

EARTO INNOVATION AWARDS 2021

Technology for a better world



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. The 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 technology infrastructures.

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

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Realising Europe's twin digital and green transition requires stronger investments in Research, Development and Innovation

The last years, EARTO has worked vigorously to promote further Research, Development and Innovation (RD&I) investments in Europe and arguing that boosting public RD&I investments and leveraging private investments are key drivers of prosperous and sustainable progress.

The COVID-19 crisis has shown the world that RD&I is indeed vital and has had a key role in supporting Member States managing this global pandemic with its socio-economic consequences. In this pivotal period globally, Europe has strongly benefited having many Research and Technology Organisations (RTOs) supporting the EU and Member States in managing the pandemic. Their capabilities have been crucial in this time of COVID-19 pandemic for developing and testing new treatments and vaccines.

Looking at its future green transition and digitalisation, Europe has launched a new set of EU Programmes (Horizon Europe, Digital Europe, Defence Fund, Space Programme, Structural Funds, etc.) for the next 7 years. In parallel, Member States have developed national recovery and resilience plans aiming at supporting socio-economy recovery of the EU.

In this context, EARTO very much welcomed the ambitions of the European Green Deal. European RD&I capabilities and skills offered by actors such as RTOs will be key to deliver many of those ambitions: for the technology scale-up and deployment needed as well as for the design and implementation of new transforming policies.

In addition, to achieve the smart combination between investments at both EU and national levels for Europe's twin green and digital transition, EARTO and its members constitute the ideal partners to support Europe in accomplishing its strategies. There is now a critical momentum for the European Institutions to put forward the new European Research Area (ERA) Pact for R&I and create effective Industrial Innovation Ecosystems for EU technology sovereignty. To have a concrete impact on Europe's technology capabilities, both the ERA industrial technology roadmaps and the national strategies need to jointly incorporate targeted investments in Technology Infrastructures (e.g. hydrogen, quantum, etc.). It is now high time to accelerate co-designing the new European Strategy for Technology Infrastructures and to orchestrate the delivery of innovative solutions within the key European industrial sectors as defined by our new EU Industrial Strategy.

By using a strategic directionality approach targeting the green and digital transition and avoiding duplication of efforts, the new ERA Pact for R&I should involve the whole RD&I spectrum in a balanced way, from basic research to innovation deployment. In this regard, all RD&I stakeholders, including RTOs and their industrial partners, should actively participate in this process. Indeed, the European Partnerships, strategic for our Industrial Innovation Ecosystems, will be key to implement the new ERA.

As last year, EARTO members managed in these hectic times to meet the expectations of industry and governments and delivered outstanding innovations. In the next pages of the EARTO Innovation Awards Brochure 2021, 38 concrete and successful innovations are showcased, thanks to our members' efforts. Focusing on the day-to-day challenges, RTOs reached their goals in creating success stories and achieving a remarkable socio-economic impact.

RTOs' (r)evolutions have been revealed. Please discover them at first hand!



Antti Vasara
President & CEO, VTT Technical Research Centre of Finland

EARTO INNOVATION AWARDS **13** **YEARS**

EARTO

INNOVATION AWARDS 2021

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 its thirteenth edition.

**NUMBER OF
APPLICATIONS SO FAR**

294
APPLICATIONS

53
RTOs

22
COUNTRIES

**NUMBER OF
WINNERS SO FAR**

57
WINNERS

17
RTOs

13
COUNTRIES

IMPACT DELIVERED

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

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
Deputy Executive Chair
& Chief Business Officer,
Innovate UK



Christian Ehler
Member of the
European Parliament



Jana Kolar
Executive Director,
CERIC-ERIC & Chair,
ESFRI



Juan Antonio Tébar
Director,
CDTI



Frank Treppe
Executive Director (acting),
Fraunhofer Institute for Molecular
Biology and Applied Ecology
(Fraunhofer IME)

IMPACT DELIVERED

Discover
more innovations
from RTOs



IMPACT DELIVERED CEA



Flying-phones in your smart hands

The CEA – Alternative Energies and Atomic Energy Commission – is a partially state-funded French 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.



CURRENTLY **100%** OF NEW
SMARTPHONES USE SMART CUT™
SUBSTRATES



MORE THAN **1,250** ACTIVE PATENTS
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SOITEC CREATED MORE THAN **300** NEW
DIRECT JOBS OVER THE PAST 5 YEARS



20B RF INTEGRATED CIRCUITS BASED ON
RF-SOI SUBSTRATES ARE NOW AVAILABLE
ON THE MARKET



www.cea.fr

Digital speed performance without any sacrifice

The integration of digitalisation in people's everyday lives has opened the floor to new opportunities for innovation in several sectors. A digitalised world plays an important role not only in economic growth and job creation but also in accelerating access to knowledge and education. Such technological advancement requires sufficient hardware systems. Responding to the need for digital transition in the mobile and IoT industry, CEA-Leti, a CEA

technology research institute, together with SOITEC developed a patented Smart Cut™ process to manufacture substrates to produce digital and low power consumption electronic components. With this groundbreaking process, higher data speed, longer battery life, digital processing and power management integration can be achieved, meeting the demanding market's request.



CEA and SOITEC developed a patented Smart Cut™ process to deliver energy-efficient electronic components.

Upscaling data speed standards

Nowadays, each connected object contains several semiconductor components for data reception, computing, sensing, system management, as well as data emission. Radio Frequency Front End Modules (RF FEM), the key elements to move to 4G+, 5G and future 6G standards, enable signal reception and transmission. However, they require high performance in terms of computing and energy power consumption at the same time. To respond to the needs of RF applications to improve the speed, quality and high computing capabilities of smartphones, a generic fabrication process named Smart Cut™, invented by CEA-Leti in 1994, has been used by SOITEC to develop RF-Silicon-on-Insulator (SOI).

Giving birth to new products

EARTO member CEA, in collaboration with SOITEC, have created the patented Smart Cut™ process of substrate fabrication, which consists of various technological steps such as oxidation, implantation, cleaning before bonding. Smart Cut™ results in a transfer of a thin active layer of silicon from one substrate to another, which can be used in all electronic devices. This process provides different family of products: the main one is dedicated to RF components for reaching high performances and power optimisation for smartphones. In addition, another main technology, named FDSOI, is a key technology well suited to mixed analogue/radio frequency and digital circuits, allowing Europe to create advanced microprocessor manufacturing capacity with STMicroelectronics and GlobalFoundries. Based on Smart Cut™, the REFERENCE project is developed to improve SOI substrates for mobile communications, scaling up a pilot line from 200mm to 300mm substrates.

Endless opportunities in many manufacturing processes

CEA and SOITEC new SOI substrates have met immediate commercial success worldwide, where 100% of new smartphones integrate these substrates. Over the past 5 years, SOITEC has gained €1B thanks to the 300mm process and created more than 800 permanent jobs. SOITEC's has many world leading clients, including STMicroelectronics, Samsung, GlobalFoundries and SONY. Today, about 20B RF integrated circuits based on RF-SOI substrates are available on the market. Such substrates allow an efficient power reduction enabling a longer battery life, without sacrificing digital speed performance as well as providing a good balance between digital performance, mixed-signal compatibility, power consumption and cost.

IMPACT
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TECNALIA



Motion without limits

TECNALIA is a leading Research and Technological Development Centre in Europe, whose mission is to transform technology into GDP to improve people's quality of life, by creating business opportunities for companies. TECNALIA works with an increasingly strategic business relationship model based on trust, collaboration, and a shared technological approach, whereby its main scopes of action are energy transition, sustainable mobility, smart manufacturing, precision health, urban ecosystem and digital transformation. TECNALIA is the first private Spanish organisation in contracting, participation, and leadership in the European Commission's Horizon 2020 programme and TECNALIA is ranked third in European patent applications.



2 FESIA PRODUCTS
ARE NOW ON THE MARKET



FESIA DEVICES HAVE BEEN
SOLD IN **16** COUNTRIES



FESIA TECHNOLOGY HAD
€300,000 SALES IN 2020



10M POTENTIAL CUSTOMERS
IN THE EU WITHIN THE NEXT YEARS

tecnal:a

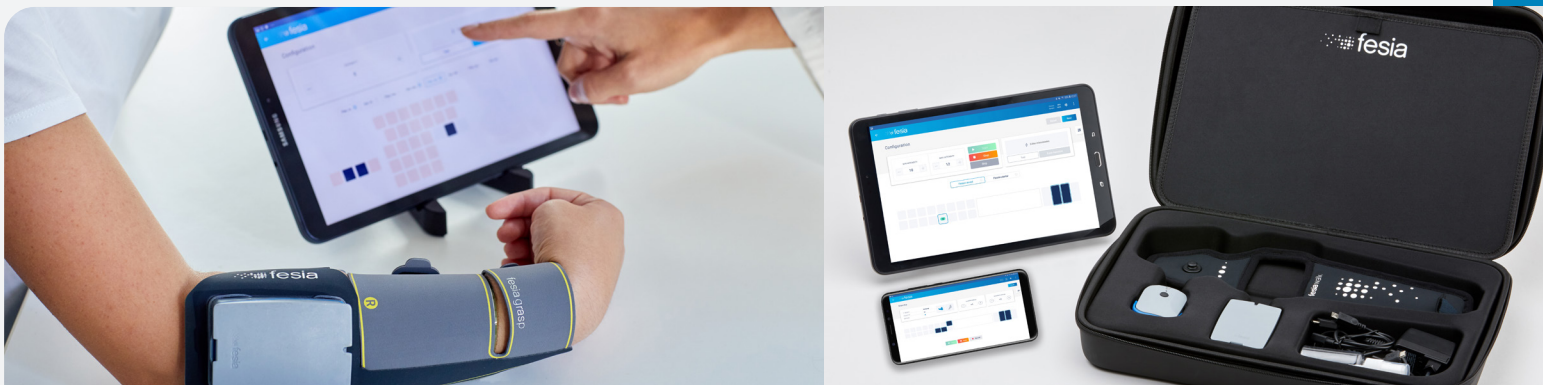
MEMBER OF BASQUE RESEARCH
& TECHNOLOGY ALLIANCE

www.tecnalia.com

Achieving large number of movements using only a single device

Unfortunately, thousands of people suffer from neurological diseases globally. In most cases, patients face several limitations in carrying out basic activities, having a severe impact on their daily life. Neurological diseases mainly affect the capacity of motor control or even the complete absence of muscular function. However, the nerve conductivity and the excitability of the muscles still remain. The technology used to activate the nerves and then, the muscles, is called functional electrical stimulation (FES).

