  
HAS A CARBON FOOTPRINT  
MUCH LOWER AND  
PROCESS EFFICIENCIES OF  
**80%**  
HIGHER THAN EXISTING SYSTEMS



THE INNOVATIVE MEMBRANES  
ARE MUCH THINNER  
THAN PREDECESSORS,  
WITH MUCH HIGHER  
PERMEATION LEVELS

Tecnalia is a Spanish RTO aiming to transform knowledge into GDP by creating business opportunities for companies through multidisciplinary and applied research, improving people's quality of life. Experts of more than 27 nationalities, in 22 headquarters all over the world, visualise, identify and develop comprehensive technological solutions with creativity and imagination for more than 4,000 clients.

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Business

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# Powering the fuel of the future with low-cost, high-quality production innovation

Hydrogen, the simplest element in nature, can be complex and costly to produce. With today's significant demand for hydrogen from industry and about to be greatly increased by its potential in low carbon energy systems, hydrogen production breakthroughs are urgently needed. TECNALIA, together with the Eindhoven University of Technology has developed an innovative hydrogen generation system designed to make the supply of hydrogen at small and medium scale much simpler and cheaper compared with other technologies. The system consists of an advanced

membrane reactor that turns four traditional process stages into one, enabling a quantum leap in process intensification. As a compact, on-site option it also avoids transport costs and associated compression and product losses. Start-up AMR aims at commercialising the innovation, initially targeting high-growth industrial markets that use hydrogen as a chemical feedstock as well as low carbon energy markets such as fuel cell electric vehicles (FCEV) and micro combined heat and power (CHP) plants. These markets have a combined value of €7 billion a year.



TECNALIA's on-site hydrogen generation system consists of a membrane reactor that simplifies the production process and generates ultra-pure hydrogen at low cost and with low carbon impact.

## Driving improvements in the production process

The small to medium scale supply of hydrogen to industry has conventionally taken the form of compressed cylinders containing hydrogen previously generated in large plants. With this option, up to 65% of the final cost relates to compression and transport, an operation in which 12% of the hydrogen is lost. In addition to the existing large industrial market for an improved solution, the role of hydrogen is about to take on as an energy vector in low carbon energy of the future – in hydrogen refuelling stations for electric cars for example – adds pressure for advances. Regulations to reduce pollution and greenhouse gas emissions are also a driver for change in the way hydrogen is produced.

## Generating the required results

EARTO member TECNALIA and the Eindhoven University of Technology responded to this need by developing a fluidised bed membrane reactor which makes on demand, on-site ultra-pure hydrogen generation economically feasible for the first time. The catalytic membrane reactors combine reaction and separation into one single, more efficient, step and allow process temperatures to be reduced, lowering the system's environmental impact beyond existing technologies. The innovation was enabled by funding from FP7 and H2020 programmes, especially the Fuel Cells and Hydrogen Joint Undertaking (FCH JU).

## Capitalising on high-growth markets

AMR, which is taking the technology to market with support from TECNALIA Ventures, is piloting a small reactor and has an industrial tester and value chain and investment partners lined up. Its priority target markets include the glass, metallurgy, oils and fats and electronics industries to whom it aims to sell 13 reactors valued at €5 million within five years. The business is also preparing to capitalise on new applications with double-digit growth rates for the use of hydrogen as an energy vector. Latin America, which has a strong need for distributed power generation, is one target market, as is Europe, whose FCEV ambitions will require hydrogen distribution networks with decentralised small and medium scale supply.

IMPACT  
EXPECTED

3

## A PLUG-AND-PLAY HUMAN FRAUNHOFER



ORGAN-ON-CHIP  
TECHNOLOGY  
HAS BEEN NAMED  
ONE OF THE WORLD'S TOP  
**10**  
EMERGING TECHNOLOGIES



THE MICROPHYSIOLOGICAL  
SYSTEM MARKET  
IS GROWING AT AN ANNUAL RATE  
OF OVER  
**60%**  
AND IS PREDICTED TO BE WORTH  
**€ 145 million**  
GLOBALLY BY 2023



FRAUNHOFER'S NEW SYSTEM  
WILL GIVE EUROPEAN COMPANIES  
A MARKET SHARE OF MORE THAN  
**30%**  
OVER THE NEXT FIVE YEARS,  
EQUATING TO VOLUME  
**€ 50 million**  
A YEAR

The Fraunhofer-Gesellschaft is a leading research and technology organisation. Its activities are conducted by 66 Fraunhofer Institutes and research units located throughout Europe. Fraunhofer employs a staff of around 24,000 who work with annual research budget totalling 2 billion euros, 70% being generated through collaborative research with industry and publicly funded research projects.

The Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS Dresden is an institute of the Fraunhofer-Gesellschaft and stands for innovations in laser and surface technology.

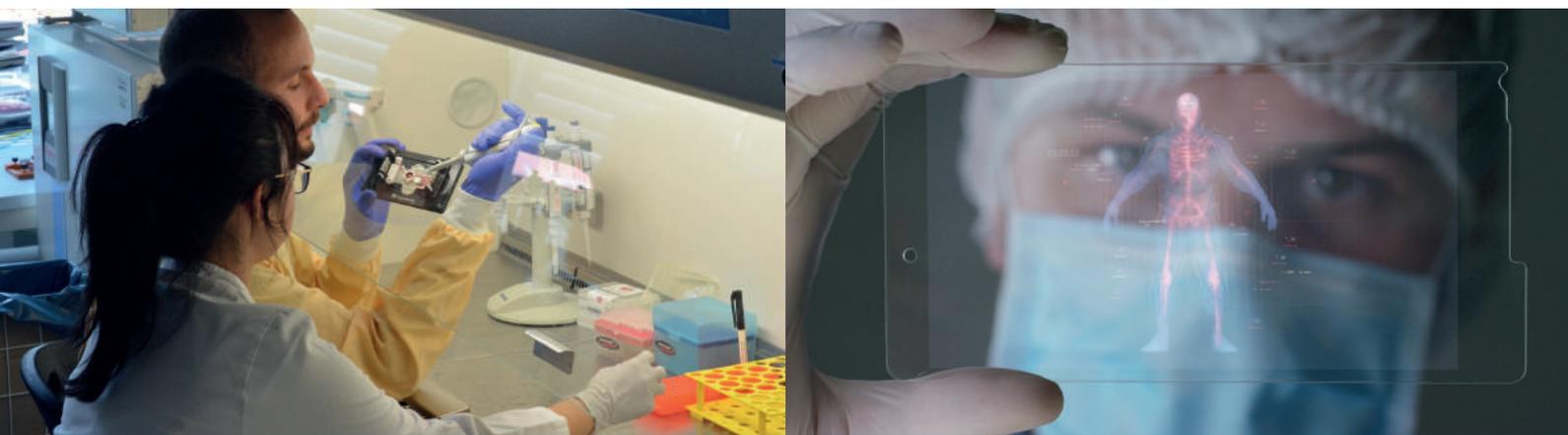


[www.fraunhofer.de](http://www.fraunhofer.de) / [www.iws.fraunhofer.de](http://www.iws.fraunhofer.de)

# Unlocking medical innovation with multi-organ chip system

Microphysiological systems that can reproduce the basic functions of the human body are considered the key to innovative new products in fields from drug development and toxicology screening to personalised medicine and disease modelling. Multi-organ systems have the greatest potential, but they also come with the greatest challenge: balancing the complexity required to authentically mimic human physiology with the need for simplicity to ensure usability and cost efficiency. Fraunhofer has risen to this challenge with its

plug-and-play Multi-Organ-Chip (MOC) system which enables tailor-made application-specific microphysiological systems to be assembled quickly and easily. Introducing valuable adaptability and universality and reducing the cost of customised systems make this innovation a game-changer. It provides access to a market growing at 60% a year and gives a greater number of global researchers' access to a powerful alternative to animal testing and in vitro testing systems.



Fraunhofer's plug and play multi-organ chip system simulates processes in the human body and is key to innovation in drug development and personalised medicine.

## Getting personal about healthcare

The rise of personalised medicine is revolutionising the way clinicians and pharmaceutical companies approach disease and paving the way for safer and more effective treatments. Microphysiological systems incorporating chips set up for each patient based on their cell material have the potential to bring about the required paradigm shift in our understanding of how individuals will respond to active substances. Most systems are, however, still limited to the implementation of one specific application at a time. As the effects of pharmaceutical compounds and chemicals are not limited to just one organ, there is global demand for a flexible system suitable for all applications that can mimic multiple organs and the intricate cascade of interconnected inter-organ events.

## Simulating whole organ systems

EARTO member Fraunhofer created the world's first fully customisable MOC platform within a closed circulation system. This universal plug-and-play system is made up of a variety of ultra-compact tissue cell culture modules and basic chips with integrated micropumps, valves, reservoirs, mass exchangers and sensors that can be freely combined with each other according to the specific application. This makes it possible to individually control the flow rate and nutrient concentrations for each tissue, guaranteeing the demand-oriented supply of tissues and organs whose absence has been a key limitation of existing systems.

## Bringing better treatments to life

The new platform will provide the most comprehensive and cost-effective technology for observing the effects of drugs in the body and investigating drug toxicity and efficacy in various organs. As well as helping to accelerate the development of drugs and realise the potential of individualised treatments, it will also bring forward the time organs can be grown to perform organ-specific functions for a short period to mitigate the decline in organ donations. The platform is expected to help European companies secure 30% of the rapidly-growing MOC market over the next five years, equating to volume of more than €50 m a year.



## Powering our connected future

It is estimated that there will be 20 billion connected devices in use worldwide by 2020. The resulting demand for batteries would, it's predicted, consume 75-250% of the world's lithium reserves and 50% of cobalt by 2050. Even if recycling works effectively, demand is likely to outstrip supply. In the race to develop new kinds of energy providers for battery-based and energy-autonomous Internet of Things (IoT) systems, competitors recognise the winning advantages of design flexibility and environmental sustainability.

**Innovation:** EARTO member VTT and its partners developed specialised 2D printing techniques for decorative solar cells that can harvest energy from light sources anytime, anywhere and convert it into electricity. As well as being ultra-thin and more flexible and lightweight than ever before, the Deco-Solar panels are made of sustainable materials and give true design freedom for the first time. They can be customised to any shape, colour and size and embedded into devices and surfaces without limiting their design.

**Impact expected:** As an alternative to non-rechargeable batteries with additional aesthetic value, longevity and eco credentials, the innovation has huge potential. Its greatest opportunity lies in IoT application areas where there is a growing need for autonomous energy harvesting under artificial, low and natural light conditions. Three product concept development projects are underway, and 10 companies are interested in commercialising the technology.



VTT Technical Research Centre of Finland Ltd is among the major research and technology organisations in Europe.

[www.vtt.fi](http://www.vtt.fi)



## Biodegradable bottles boost dairy industry

Most liquid dairy products in Europe are packaged in bottles, pouches and TetraPak® systems with good recyclable properties. The reality is that only 10-15% are actually recycled as they have to be cleaned well to be safely reused and selective waste collection is not universal. Dairy product packaging is subjected to medium to high temperatures during sterilisation and existing biodegradable materials are only of use in a limited range of temperatures.

**Innovation:** Working with seven partners, AIMPLAS Plastics Technology Centre, EARTO member through FEDIT, developed a novel biodegradable and compostable material that overcomes these limitations. With funding from FP7 project BIOBOTTLE, the consortium modified the chemical structure of current materials in a way that increased their thermal resistance without decreasing their mechanical resistance and biodegradability. The new material can be processed with conventional methods and at a lower cost.

**Impact expected:** It is estimated that over the first five years market penetration for big bottles will reach 20,000 tons, which translates into turnover of €85.9 million. As well as providing this competitive boost for the European dairy industry, the packaging degrades into compounds that do no harm to the environment and saves energy as no waste management process is required.



FEDIT is a Spanish association of RTOs whose main mission is to boost and encourage innovation, technological development and private research.

[www.fedit.com](http://www.fedit.com)



## Vinyl records are back

While the demand for other sound storage media has declined, vinyl has bucked the trend. Today it has a 20 % share of the global music market. The 60-year old vinyl manufacturing processes are, however, laborious and bad for the environment, requiring the use of toxic chemicals. The limited number of traditional stamping presses is also causing production bottlenecks that are hampering growth.

**Innovation:** EARTO member Joanneum Research developed a ground breaking technology for producing vinyl records that overcomes all the constraints of conventional processes – and brings with it valuable sound quality, playing time, cost and ecological benefits. The innovation is based on 3D-based topographical mapping and laser inscription technology which has the great advantage that the new High Definition (HD) Vinyl can be played on standard record players.