TECNALIA has fully contributed to the development of an innovative patented technology, Fesia, for functional electrical stimulation to scale-up new therapeutic and neuroprosthetic devices for patients suffering from neurological diseases. Fesia technology is based on matrix arranged electrodes, wireless stimulation and sensing means to overcome the limitation of the state-of-the-art solutions and massively reach the market of functional electrical stimulation.



Fesia is an innovative technology to power new therapeutic and neuroprosthetic devices for people affected by neurological conditions.

FES in S.O.S.

Today, the current technology applies mainly to neurorehabilitation and helps the patients to recover and improve mobility of the affected limbs, stroke, spinal cord injuries, cerebral palsy, and multiple sclerosis. FES uses electrical current to revitalise nerves and muscles via a common rehabilitation technique for managing the central nervous systems lesions. The stimulation effectiveness of conventional FES still needs to be improved due to the remaining limited number of movements and absence of comfort and user-friendly equipment. Complex neurological problems can only be solved with the use of a sensor-based cable-free technology to allow more movement and flexibility, offering greater freedom to all patients.

Improving FES effectiveness

EARTO member TECNALIA developed the Fesia, a flexible, modular, configurable and lightweight technology, which enhances the basic capacity of FES by applying it to multi-pad electrodes. Fesia comprises a stimulation device, a multi-pad electrode with up to 32 small pads and a wireless sensor network for gathering sensory information. This provides the functionality of assessing the specific progress in rehabilitation (for instance the grasp function) and evaluating the progress of the patient in this particular function in need. TECNALIA developed a novel automatic algorithm to select the preferred electrodes, based on an innovative reaction to a known impulse which drastically reduces the time dedicated to testing compared to classical "place-test-replace-test" strategy.

Solution to complex problems

Thanks to TECNALIA, Fesia technology has already made significant achievements in its three years of operation, including reinforcement of clinical evidence of its technology, establishment of quality management program, and launch of 2 Fesia products (Fesia Walk and Fesia Grasp). The project has also been awarded twice with the seal of excellence by the European Innovation Council and received EU funding in the WALKHOME project. Fesia technology is now present in 16 countries and in ongoing clinical usability and evaluation. Fesia patented technology can also be applied in different markets, offering premium comfort and usability to interested patients experiencing mainly neurorehabilitation.

IMPACT
DELIVERED

FEDIT-AITIIP



3D printed parts from organic raw materials

Fedit is a Spanish association of research and technology organisations whose main mission is to boost and encourage innovation, technological development and private research.

AITIIP Technology Center, with its 25 years' experience, offers to companies and researchers its infrastructures with the latest technology available and the most qualified staff to develop their products as well as to develop innovative projects connected with industrial and social needs.



BARBARA PROJECT SAVES
50%
ENERGY CONSUMPTION



95%
REDUCTION
OF **SCRAP MATERIAL**



FEDIT-AITIIP WILL GAIN
€1.5M IN 5 YEARS



BARBARA CAN MOBILISE
28 DIRECT JOBS



www.fedit.com



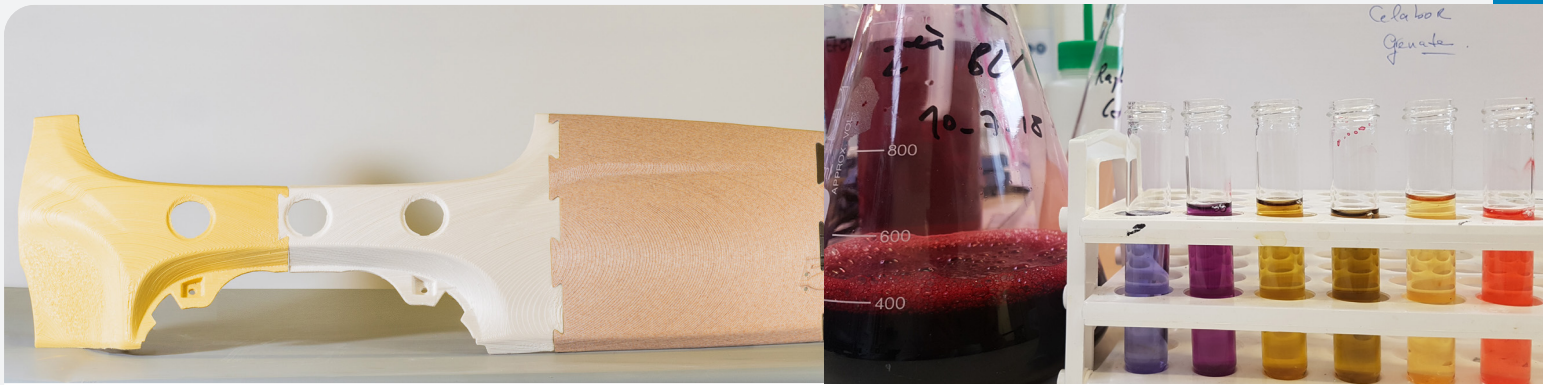
centro tecnológico

www.aitiip.com

Transforming agrowaste into the most innovative 3D printed materials in manufacturing industry

Additive manufacturing, or, in other words, 3D printing, has become one of the most attractive and innovative ways to upgrade the manufacturing industry, including the automotive and construction sector. Many new products have been created out of unusual compounds which could lead to a more responsible consumption and production while increasing circularity and recyclability of different materials. Current research initiatives aim at better understanding the material, process, and

part properties although the reduction of material consumption while using complex components cannot be considered as an easy process. AITIIP Technology Centre, EARTO member through Fedit, developed the cutting-edge BARBARA project which allows manufacturers to produce high-tech parts using organic residues. The high added value compounds, coming from pomegranate, lemon and corn, are thus transformed into brand new bio-based materials with innovative functionalities through 3D printing.



BARBARA project develops biopolymers with advanced functionalities for building and automotive parts through 3D printing technology.

Lack of innovative 3D printing materials

Geometrical and structural complexity of additively manufactured parts is unlimited. Additive manufacturing enables the production of individually shaped parts whose production was previously inconceivable. It allows the customisation of products for specific sectors. However, the demanding need of new biobased materials with excellent structural and functional properties while increasing sustainability is a challenge for the additive manufacturing sector.

New era for polymer filaments

AITIIP Technology Centre, EARTO member through Fedit, has successfully completed the BARBARA project, which proposes a new process for the extraction and functionalisation of high added value compounds, such as essential oils, antimicrobials and dyes from agrowaste feedstock. BARBARA extracts bio-additives from pomegranate, lemon, almond shell and corn by-products which are incorporated into engineering bio-plastic matrices. These compounds are used as main additives to give the polymer filaments the required properties for each application like aesthetics, well-being or thermal and mechanical resistance for advanced manufacturing processes. At the final stage, the materials made are processed into nano-biocomposite filaments for 3D printing, while protecting the properties of the natural materials used.

AITIIP's "golden" project

BARBARA, a project in which 12 different European partners have been involved, has created 8 new materials from agrowaste, while validating 3 consumer products in 2 new bio-based value chains: direct final part (car door trim and fascia) and hybrid manufacturing (mould for truss joints). BARBARA's technology and innovation can be applied not only in the automotive and construction sectors but also in different other sectors, such as aeronautical, cosmetic, food and medicine. Thanks to BARBARA, AITIIP will get a return on investment of almost €3.4M for technological transfer, services, licensing. The commercial viability of the project can be achieved by either commercialising the reels for 3D printing or by selling final industrial pieces which are 3D printed with BARBARA filaments. AITIIP is expected to gain €1.5M in 5 years.

Promising design & advanced manufacturing concept



Although the use of electrical cables is necessary in many systems, it has several disadvantages. Electrical cables are vulnerable to physical and chemical aggressions and often difficult to integrate during the design phase of miniaturisation and digitalisation. The multi-material manufacturing technologies, aiming at developing parts with embedded functions that involve electrical energy, cannot compete with the mechanical and electrical performances of metals.

Innovation: EARTO member CSEM developed the REEF technology (Really Embedded Electric Functions), based on a patented design and additive manufacturing concept which merges mechanical and electrical functions into a single metallic part. The built-in electrical conductors produced can take various shapes and trajectories and bring energy to strategic locations of the part. This energy can be used to supply various type of sensors coupled to wireless transmitters for IoT applications.

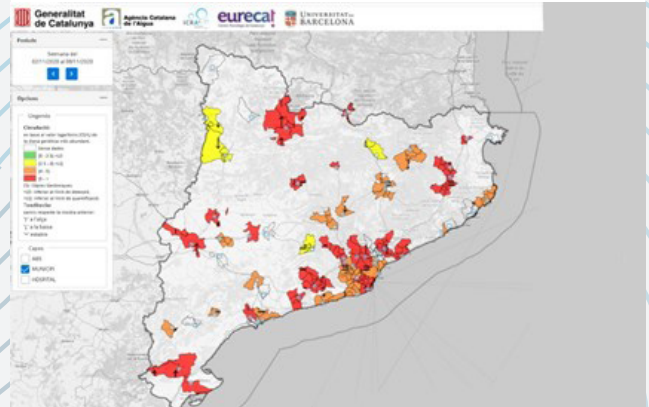
Impact Delivered: CSEM's innovation has been applied to the "SRA rotor" application in partnership with RUAG Sliprings SA, where REEF enables production cost saving up to 40%, overall lead time reduction from 6 to 3 months, development costs' reduction by 25% and material savings of up to 50%. In smart factories, the manufacturing flow time could be reduced by up to 3.7 times. REEF could find applications in Additive Manufacturing for space, aerospace, and electric motors with an estimated market penetration of \$11B in the next 5-10 years.



CSEM is a Swiss private, non-profit research and technology organisation (RTO) with 35 years of Deep Tech development and transfer to industry.

www.csem.ch

Fast-track COVID-19 detection in wastewater



Scientific studies highlight that untreated wastewater is an important indicator of virus circulation in a population. In the case of the SARS-CoV-2 virus, individuals infected with the virus, are both symptomatic and asymptomatic. A valuable tool to complement and strengthen the clinical and epidemiological surveillance of COVID-19 would thus be to detect RNA in wastewater.

Innovation: EARTO member Eurecat developed the SarsAigua, in collaboration with Catalan health authorities (ASPCAT), water authorities (ACA), University of Barcelona (UB) and ICRA, a genetic detection program which tracks the spread of COVID-19 in wastewater treatment plants. It is available through a software platform, consisting of data homogenisation, continuous research on genome regions correlations as well as data systemic exploitation, being integrated with clinical and socioeconomic data.

Impact Delivered: SarsAigua contributes to the control, minimisation and prevention of COVID-19, identification of emerging variants and preparation of upcoming epidemics. It also offers a sewage surveillance of over 80% of the incoming wastewater of the Catalan population. SarsAigua transformed the way health authorities make real-time decisions during coronavirus waves by providing information on how viruses circulate among social communities.