**Impact expected:** As a 60 % faster and 50 % cheaper technology capable of producing records with more faithful sound reproduction, HD Vinyl equips the industry for the 21<sup>st</sup> century. Currently being further developed and commercialised by REBEAT Innovation, HD Vinyl is expected to stimulate significant market growth. It is predicted that the vinyl market will achieve a 50 % share of the total music storage market by 2023 and that over 290 million HD Vinyl records will be produced by 2026.



Joanneum Research is an Austrian RTO which focuses on application-oriented research and development projects to promote technology transfer into the economy.

[www.joanneum.at](http://www.joanneum.at)



## Turning organic waste into valuable raw materials

The organic elements of municipal solid waste are currently composted, fermented or incinerated, despite the industry's desire to move towards a circular economy. The chemical industry, meanwhile, is keen to reduce its CO<sub>2</sub> emissions through the use of materials not produced from fossil sources. Both industries' needs could potentially be met if organic waste could be turned into building blocks for the chemical industry.

**Innovation:** Under the flag of Shared Research Center Biorizon, EARTO member TNO worked with 11 value chain partners to develop a blueprint for a pilot plant that can convert organic municipal solid waste into furanics. These are the valuable raw materials to produce bio-aromatics which are used by the chemical industry to produce plastics, lubricants, coatings and packaging. By swapping the chemical industry's fossil sources for waste such as manure, sieve fraction, SSO and nappies, the Waste2Aromatics project has the potential to be a game-changer for both industries.

**Impact expected:** The innovation represents an important shift towards the bio-based economy as well as a rare green solution that is no more expensive than its predecessor. Fully utilised by waste companies in Europe, it could produce 15 Megatons of bio-aromatics, surpassing Europe's current demand. Reduction of CO<sub>2</sub> emissions of up to 75 % could be achieved by the chemical industry. Embracing the technology would also make Europe less reliant on imported fossil feedstock.



TNO, an independent Research and Technology Organisation, has some 3,000 professionals who put their knowledge and experience to work in creating smart solutions to complex issues.

[www.tno.nl](http://www.tno.nl)



## Co-creating circular furniture loops

Swedish office furniture is often discarded before the end of its technical lifetime when repairs are needed, businesses relocate or redecorate. The sector's impact on the environment – 150,000 tons of CO<sub>2</sub> equivalents a year – could be substantially reduced by moving to a circular model where furniture is renovated, repaired and sold again.

**Innovation:** Working with 25 partners, EARTO member RISE created and piloted innovative business models for circular office furniture flows. Funded by Swedish innovation agency Vinnova, their work aimed to stimulate interest and spread knowledge, lower barriers to entry and gain acceptance of a 'use and reuse' approach. The collaboration also focused on making the loops in the new circular system as short as possible to increase its environmental, economic and social sustainability.

**Impact expected:** The new models have shown a potential 50% reduction in raw material use and a 30% reduction in CO<sub>2</sub> equivalents. The project has also showed that the profitability of those who circulate tends to be higher than those who do not. There is now a common vision for the industry and its role in Europe as an exemplar of large-scale transition to the circular economy. There is also a five-year ambition for 80% of manufacturers to have circular alternatives and to extend the models to more sectors.



RISE Research Institutes of Sweden, is an independent state research institute and innovation partner. In international collaboration with companies, academia and the public sector, RISE contribute to a competitive business community and a sustainable society.

[www.ri.se](http://www.ri.se)



## Flying robot makes sewer inspection safer and faster

Regular inspection of sewage networks is critical, not only to detect and repair tunnel and pipe defects but also to maintain the structural integrity of roads and buildings on the surface. Inspecting sewers is a difficult, time-consuming and hazardous task, with brigades suffering posture-related injuries and exposure to toxic gases. Replacing humans with robots would make for safer and cheaper inspections.