Eurecat is the main Technology Centre in Catalonia, Spain. Its multidisciplinary and multinational team of 650 professionals work in more than 170 projects of applied R&D.

www.eurecat.org

Villages now go digital



In Germany, the state of digitalisation in rural areas is unstable. The digital infrastructure is indeed lagging behind and the use of digital services, especially in public administrations, is not yet comparable to recent developments in the smart city sector. While the fields of action are similar as in urban settings (such as public services, mobility and local supply), the challenges are different and, therefore, smart city solutions cannot be easily transferred.

Innovation: EARTO member Fraunhofer-Gesellschaft – and its Fraunhofer Institute for Experimental Software Engineering (IESE) has developed the “Digital Villages Platform” which offers software services for the specific requirements of rural areas. The platform design follows a modular concept comprising 6 software services, which cover various fields of action and are interconnected through the platform, while operating independently.

Impact Delivered: The Digital Villages Platform has more than 65 contract partners, including states, municipalities and other organisations. Throughout Germany, the practical deployment of the platform can be expressed in particular by three communication services (DorfFunk, DorfNews, and DorfPages). Currently, there are more than 75K registered users on the platform overall. Thanks to this project, Fraunhofer IESE has received €9M in total.



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 - www.iese.fraunhofer.de

Wireless standard for massive IoT



It is estimated that around 30B IoT devices will be needed to overcome the current lack of digitisation shortcomings. Conventional low-power wide-area network (LPWAN) technologies are not able to cope with this growing demand due to their low interference immunity, resulting in reduced scalability and suitability for large-scale deployments.

Innovation: EARTO member Fraunhofer-Gesellschaft – and its Fraunhofer Institute for Integrated Circuits (IIS) developed the mioty®, a software-based LPWAN network protocol for a massive wireless IoT connectivity of thousands of sensors per base station. mioty®'s core relies on the Telegram Splitting Multiple Access (TSMA) method, where it packs data into smaller sub-packets for wireless transmission and reconstructs data packets after reception. It ensures high reliability through an optimised forward error protection for data packets.

Impact Delivered: mioty® reduces equipment, installation, and maintenance costs by 20 to 200 times compared to other technologies on the market. Patent and software licenses are available for use of mioty® in products such as sensor nodes or base stations. mioty's IoT market share is growing rapidly through an increasing number of mioty alliance members and its enhanced product portfolio. The key application markets for mioty® are Smart City, Industrial IoT and Smart Metering.



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www.fraunhofer.de - www.iis.fraunhofer.de

Modular automation controller for smart switchgear



The ongoing trend in switchgear construction is to replace electromechanical relays, which are inherently failure prone and expensive to purchase and service. The lack of automated diagnostics of switchgear components necessitates direct trips of the service personnel, often to unspecified remote places of failure.

Innovation: EARTO member Łukasiewicz Research Network developed a modular controller for ring switchgears to digitalise and simplify the switchgear construction. The core innovation relies on multi-protocol transmission capabilities reducing the number of copper connections in ring switchgears, which increases the functionality with fewer components. The controller's digital interfaces enable remote switchgear monitoring, control and field programmable logic functions implementation. They also results in increased personnel and equipment safety and fast reaction to equipment failure.

Impact Delivered: The technical solution was introduced to the market in 2018 and so far, the technology has been delivered to the company ZPUE. This modular controller reduces the maintenance services' time and costs as well as the number of components, connections, and wirings need to assemble the switchgear. Thanks to Łukasiewicz, the time for wiring, assembling, and testing the switchgear section has been reduced by 7%.



The Łukasiewicz Research Network is the third largest research network in Europe. It employs 7,500 staff and has 33 research institutes located in 11 cities across Poland.

www.lukasiewicz.gov.pl

A digital toolset for SMEs



While much information already exists in terms of the benefits of digitalisation for large companies, there is a gap in support available for small businesses to understand how they could start their own journey. The technologies are often available and suitable for deployment, however they still present adoption challenges for many SMEs who need support in implementation.

Innovation: EARTO member MTC – The Manufacturing Technology Centre developed an improved digital toolset to offer pragmatic, measurable adoption benefits to small companies. It consists of eight tools. Each tool could work as a stand-alone improvement, or as part of a set of tools to be adapted to the user's needs. All have a delivery methodology and transferable best practices, supported by software and, in some cases, hardware. Each tool overview describes the typical challenges faced by SMEs, an approach to overcoming these, as well as the practical benefits of digitalisation.

Impact Delivered: Thanks to MTC's digital toolset, over sixty SMEs have benefitted from one or more tools over a two year period. This number is expected to increase to at least 100 SMEs per year in the future. The average purchase order value is around £4.5K. An overall economic impact of over £1.5M is expected, given that participating SMEs have invested approximately £250K up to now.



The Manufacturing Technology Centre (MTC), established in 2010, is an independent RTO aiming at bridging the gap between academia and industry – often referred to as 'the valley of death'.

www.the-mtc.org

Innovative toolkit to create robust & resilient supply chain



There were many recent attempts to find a suitable tool to satisfy the need for the creation of Supply Chain Readiness Levels (SCRL). Nine existing tools have been evaluated. However, none of them can be a suitable solution for the SCRL development, as they are either sector specific or provide in depth analysis at high cost both in financial terms and in time committed by the organisations that use them.

Innovation: EARTO member MTC – The Manufacturing Technology Centre developed the SCRL methodology and digital toolkit, which is a simple and inexpensive digital application to help companies focus their resources on improving both (tactical and operational) robustness and (strategic) resilience. It can be completed in around 2 to 3 hours at low cost, while measuring supply chain capability across nine business-critical themes. SCRL is a consultant guided-assessment, used as a benchmark for business improvement and supplier development.

Impact Delivered: MTC's SCRL toolkit has been deployed in 120 companies in the rail, construction, digital, medical, aerospace and space sectors. It has been used in 3 completed projects with a total value of £362K. Ten projects are currently either underway or confirmed with a contractual value of £615K. It has influenced changes in the operating model of many organisations.



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www.the-mtc.org

Effective garment disinfection to boost the textile industry



Due to COVID-19, the drop in sales' revenue has urged some companies to close down, leaving many people unemployed. In order to regain consumer's confidence and increase again purchasing opportunities for textile products, a disinfection tool for textile surfaces infected by coronavirus needs to be developed.

Innovation: AITEX, EARTO member through REDIT Innovation Network, developed a bio-indicator system for the evaluation and validation of different disinfection procedures and technologies against SARS-CoV-2. This bio-indicator, due to its size and morphology, has a behaviour similar to the coronavirus and can ensure that any possible particles of the coronavirus present in the garment have been inactivated. Based on the knowledge gained from the use of the bio-indicator, a label has been developed to verify the garment disinfection when it is applied correctly and reaches the desired temperature at the right distance and time.

Impact Delivered: Up to now, AITEX has already developed and sent 40K labels to more than 40 important Spanish fashion distribution chains, such as Inditex.



The Network of Technological Centres of the Valencian Community (REDIT) is a private non-profit association that integrates and represents the 11 technological centres of the region.

www.redit.es - www.aitex.es

Digitalised solution for energy resources' management



Nowadays, the exponential growth of renewable energy users and the adoption of new markets and actors strongly depend on the regulation. In order to bypass restrictions on the innovation demonstration paths, sandboxes have been created. Boosting the technological change towards the energy transition requires facilities which cover all current energy generation and storage technologies. However, all these systems need to be monitored and controlled before entering the market.

Innovation: ITE, EARTO member through REDIT Innovation Network, developed the GAMMA - real-time monitoring and management of energy variables to improve the planning and operation of energy resources through the implementation of a digital twin of the system. GAMMA implements concept tests, by using modelling and simulation tools and a micro-grid infrastructure in an optimal and coordinated way that validates new technological solutions and business models related to local energy communities and the industry.

Impact Delivered: In its first months, ITE's innovation will reach a total income of €200K from 8 different private contracts and services as well as €150K from competitive public aids and projects, including 7 private projects and 3 European projects. ITE has reduced emissions by 32% thanks to the launch of GAMMA's system, representing 2,900 kg CO₂ per month.

REDIT
INNOVATION
NETWORK

ITE
INSTITUTO TECNOLÓGICO DE
LA ENERGÍA

The Network of Technological Centres of the Valencian Community (REDIT) is a private non-profit association that integrates and represents the 11 technological centres of the region.

www.redit.es - www.ite.es

Robin Radar Systems: Making airspace safer



As well as needing to mitigate the serious hazard of bird strikes, airports and airfields face another formidable safety and security threat: drones. Each year drone numbers almost triple worldwide, resulting in a growing concern around their potential misuse. Drones present an evolving risk, as they become more accessible and their technology more advanced.

Innovation: TNO helped to develop IRIS®, a 3D drone detection radar, including antenna design and partial electronics. Robin Radar Systems thus combine hardware with future-proof software algorithms, ensuring IRIS® can accurately detect and classify small targets. Full 3D classification, 360-degrees azimuth coverage and a huge elevation coverage of 60-degrees gives the radar critical performance capabilities. It can even detect hovering drones.

Impact Delivered: Robin has become a European technology leader in radar tracking and classification of small objects. With more than 100 radars installed across the world – mainly in Europe but also in other global locations such as Tasmania and Taiwan – Robin even has the potential to become a European export product. In 2020, Robin achieved a revenue of over €10M, thanks to the creation of avian radar MAX® and drone radar ELVIRA®. Robin caters for four unique markets: wind farms, civil aviation, military aviation and security.

TNO innovation
for life

TNO, an independent Dutch RTO, has some 3,200 professionals who put their knowledge and experience to work in creating smart solutions to complex issues.

www.tno.nl - www.robinradar.com

How to bring transparency to complex software systems



The growing complexity in our everyday life requires the use of increasingly intelligent software algorithms. The main problem of this rapid evolution of new computer systems and algorithms arises from their difficult functioning and programming language for users. The know-how about the structure of these legacy systems can only be read by specialists, failing to be understandable and readable-friendly for all individuals.

Innovation: The Software Competence Center Hagenberg GmbH (SCCH), EARTO member through UAR, developed the Sysparency to make complex software systems and artificial intelligence algorithms transparent and understandable. With its scientifically developed software analysis algorithm, Sysparency automatically documents software from a usage perspective, using natural language along with corresponding graphic models.

Impact Delivered: Developed in 2010, the Sysparency algorithm has already been used successfully in numerous customer projects with an order value of more than €2M. Sysparency is aimed at large companies and corporations with more than €500M in annual sales with large critical software systems.



UAR (Upper Austrian Research GmbH), together with its associated RTO companies, is promoting innovative solutions at the crossroads where fundamental research meets applied research and offering businesses access to high quality R&D.

www.uar.at - www.scch.at

Track your grain quality instantly, anywhere



In grain farming, having fast accurate information about the crop is very crucial for farmers and grain growers to take right decisions promptly. Traditionally, big samples of grain are sent to laboratories, which are not only expensive but also take days or even weeks to deliver obsolete results. In order to know the crop's quality and measure protein, oil and carbohydrate, food businesses need to have an equipment which is affordable and can provide instant accurate results.

Innovation: EARTO member VTT developed the GrainSense Analyzer - a battery-powered handheld device which uses near-infrared (NIR) technology, to take accurate grain quality measurements anywhere. It is currently owned and commercialised by VTT's spin-off, GrainSense Oy. The key innovation is the 360° light penetration method (integrating sphere), where it measures the moisture, protein, carbohydrates, and oil in just under 30 seconds from new and old harvest. The sample size is only 3 grams and the results are saved in the GrainSense application and can be uploaded to a secure cloud database immediately, when an internet connection is available.

Impact Delivered: GrainSense has systematically built up its activities from a start-up to a fast-growing scale up organisation. GrainSense Analyzer's price is below €4K. There are over 1K GrainSense Analyzers used in over 40 countries around the world, building a partner/distributor network across Europe, Asia, North America, Latin America and Australia. In 2020, GrainSense's turnover was around €1.1M.



VTT Technical Research Centre of Finland is a visionary research, development and innovation partner. It is one of Europe's leading research institutions.

www.vttresearch.com

IMPACT EXPECTED

Discover
more innovations
from RTOs



IMPACT
EXPECTED

TYNDALL NATIONAL INSTITUTE

European Technology will be MagIC

Tyndall National Institute is a leading European research centre in integrated ICT (Information and Communications Technology) materials, devices, circuits and systems. Specialising in both electronics and photonics, Tyndall works with industry and academia to transform research excellence into high impact products in Communications, Energy, Health & Well-being, Advanced Manufacturing, Precision Agriculture and the Environment.

PRIZE
1ST



MAGIC CAN **REDUCE THE INDUCTOR COMPONENT HEIGHT**
BY **5 TO 10 TIMES**



MAGIC WILL **ENABLE UP TO 10 TIMES**
REDUCTION IN THE MAGNETIC COMPONENT COSTS



MAGIC **DELIVERS UP TO 50%**
IN SYSTEM-LEVEL ENERGY SAVINGS



MAGIC HAS **RECEIVED** MORE THAN
€10M IN RESEARCH, LICENSE
AND PRODUCTISATION FEES

 **Tyndall**
National Institute
Institiúid Náisiúnta

www.tyndall.ie

How to achieve electronics miniaturisation with Tyndall's MagIC wand

Minimising energy consumption in electronics (from Smart phones to data-centre servers and network infrastructure) has been a major, long-standing, technological challenge, in both science and engineering communities. Discrete, bulky, wire-wound, magnetic components used for power delivery in electronic systems are a road-block to the power efficiency improvements required to address increasingly demanding environmental concerns, including the United Nations Sustainable Development Goals. Responding to this challenge, Tyndall National

Institute has over the last decade, developed "MagIC", a disruptive magnetic inductor component technology which will enable significant reductions in energy consumption in future battery-critical and power-intensive applications. When in high volume production, MagIC will create its magic by dramatically reducing system energy consumption, extending battery life and reducing the overall size, weight and cost of future electronic systems.



Tyndall's MagIC Technology has the potential to enable high efficiency, power management of future electronic systems including smart phones, electric vehicles, intelligent sensors, high performance computing and data centres.

Moving one step forward

The power of MagIC is that it can eliminate the use of bulky wire-wound inductor components that are essential for efficient power management of electronic circuits. By enabling the making of tiny magnetic components that can be built directly on silicon chips. MagIC can dramatically increase battery life of electronic systems while reducing both the weight and cost of the power supply circuits. Tyndall's MagIC effectively does for magnetics what the silicon chip has done for transistors over the last 50 years – MagIC makes magnetics disappear into silicon chips.

Making magnetics disappear

Created by EARTO member Tyndall National Institute, the MagIC platform delivers thin-film micro-magnetics components that can enable dramatic reductions in electronic system energy use, by allowing magnetics to be integrated directly onto microprocessor and other system chips. With a multi-disciplinary team approach, Tyndall's micro-magnetics offering comprises validated design/simulation tools, thin-film magnetic material specifications and characterisation methodologies, fully-documented process flows and design rules for high-volume fabrication, test and characterisation procedures for thin-film magnetic cores, micro-inductors and micro-transformers.

Achieving the impossible

Tyndall's technology is considered one of the world-leading solutions for powering future electronics. Tyndall has established itself as a thought-leader in this emerging technology and has led the global semiconductor industry in the definition of technology roadmaps and supply chains to deliver on MagIC's promise. MagIC is expected to achieve initial commercial evaluations in 2022 as it approaches the inflection milestone of high volume, low-cost deployment of production-grade integrated magnetics in 2022-2023. With a granted patent and more than €10M of research funding to date, Tyndall National Institute has already achieved commercial success in 16 funded projects at national and EU levels, platform licenses with 2 global smartphone brands and a major semiconductor foundry while engaging with more than 16 global leading companies.

IMPACT
EXPECTED
VTT

PRIZE
2ND

From waste to wonderful

VTT Technical Research Centre of Finland is a visionary research, development and innovation partner. It is one of Europe's leading research institutions. Through scientific and technological means, VTT turns large global challenges into sustainable growth for businesses and society. VTT brings together people, business, science and technology to solve the biggest challenges of our time. This is how VTT creates sustainable growth, jobs and wellbeing and bring exponential hope.



THE TECHNOLOGY DEVELOPED
BY VTT AND INFINIT FIBER COMPANY
COULD **SAVE UP TO 15,000 HECTARES
OF LAND** IF 30,000 METRIC TONS OF COTTON
WERE REPLACED WITH ITS REGENERATED
INFINNA™ FIBRE



THE PRODUCTION OF ONE
T-SHIRT WITH INFINNA™
RATHER THAN COTTON
CAN SAVE NEARLY
600 LITRES OF WATER



INFINNA™ IS CURRENTLY
PRODUCED OUT OF
**100% POST-CONSUMER
TEXTILE WASTE**



THE COMMERCIAL-SCALE PRODUCTION
OF INFINNA™ IS EXPECTED TO BEGIN
IN 2024 AND ANNUAL NET SALES ARE
EXPECTED AT AROUND **€100M**

VTT

www.vttresearch.com

Turning trash into premium textile fibres

It is estimated that less than 1% of clothes are recycled back to clothing, and the United Nations has identified fashion as one of the biggest global polluters. The land and water needed to produce textiles have a tremendous impact on the environment, and every second, a truckload of textile waste is burned or landfilled, causing pollution and greenhouse gas emissions. Consequently, there is a growing need for more sustainable alternatives to virgin cotton, polyester and viscose, and a shift to less wasteful, circular production processes in the

fashion industry that can reduce the burden on the use of land and water as well as toxic chemicals in textile production. In 2016, the technology developed by VTT was spun off and Infinited Fiber Company was founded to commercialise its innovation for turning textile waste into new, premium-quality textile fibres. VTT's spin-off and owner of four patents eliminates cellulose-rich waste by regenerating it into a brand-new circular material, a textile fibre called Infinna™.



Infinna™ looks and feels soft and natural like conventional cotton, but nothing new needs to be grown to create it. It is reborn from household textile waste through responsible chemistry.

Unique textile fibres without compromises

A lack of scalable fibre regeneration technology and the challenge of textile recycling often resulting in inferior fibre quality have held back the shift to circularity in fashion. The fact that most clothes today contain a mix of fibres and chemicals further complicates the recycling of textile waste and makes them extremely difficult to upcycle. Mechanical recycling is a solution for recycling pure cotton waste, although the resulting product is always inferior in quality compared to virgin cotton. Infinited Fiber Company's technology is a true enabler of circularity in the textile industry, as it can turn mixed-fibre textiles that can no longer be reused, repaired, or mechanically recycled into a valuable commodity through responsible chemistry.

Regenerating cellulose-rich waste

EARTO member VTT with its spin-off developed a ground-breaking technology which creates a completely new fibre with unique characteristics – Infinna™. Most other next-generation textile recycling innovations produce a pulp that is used to create conventional textile fibres such as viscose. Infinna™ is made from 100% post-consumer textile waste. The finished fibre doesn't contain any microplastics, and it looks and feels like virgin cotton. VTT's innovation uses responsible chemistry to capture the value of the waste at the polymer level in discarded textiles, used cardboard or even rice straw. The textiles created with Infinna™ can be recycled again alongside other textile waste. Due to the unique characteristics of Infinna™ fibres, vibrant colours can be achieved using far fewer colorants compared to cotton or viscose.

A feasible alternative to virgin materials

The Infinna™ fibre enables the fashion industry to embrace circular practices. Producing the fibres to make one T-shirt with Infinna™ takes only a fraction of the water needed to grow a similar amount of cotton, resulting in around 600 litres of water savings per T-shirt. Infinited Fiber Company plans to begin the commercial-scale production of Infinna™ at a flagship factory due to open in 2024 with an annual capacity of 30K metric tons and targeted annual net sales of over €100M. The Infinna™ fibre has been tested, validated, and endorsed in several kinds of textiles and applications including by leading fashion brands, such as H&M Group.

IMPACT
EXPECTED

CSEM

PRIZE

3RD

Personalised skin on demand

CSEM is a Swiss private, non-profit research and technology organisation (RTO) with 35 years of Deep Tech development and transfer to industry. A bridge and catalyst for the transfer of technology and know-how between science and the economy, CSEM continually adapts its research focus to meet industry's needs. Today, CSEM supplies a broad range of markets - including medical, life sciences, automotive, machine and space - with an even broader range of technological solutions.



WITHIN 3 YEARS' COMMERCIALISATION, **DENOVOSKIN™** IS EXPECTED TO TREAT **4,000** PATIENTS



DENOVOSKIN™ IS APPLIED IN ONLY **1** SURGICAL INTERVENTION



DENOVOSKIN™ COULD COST MINIMUM **€28** PER CM²



DENOVOSKIN™ REVENUES WILL ACCOUNT FOR **50M** CHF



csem

www.csem.ch

Superior skin treatment needed

Burn injury is considered one of the most devastating injuries which can cause significant impact on the physical and psychological health of the victims. In 2014, around 11M people worldwide required medical attention due to incidence of burns, out of which 4-11% are total body surface area burns. Severe burn patients have to manage possible physical limitations related to scarring, but also overcome substantial emotional as well as social challenges. The Swiss start-up CUTISS has the solution – bioengineered skin tissues produced

from patient's own healthy cells. denovoSkin™ can replace the current methods of treatment, opening a new way of curing skin diseases and disfigurement. However, the current manufacturing process is manual, time-consuming, and costly – limiting the scale-up and adoption of this advanced therapeutic product. CSEM stepped in to develop a fully automated manufacturing process compatible with the requirements in terms of tissue engineering, safety, sterility and quality control.