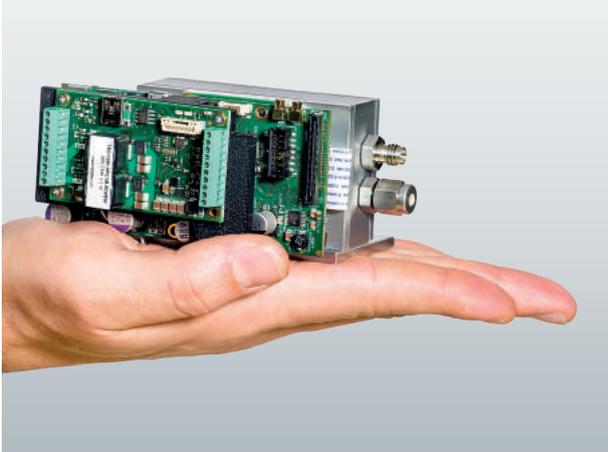
**Innovation:** EARTO member Eurecat and its partners developed a micro aerial robot for sewer inspection (ARSI) whose sensors enable accurate navigation and data collection while providing live video feedback over a wireless link to the operator on the surface. The data is then processed to generate high-resolution 3D models of the sewer tunnels, automatically flagging up defects, leaks or spills which the maintenance team can go to directly to fix.

**Impact expected:** ARSI reduces the time workers are exposed to harsh conditions by at least 50% and cuts the cost of inspections by 30%, allowing for more frequent inspections and more secure sewage systems. Partner FCC is planning to use ARSI in Barcelona for the inspection of sewers and other infrastructures – it can also be applied in train tunnels and bridges – and the consortium has already received interest from cities in Europe, Latin America and the United States.



Eurecat is the main Technology Centre in Catalonia, Spain. Its multidisciplinary and multinational team of 600 professionals work in some 160 projects of applied R&D.

[www.eurecat.org](http://www.eurecat.org)



## Revolutionising the gas sensing industry

The need to detect and analyse gases grows stronger every day in the face of environmental and industrial challenges and new opportunities in fields such as healthcare. Existing solutions are driving the search for a new class of highly-sensitive, affordable detection module which can be easily integrated into ever-smaller gas analysis systems and detect multiple gases in real-time.

**Innovation:** EARTO member CEA worked closely with MirSense to develop and commercialise an off-the-shelf gas detection unit with these prized characteristics. Combining miniaturised, tunable quantum cascade lasers with the compactness of photoacoustic detection, the MultiSense module is up to 100 times smaller and three times cheaper than predecessors. This technology was enabled by the involvement of MirSense in Framework 7 and Horizon2020 projects.

**Impact expected:** MultiSense will help industries including oil and gas, metallurgy and agriculture optimise resources and productivity. Through applications such as leak detection, in-car emission monitoring and city pollution mapping it will play a role in the safety of citizens and the tackling of climate change. It will also enable new applications such as breath analysis to detect alcohol or glucose in the blood. The innovation's market potential is estimated at €1 billion and MirSense predicts growth of over 50% in the next four years.



The Alternative Energies and Atomic Energy Commission (CEA) is a French government-funded RTO and a prominent player in the European Research Area.

[www.cea.fr](http://www.cea.fr)



## Optimising biological pest control

Food security is continuously threatened by insect pests which destroy an estimated 20% of the world's crops. Pesticide use is, however, reducing as regulations become stricter to protect human health and the environment on one hand, and due to insects developing resistance on the other hand. Biological control, is considered a more sustainable approach. This sets a challenge to optimise the performance of baculovirus-based products, the only virus group accepted as control agents against insect pests.

**Innovation:** EARTO member ARMINES and its collaborators developed a crop protection innovation that realises the full potential of baculoviruses to prevent resistance development and target multiple pests. This has been achieved by retaining a controlled level of genetic diversity in the baculovirus, as the probability of pests being resistant to all genotypes will be low, and by producing virus occlusion bodies, which protect infectious particles after release into the environment, containing two or more baculovirus species.

**Impact expected:** The innovation, which has been licensed to an industrial partner, provides access to the global bioinsecticides market, currently valued at €1.2 billion and expected to almost quadruple over the next seven years. It is estimated that once it is fully exploited, over 70 million hectares around the world could make use of the new technology.



ARMINES is a private non-profit research and technological organisation (RTO) funded in 1967 at the instigation of its partner engineering schools, the Ecoles des Mines network.

[www.armines.net](http://www.armines.net)



European Association  
of Research and Technology Organisations

Rue Joseph II, 36-38  
B-1000 Brussels  
Tel: +32 2 502 86 98  
Fax: +32 2 502 86 93  
Email: [secretariat@earto.eu](mailto:secretariat@earto.eu)  
Website: [www.earto.eu](http://www.earto.eu)

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