CSEM's patented system is a closed system graft box, allowing to produce personalised bioengineering dermo-epidermal skin graft in a fully automated and safe manner.

First-in-class automated production of bioengineered skin grafts

The current activities in skin tissue engineering require large amounts of skin grafts in order to regenerate skin from wounds that cover more than 50% body surface areas. The manual processes of skin graft production are proven to be risky as well as inefficient and need to be automated. While there are several devices on the market for automated cell isolation and expansion, no fully automated solution has been found so far worldwide which could decentralise the tissue engineering production. More precisely, an automated process is facing several challenges due to sterility risks, including possible aseptic processing compliance and cross contamination.

Producing large quantity of skin can save a life

Ameliorating scarring can change a life. EARTO member CSEM, together with CUTISS, created denovoCast, the first automated skin graft production platform, allowing to produce large area of personalised skin grafts – denovoSkin™ – from isolated, expanded cells in a secured, robust, efficient and automated manner. The core of the innovation is found in the denovoSkin™ graftbox, which can perform the whole process in a fully closed and aseptic environment. CSEM developed a complete process from concept, design of the graftbox, automation in the denovoCast system and biovalidation experiments, which can generate several skin grafts in parallel. A healthy skin biopsy sample is taken from the same patient's body and transplanted on the full-thickness wound. The resulting graft is composed of both epidermal and dermal layers and is expected to result in minimal scarring after transplantation, significantly improving quality of life.

Treating your skin is the next best thing

Protected by two patent applications on the graftbox and automated protocol, CSEM's denovoCast will allow CUTISS to scale-up and expand decentralised production while decreasing quality risks and opening new market opportunities for regenerative medicine. CUTISS aims to sell denovoSkin™ directly to hospitals and burn centres in the European Union which can carry out the surgeries for burn patients. The price of denovoSkin™ is envisaged at a minimum of €28 per cm² within 3 years of commercialisation. Thanks to CSEM technology, CUTISS expect to treat 4K patients, with a turnover of 50M CHF. The denovoSkin™ technology could be extended to other applications and skin market including reconstructive surgery, including scar or tumor removal, and chronic wound market.

Achieve efficient CO₂ capture with the GRAMOFON project



Global warming resulting from the emission of greenhouse gases has received widespread attention worldwide. Among the greenhouse gases, CO₂ contributes more than 60% to the global warming and its capture process represents typically about 70% of the total cost of the Carbon Capture and Storage (CCS) chain. Novel adsorption technologies that can offer various advantages over conventional adsorption, such as high operating flexibility and low maintenance costs, are gaining support progressively.

Innovation: EARTO member AIMPLAS Plastic Technological Centre developed the GRAMOFON Project – an innovative process for efficient CO₂ capture. It is a new energy and cost-competitive dry separation process for a full operative CO₂ capture prototype. GRAMOFON consists of a synthesis of new adsorbent materials, characterisation and modelling, as well as process design and economic projections.

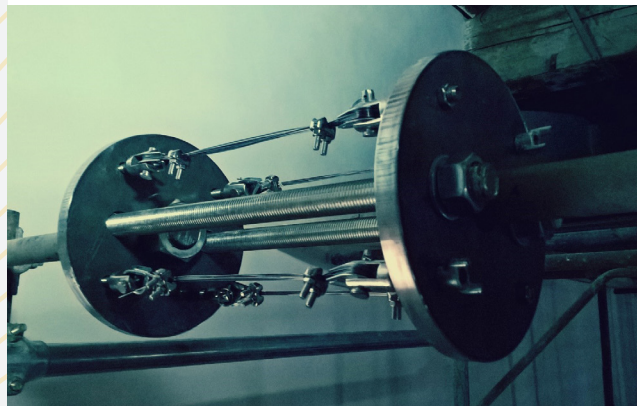
Impact Expected: Thanks to AIMPLAS, a significant reduction of the energy intensity of the capture process for power plants such as 53% reduction in cement plants, and a substantial decrease of the cost of capture, are expected. The GRAMOFON project has received around 4M€ of funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n.727619. High TRL funded projects based on GRAMOFON materials' developments with their excellent regeneration properties are also currently underway.



AIMPLAS, a technology centre with 30 years of experience in the plastics industry, provides solutions to raw material manufacturers, plastic processors and end users.

www.aimplas.es

Novel SMA-based anti-seismic device for a durable building solution



Frequent and catastrophic seismic events can result in damaging existing buildings and historical architectural assets, the demand for structural upgrading of buildings is increasingly growing. The use of metal tie rods in thrusting structures (i.e. arches and vaults) is a widespread practice, but it can be seriously dangerous in case of an earthquake.

Innovation: EARTO member CETMA – European Research Center for Technologies Design and Materials developed an innovative anti-seismic device named ANTISISMA and dedicated to all thrusting structures of both industrial and cultural heritage buildings. This device, composed of Shape Memory Alloy (SMA) elements, is able to recover initial shapes even after having been deformed. It exploits the pseudoelasticity property of SMA wires and it is capable to dissipate large amounts of energy during the seismic event, thanks to a reversible phase transformation in the solid state.

Impact Expected: This innovation can lead to the reduction of reconstruction and repair cost of buildings, caused by an earthquake and can also increase the turnover of companies involved in seismic upgrading. This project is expected to reach the market within 2 years. Its target market is mainly Europe and especially Mediterranean countries which face high seismic risk.



CETMA, European Research Center for Technologies Design and Materials, is a Research and Technology Organisation (RTO) which carries out applied research, experimental development and technology transfer.

www.cetma.it

Competitive and sustainable thermoset composites



3R laminates can be heated above the T_g and re-shaped in a few minutes applying pressure, which allows the thermoforming of cured 3R laminates to obtain 3D geometries.

Fibre-reinforced polymer composites (FRPC) based on thermoset epoxy resins are widely used in many industrial sectors as an efficient alternative to metals. However, due to their thermosetting nature, epoxy composites also have some significant drawbacks: Once a thermoset composite is cured, it cannot be repaired, thermoformed or dissolved, hence, their recycling or repairing is extremely difficult arising serious environmental concerns.

Innovation: EARTO member CIDETEC developed and patented the 3R Composites, a novel class of fibre-reinforced thermoset composites which enable a new generation of composites that preserve their high performance, while being fully recyclable, repairable and reprocessible. With the use of conventional thermoplastic compression moulding and thermoforming processes, 3R Composites allow faster and more automated production rates compared to conventional methods.

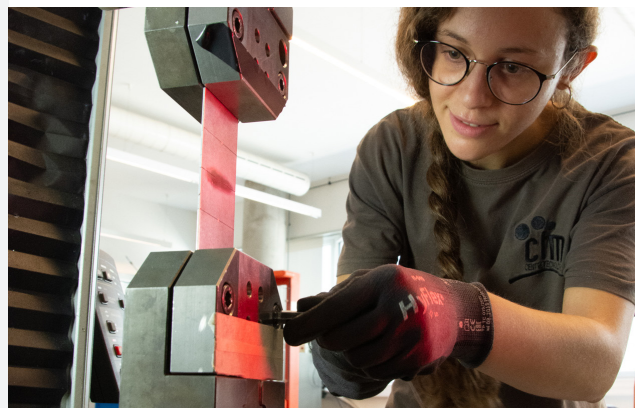
Impact Expected: Thanks to its unprecedented features, this innovation has benefitted from 4 Horizon 2020 projects. CIDETEC's composites can reduce manufacturing time from hours to minutes as well as reduce labour costs by 50%. CIDETEC expects that this 3R technology will reach the market by 2023, having a significant orders' value of €1M per year until 2025. It already had a €6M revenue during the last 5 years.

cidetec

CIDETEC is an organisation for applied research that integrates three international reference institutes in the fields of energy storage, surface engineering and nanomedicine.

www.cidetec.es

Fatigue & fracture advanced characterisation techniques for high-performance lightweight materials



There are different standard testing procedures to characterise the fatigue and fracture toughness of lightweight materials. However, these testing procedures are very expensive and time consuming since they involve exhaustive specimen preparation and long testing times. Such characteristics impede the implementation of these techniques as routine testing for material screening at the industrial level.

Innovation: EARTO member Eurecat developed a set of innovative and inexpensive alternative testing strategies for fatigue and fracture characterisation of high-performance lightweight sheet materials in the transport sector. The fracture toughness test is a simple method that uses specimens with mechanically sheared notches. The fatigue test is a load sequence based on damage evolution.

Impact Expected: The innovation will reach the market by the end of 2022 as a service offered through the launch of FormPlanet Open Innovation Test Bed, which is currently under construction. The solutions dramatically reduces the testing time of lightweight materials: with its fracture toughness approach, from 20 hours to less than 15 minutes at lab scale and with its fatigue method, from 1 week to less than 3 hours. These novel technologies result in a better optimisation of material selection in the application of lightweight materials in the European industry.

eurecat

Eurecat is the largest cross-sectoral and trans-national RTO in Catalonia, Spain, with 700 professionals covering all technological specialities to deliver added value to our society.

www.eurecat.org

Unique textiles that make the elderly happy



The use of creative design-driven approaches for the production of assistive technology (AT) that is more fashionable, desirable and acceptable to older people will enable them to feel more secure and safe in their own homes. Indeed, a design AT-management approach will reduce the number of visits to hospitals and prevent “bed blocking”, allowing the elderly to live more independent and improving their quality of life.

Innovation: The Footwear Technology Center of La Rioja (CTCR), EARTO member through Fedit, developed the MATUROLIFE project – a metallisation process to encapsulate fibres in textiles which can detect the risk of falling and balance change of the elderly footwear. With the metallised printed electronic sensors incorporated in the insole textiles, the fibres within the fabric become multi-functional, while retaining the properties of a conventional textile and having the functionality of a metal coating.

Impact Expected: These novel textiles can prevent elderly injuries and/or problems by more than 25%. This project targets primary the smart textile market and the AT market for elderly persons, expecting to be available in early 2022. In parallel, CTCR has already secured a lead customer, Calzados Pitillos, who will manufacture a new collection every season of this newly developed shoe.



Fedit is a Spanish association of research and technology organisations whose main mission is to boost and encourage innovation, technological development and private research.

www.fedit.com - www.ctcr.es

Let your packaging look greener



The high demand for Europe to be climate-neutral by 2030, as part of the European Green Deal, has forced the Circular Economy Action Plan to focus on the production of sustainable products, especially in the plastics' sector. To achieve this target, it is important to adopt new technologies that contribute to solving the global crisis with sustainable packaging solutions, using bio-based materials.

Innovation: EARTO member Fraunhofer-Gesellschaft - and its Fraunhofer Institute of Silicate Research (ISC), has developed the bioORMOCER® innovation which aims at replacing the current multilayer plastics packaging into a mono-material or paperbased, compostable and/or recyclable packaging, with a bio-based coating material. Thanks to its low thickness and high functionality, this novel concept offers a comparable barrier protection on plastics and paper substrates, while using vegetable waste or fruit residues. This barrier film also facilitates re-use of recycled plastics.

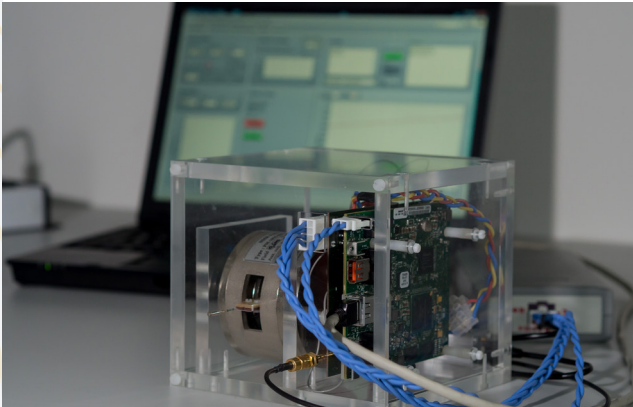
Impact Expected: The bioORMOCER® packaging solution shows a way to solve existing challenges regarding pollution, sustainability and social responsibility. This technology can be part of the growing bioplastic market, expecting to reach a 20% growth by 2024, and can help to decrease plastics' packaging waste by 5%. It also paves the way to packagings using recycled plastics. The bioORMOCER® solution can reduce CO₂ emissions, energy and material consumption and, at the same time, it can maximise the independence from fossil resources.



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 - www.isc.fraunhofer.de

Personalised medicine thanks to transformative EPR sensors



Paramagnetic states (spins) play a crucial role in many of today's societal challenges, such as healthcare. Electron paramagnetic resonance (EPR) is the “golden tool” for the detection of paramagnetic species which critically determine the performance of semiconductor devices. The current EPR spectrometers use electromagnets and conventional microwave technologies. However, they are expensive, bulky, and power-hungry, preventing the widespread use of EPR.

Innovation: The Helmholtz-Zentrum Berlin für Materialien und Energie (HZB), EARTO member through Helmholtz Association, developed the EPR-on-a-Chip (EPRoC), a universally applicable, easy-to-operate, and affordable sensor for paramagnetic states. EPRoC can be operated from a battery and is compatible with miniaturised permanent magnets. It integrates the entire EPR spectrometer into a single microchip with a tiny footprint of only a few mm².

Impact Expected: EPRoC can be manufactured at approximately 1% of the cost of conventional EPR. The EPRoC technology is currently being explored as part of a nationwide network project lead by HZB. A spin-off company is expected to start in late 2022 and two major applications will be targeted within the next five years. EPRoC opens up a €50B market potential, with an average price of about €5K per unit.

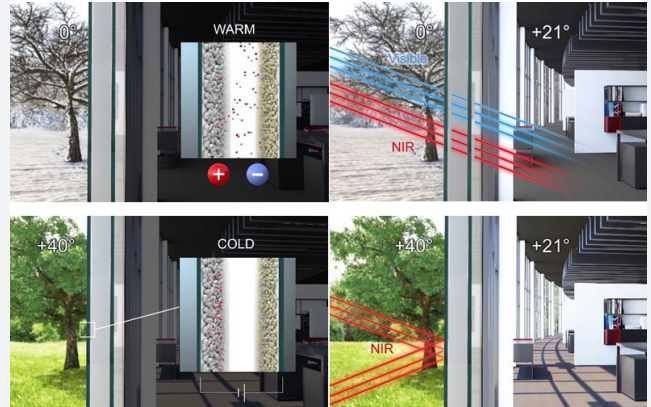
HELMHOLTZ
RESEARCH FOR GRAND CHALLENGES

HZB Helmholtz
Zentrum Berlin

Helmholtz is Germany's largest scientific organisation. With more than 43,000 employees at 18 research centres, it contributes to solving major societal challenges.

www.helmholtz.de - www.helmholtz-berlin.de

Smart windows for smart buildings



The building sector accounts for more than a third of the global energy consumption. More than half of this energy is used for heating, cooling and lighting. Glazed facades are still the main source of energy leakage, as they are designed to operate at a fixed condition, while both outdoor and indoor conditions are dynamic variables. Heat gain and loss through windows are therefore responsible for 45% of residential heating and cooling energy use.

Innovation: EARTO member Leitat developed a plasmochromic window to respond to the ever-changing lighting, heating and cooling buildings' requirements. Based on an innovative fabrication process, it can selectively control the incoming near-infrared solar radiation and visible radiation. Leitat's window integrates sensors and batteries turning them into a unique autonomous innovative facade concept.

Impact Expected: Leitat's innovation is expected to reach the market within the next 30 to 36 months. The implementation of this technology has the potential to reduce the building's energy consumption by more than 35%, with respect to the top performing commercially available solar control windows. Plasmochromic technology reduces the cost to a range of €250–400/m², compared to current commercial solutions which cost approximately €1,000/m².

LEITAT
managing your technologies

Leitat is a leading Catalan RTO that offers disruptive solutions to the technological needs of companies, with a clear orientation towards generating competitive value

www.leitat.org

Have a cacao treat with Colombian Cocoa Control System (COLCO)



Colombia's 50K cacao smallholders produce approximately 60K tons of cacao annually. The global chocolate sector is expected to continue to grow year on year at CAGR of 4.8% over the period 2021-2028. Currently, the sector suffers production losses of up to 60% due to pests, diseases, and non-standard post-harvest processes. Productivity is at a quarter of a theoretical maximum of 1,600kg per hectare with varying product quality.

Innovation: EARTO member MTC – The Manufacturing Technology Centre is developing COLCO in collaboration with lead partner Satellite Applications Catapult. This value chain transformation project seeks to deliver a sustainable change through the implementation of a set of integrated technologies and services for the cacao value chain in Colombia. It increases productivity, monitors and controls fermentation and drying processes as well as delivers standardised quality assessment.

Impact Expected: The innovations are helpful tools especially for smallholder farmers to deliver higher yields, better quality, consistent cacao in a fairer, more transparent price, improving their socio-economic welfare. COLCO has already supported 260 farms, trained over 500 farmers, developed 7 applications, and is currently running 7 post-harvest pilots in-country. Over the next 5 years, COLCO aims to impact at least 10% of the current market (5K farmers) through scaling with strategic partners in Colombia and the UK. The approach can be scaled across other supply chains in other geographies, increasing the attainable impact of COLCO.



Innovate UK

The Manufacturing Technology Centre (MTC), established in 2010, is an independent RTO aiming at bridging the gap between academia and industry – often referred to as 'the valley of death'.

www.the-mtc.org

New antibacterials on their way to success



Antimicrobial resistance caused by the uncontrolled use of antibacterials is a major health concern globally, associated with a growing number of bacterial infections. The reducing efficacy of the current antibacterials has led to the need for successful therapeutic antibacterial alternatives to overcome bacterial resistance. Unfortunately, existing therapeutics are becoming ineffective with each new resistant strain, yet the recently invented alternative antimicrobials from the NBTI class lack clinically developed bacterial resistance.

Innovation: EARTO member National Institute of Chemistry (NIC) and University of Ljubljana (UL) developed antibacterials from NBTI class with new structural fragments and mode of DNA gyrase inhibition by forming bifurcated halogen bonds in the enzyme active site. These compounds inhibit the growth of several multi-resistant bacteria and selectively inhibit the bacterial enzyme compared to a comparable human enzyme.

Impact Expected: This innovation is currently at a pre-clinical level but is directed towards the development of a "lead" compound and selling of the patent within approximately 3 years. As an initial step, these novel compounds obtained a small start-up grant of €23K. NIC and UL have already been in touch with several companies to further develop this innovation and to invest in the pre-clinical studies on their antibacterials.



NATIONAL INSTITUTE OF CHEMISTRY

Univerza v Ljubljani



National Institute of Chemistry is a scientifically excellent and breakthrough research institution based in Slovenia. It has 8 departments and 2 infrastructure centers.

www.ki.si - www.uni-lj.si

New cellulosic eco-packaging



Several companies in the packaged food industrial sector are seeking a more sustainable packaging to meet the growing environmental as well as consumer's demands. The new packaging needs, on the one hand, to guarantee the maintenance of quality and food safety level and, on the other hand, to reach the life-cycle level of plastic materials. There are already many eco-friendly packaging proposals on the market, however, their use is not widespread yet.

Innovation: AINIA, EARTO member through REDIT Innovation Network, developed the FIBTRAY, a cellulosic tray to reduce plastics in food packaging. It allows to obtain containers based on cellulosic material with a completely flat edge, which can be applied to all kinds of packaging and different types of flexible foil, depending on the requirements of each packaged food.

Impact Expected: AINIA's innovation is in the technology transfer phase and its exploitation is already being negotiated. The FIBTRAY container aims to reach the market within the next year with an estimated business volume of €6M. It can reduce the use of plastics by 80%. More than 10 companies that produce packaged food, with an annual consumption of more than 700M packages, expressed their interest in AINIA's product.

REDIT
INNOVATION
NETWORK

ainia

The Network of Technological Centres of the Valencian Community (REDIT) is a private non-profit association that integrates and represents the 11 technological centres of the region.

www.redit.es - www.ainia.es

PIPEOPSY: The new biopsy for more durable pipes



District heating (DH) is of utmost importance to achieve environmental and sustainable energy policies of the cities. Collective DH systems are a key element of the green transformation, as they provide high quality heat with lowest impact on the environment. Pipelines constitute an essential part of the DH system. To make pipes most durable and keep them longer in operation in the network systems, the status of the pipelines needs to be periodically evaluated to be maintained in the right way and in prompt time.

Innovation: EARTO member RISE developed the PIPEOPSY, a predictive maintenance model for the assessment of status and usage age of district heating pipes. It is a resource-efficient preventive method that is performed by cutting a piece of the pipe in the field and taking it out for examination and estimation of its status and/or degree of ageing. PIPEOPSY consists of two examination parts: the instruments to measure the adhesion strength in the field as well as a quick chemical analysis to predict the status and the real age of the pipe.

Impact Expected: This innovation can reduce the repair and maintenance cost for the DH-pipes' owners by 60%. €15K has been allocated for further development of PIPEOPSY at a Swedish ongoing project and, in parallel, there is an increasing interest from several companies worldwide. PIPEOPSY is in the last steps of adjustment and verification. RISE expects it can be commercialised and reach the market in 2-3 years.

**RI
SE**

RISE is an independent, state-owned research institute. RISE helps develop technologies, products, services and processes that contribute to a sustainable world and a competitive business community.

www.ri.se

Find your skin code for a personalised treatment



Transdermal delivery, or passive diffusion-based patches, has always been seen as a pain free, self-administration and generally applied treatment for local skin solutions. However, it has limited efficacy and is only applicable with certain characteristics substances. Many therapeutic strategies rely on the application of electric fields/currents through the skin with an electronic device comprising skin-contacting electrodes, while aiming at overcoming the skin barrier of the patient.

Innovation: EARTO member TECNALIA developed the ELCODE – a personalised delivery of active ingredients through a smart device. It is an electrode-controlled transdermal delivery system, which is based on iontophoresis technology and merged with electronics. With its 4 layers, the device offers enhanced permeation of the substance, provides unique features of temporal and spatial control and minimises skin irritations thanks to the electric current applied.

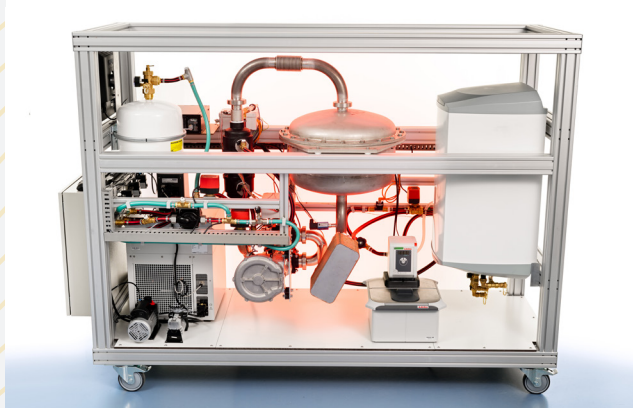
Impact Expected: The ELCODE device has been fully tested in more than 20 model substances in both pharma and cosmetic applications, showing 2-5 times better efficacy treatment. ELCODE is expected to reach the cosmetics' market in 2022 and the pharmaceutical market in 2025. There is already a confirmed interest from an investor accounting for €300K. The launch of the first ELCODE product could generate revenue around €30K in 2022, which is expected to quickly escalate to €5M total revenue in 2025.



TECNALIA is a Spanish RTO aiming to transform technology into GDP, helping companies to be more competitive and generate wealth and employment.

www.tecnalia.com

Beat the heat with TNO's heat battery



Most of the energy consumed globally is in the form of heat, covering 50% of global energy consumption and thus resulting in 40% of CO₂ emissions worldwide. There is therefore an undeniable demand to focus on the heat storage potential, the largest single energy storage application field in Europe.

Innovation: EARTO member TNO developed a heat battery which stores heat and/or electricity and delivers heat independently of time and place, using the most common raw materials on earth (salt and water). TNO's heat battery, applicable not only to individual houses but also to districts, is a low-power, high-capacity energy storage solution for low-temperature levels (in less than 150°C). It is based on two main breakthroughs: a multicyclic stable thermochemical composite and a closed-loop system.

Impact Expected: Thanks to TNO and its spin-off, Cellcius, the electricity grid investments are estimated to be reduced in a billion euros' range in the Netherlands. With an active material containing 220 kWh/m³ and a stored energy price of €5-8/MJ, TNO's system is 2 times more compact and 10 times cheaper than state-of-the-art electric batteries, while being 10 times more compact than domestic water storage. The full heat battery value chain received a €12.5M total funding through European and national running projects.



TNO, an independent Dutch RTO, has some 3200 professionals who put their knowledge and experience to work in creating smart solutions to complex issues.

www.tno.nl



RTOs INTERNATIONAL NETWORK **RIN**



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A*STAR

RESOLUTE and RAVE speed up testing for COVID-19

The Agency for Science, Technology and Research (A*STAR) is Singapore's lead public sector R&D agency. Through open innovation, A*STAR collaborates with its partners in both the public and private sectors to benefit the economy and society. A*STAR plays a key role in nurturing scientific talent and leaders for the wider research community and industry, and its R&D activities span biomedical sciences to physical sciences and engineering.



RT-PCR TESTING HAS
SENSITIVITY AND SPECIFICITY RATES
OF OVER **90%**



RESOLUTE **2.0** IS A
BREAKTHROUGH DIRECT
PCR METHOD
THAT CAN HALVE TESTING TIME



RESOLUTE 2.0 AND RAVE
CAN PROCESS A THROUGHPUT THAT IS
4 TIMES
THE USUAL RT-PCR THROUGHPUT



TO DATE, **THE JOINT SOLUTION**
IS DEPLOYED TO
3 HOSPITALS IN SINGAPORE

 Agency for
Science, Technology
and Research
SINGAPORE

www.a-star.edu.sg

A*STAR and partners roll out direct PCR test and automated lab system that ups test delivery throughput by four times

In battling the COVID-19 pandemic, Singapore has turned to its deep capabilities in biomedical sciences and infectious diseases R&D, built over the past two decades. These capabilities cover areas such as genomics, molecular biology, immunology, bioinformatics, data analytics, and productisation of diagnostics. Singapore has also placed emphasis on a multi-disciplinary and collaborative approach to research on infectious diseases which spans public research institutes from A*STAR, the institutes of

higher learning, and public hospitals. Singapore's R&D efforts have led to the development of many cutting-edge technologies that help track and stem the spread of COVID-19. Proactive testing remains a critical pillar of Singapore's strategy against COVID-19. As the nation looks to balance between containing the virus and reopening the economy, it needs to enhance its testing capacity to control community transmissions and prevent future outbreaks.



The development of RESOLUTE kit and RAVE is a result of a close collaboration across the Singapore R&D ecosystem.

Expediting turnaround time of COVID-19 Testing

The real-time Reverse Transcriptase Polymerase chain reaction (RT-PCR) COVID-19 testing method has sensitivity and specificity rates over 90%. For this reason, the technique is widely regarded as the gold standard for detecting and diagnosing viral infections. However, it is a time-consuming process. The results would take about a day or longer after factoring the time taken to collect patient swabs and extract RNA, as well as testing backlogs. As speed is essential in containing the virus, scientists worldwide have been searching for ways to make the testing process more efficient, as well as resilient to shocks in the supply chain.

A breakthrough direct-PCR diagnostic test kit developed

DSO National Laboratories and the Diagnostics Development (DxD) Hub, a national platform hosted by the Agency for Science, Technology and Research (A*STAR), have developed the RESOLUTE 2.0 test kit, which does not require the extraction of viral RNA from patient test samples. This minimises potential human errors and halves the test delivery time, compared to a conventional PCR test which takes around two and a half hours. A*STAR also developed a robotics lab system called Rapid Automated Volume Enhancer that automates some of the manual steps usually required in sample processing. The joint solution processes a throughput of close to 4K samples a day, four times the usual RT-PCR throughput.

From development to production

The joint RESOLUTE 2.0 and RAVE system is distributed by Advanced MedTech Holdings, a medical technology enterprise headquartered in Singapore. Advanced MedTech was granted Provisional Authorisation from Singapore's Health Sciences Authority (HSA) to manufacture and supply the RESOLUTE 2.0 tests; thus helping to scale-up Singapore's testing capability. Advanced Medtech set up one of the largest automated in-vitro diagnostics manufacturing facilities in Singapore in just six weeks. As of 2 March 2021, it has the capacity to produce 2M Resolute tests per month. To date, the joint solution is being deployed to three hospitals in Singapore.

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AIST

Safety in numbers

The National Institute of Advanced Industrial Science and Technology (AIST), one of Japan's largest public research organisations, focuses on the creation and practical realisation of technologies useful to industry and society, and on "bridging" the gap between innovative technological seeds and commercialisation. AIST is organised into 7 research areas and has around 2,300 researchers at 11 research bases nationwide.



MEASUREMENT AND RISK
ASSESSMENT OF LARGE-SCALE EVENTS
WERE CONDUCTED



CO₂ CONCENTRATIONS
WERE TYPICALLY BELOW
1,000 PPM



MASK WEARING RATE WAS
94% ON AVERAGE



A SIMULATION ESTIMATED
THAT **PREVENTION MEASURES**
INCLUDING MASK WEARING
AND SPACING OF SPECTATORS
REDUCED THE INFECTION RISK BY
94%

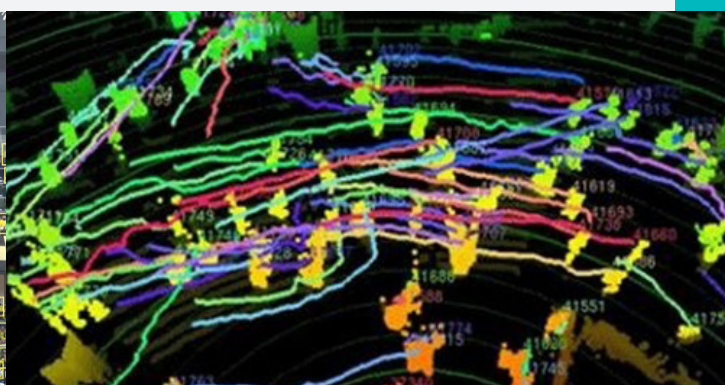
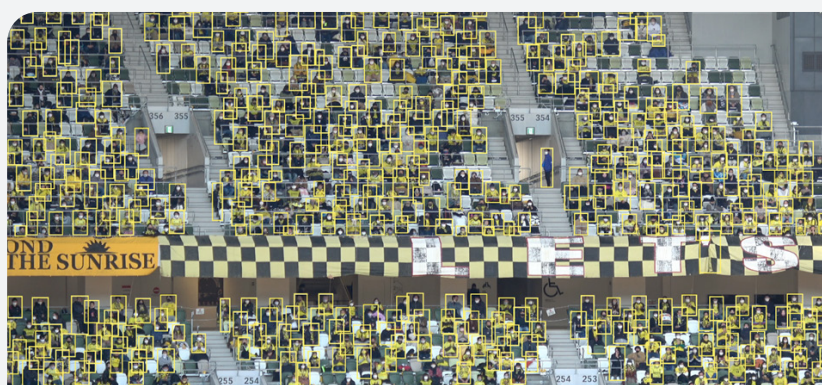
 **AIST**

www.aist.go.jp

Monitoring of crowd behaviour and stadium conditions to reduce the spread of infection at large-scale events

In the current situation with the novel coronavirus, the cancellation of large-scale events, or the holding of events without spectators has an extremely negative impact on society, in addition to the severe economic impact. The risk of infection can be decreased by avoiding the 3Cs, closed spaces (i.e. poor ventilation), crowded places (i.e. high density of people), and close contact. To establish safe operating protocols, the National Institute of Advanced Industrial Science and Technology (AIST) has been conducting research to

quantify the infection risk of large-scale events. With the cooperation of the relevant stadium authorities, the Japan Professional Football League (J-League) and others, AIST has conducted surveys into the infection risk conditions at a number of domestic league games over the last 6 months. Based on the in-stadium measurements, a Monte-Carlo simulation showed a maximum risk reduction of 94% when all the considered prevention measures were implemented.



Using AI to monitor individual crowd behaviour (mask wearing etc.) inside the stadium and laser radar to monitor crowd movement at ticket gates.

Reducing infection risk at large events

As the ongoing situation with COVID-19 has shown, it is important to know what measures are effective to reduce the risk of spread of infection. For events where many people congregate in a confined area, such as sporting events in stadia, there is concern that the total number and seating density of spectators, whether or not masks are worn, the degree of congestion at entrances, exits, toilet areas etc., and differences in cheering methods may affect the spread of infection.

Analysis of stadium crowds

In order to assess the risk of infection of the new coronavirus among spectators, players, and staff, AIST has been conducting a survey on stadium crowds using a CO₂ measuring device as an indicator of air circulation, laser radar (LiDAR) as an indicator of crowd density and image and acoustic sensors to analyse crowd behaviour. A Monte-Carlo simulation model, previously used to evaluate the risk of the opening ceremony of the Tokyo Olympics¹, was modified to take into account the mask-wearing rate, seat spacing, and number of accompanying persons, etc. By using the above model with the measured data such as the mask-wearing rate and so on, the effectiveness of the infection risk countermeasures was evaluated.

Reducing the infection risk at large events

The analysis of CO₂ levels both around seating areas and the areas where transient crowds congregate (concourse, ticket gates etc) showed that the air was sufficiently circulated to keep infection risk low. Spectators were seen to follow the requested measures well, with an average rate of mask wearing at the matches surveyed at 94%, and audio data showing spectators refraining from singing or loud chanting. A Monte-Carlo simulation showed a maximum risk reduction of 94% when all the prevention measures were implemented. The risk assessment method attempted in this study should also be applicable to risk assessment in events other than soccer, and efforts will be made to confirm the effectiveness of countermeasures.

¹M. Murakami et al., Microbial Risk Analysis, In press (2021)

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CSIRO

One House to save many

CSIRO is Australia's national science agency, solving the greatest challenges through innovative science and technology. CSIRO has 5,500 dedicated people across sites, labs, offices and diplomatic postings in Australia, Singapore, Vietnam, Indonesia, US, Chile and France. CSIRO works with 2,400 industry, government and research partners. CSIRO has been conducting bushfire research for over 60 years.



33 PEOPLE DIED AND
3,094 HOUSES WERE LOST
IN AUSTRALIA'S 2019-20
BUSHFIRE SEASON



THE COSTS OF ONE FLOOD EVENT
IN 2019 EXCEEDED
\$4.36B



90% OF AUSTRALIAN
HOMES **ARE NOT AS RESILIENT**
TO BUSHFIRES AS THEY COULD BE



CSIRO PUT **ONE HOUSE**
THROUGH A BUSHFIRE SIMULATOR
WHICH PRODUCES A
12-METRE-WIDE FIRE FRONT

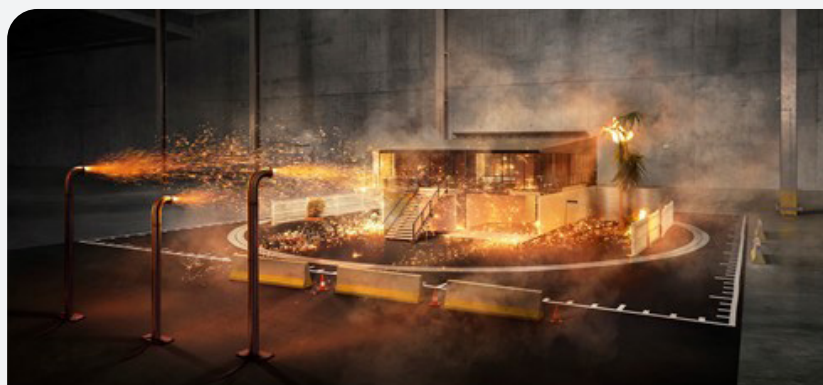


www.csiro.au

CSIRO's collaborative and ambitious work to design a house that is resilient to multiple extreme events

Destructive bushfires are a global problem, resulting in loss of life, property and infrastructure in many countries. The increase in fire season severity and the expansion of the Wildland Urban Interface has dramatically increased the consequence of bushfires in recent decades. A CSIRO study of a 110-year period (1901-2011) in Australia, found that 260 bushfires had been associated with a total of 825 known

civilian and firefighter fatalities. More than 75% of all fatalities from major bushfires were within structures, with people dying while attempting to shelter, mainly in their places of residence. To address this, CSIRO worked with Suncorp, James Cook University and Room 11 Architects to design, build and test a prototype house resilient to multiple extreme events, including bushfires. The result was One House.



CSIRO's One House has been designed, prototyped and tested in a collaborative project between industry and researchers with the aim of developing Australia's most resilient home design.

The challenge

Destructive bushfires are a global problem, and in many countries, have resulted in the loss of life, property and infrastructure. The Australian summer of 2019-20 was defined by a series of consecutive and at times coincident natural events involving a confluence of bushfires, floods, drought, and heat extremes. Thirty-three people died in bushfires in south eastern Australia, including nine firefighters. A total of 3,094 houses were lost. The financial costs were also significant. Insurance losses alone from the fires exceeded \$1.79B, while the costs of one flooding event in Australia's north in 2019 exceeded \$4.36B.

One House innovation

To tackle these losses, Australia's national science agency CSIRO teamed up with Suncorp, James Cook University (Cyclone Testing Station and Centre for Disaster Studies) and Room 11 Architects to design, build and test a prototype house resilient to multiple extreme events. The result was One House. At James Cook University's Cyclone Testing Station and CSIRO's Bushfire Burnover Facility, researchers tested which aspects of the house would fail or resist fire, cyclone and flood impacts. The bushfire simulator produced a 12-metre-wide fire front to replicate fire in a series of simulations. Up to 100 sensors were embedded in and around the house prototype to measure air and surface temperatures, radiant heat flux and track how individual elements of the house survive different fire intensities.

Watch a video of the burnover testing here:
www.vimeo.com/536225296/f2fb21d210

One House impact

The results of One House collaboration, research and testing have enabled CSIRO and its partners to qualify specific design principles and demonstrate how clever use of design and material selection can dramatically increase the resilience of a home. This has led to a more robust and resilient house design that can help to protect against extreme weather. Having a liveable house after a fire passes through addresses two very practical problems. It ensures people are not left homeless and gives people the confidence to leave their houses undefended in the face of a fire, potentially saving lives.

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ITRI

Developing a solid-state electrolyte of Li-batteries to the next generation

The Industrial Technology Research Institute (ITRI) is a leading research and technology organisation with more than 6,000 outstanding researchers. Its mission is to drive industrial development, create economic value, and enhance societal well-being through technology R&D. Founded in 1973, it pioneered in IC development and continues to nurture emerging tech ventures and deliver its R&D results to industries.



IMPROVING THE CYCLABILITY
OF CELLS AT HIGH VOLTAGES
OF **4.5V** AND TEMPERATURES OF
55°C



REDUCING 10% ELECTROLYTE
CONSUMPTION AND 4% CELL COST
ENHANCING **3.5%**
ENERGY DENSITY OF CELLS



SIMPLIFYING THE
MANUFACTURING PROCESS
OF SOLID-STATE LIBS
WITHOUT THE REQUIREMENT
OF HEATING OR UV LIGHT FOR
POLYMERISATION



NAEPE/CERAMIC SOLID-STATE
ELECTROLYTES CAN BE **INTERNALLY
CONNECTED** IN SERIES FOR 12V OF LIBS,
AND **REDUCES CELLS PACKAGING COSTS**
AND **INCREASES BY 20%**
MODULES ENERGY DENSITY



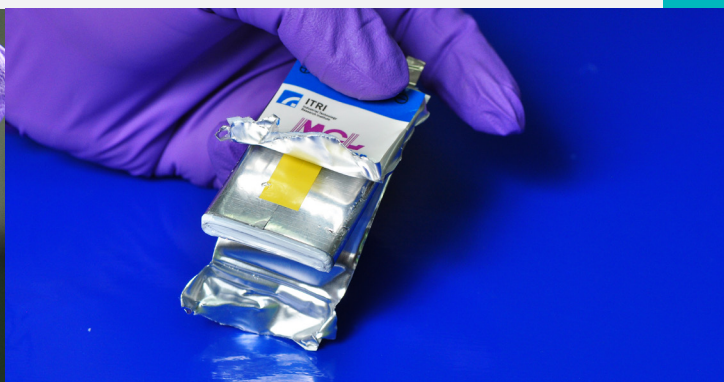
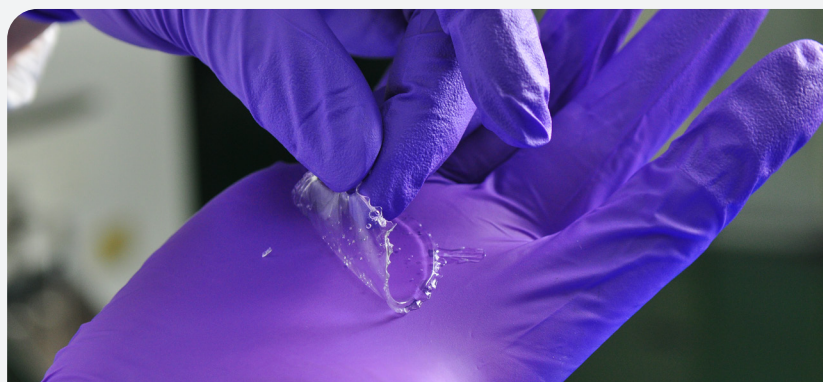
ITRI
Industrial Technology
Research Institute

www.itri.org.tw

NAEPE is a solid-state electrolyte with high conductivity and easy manufacturing process for Li-batteries (LIBs) for electric vehicles

It is known that conventional Li-batteries (LIBs) with organic liquid electrolytes have safety issues such as flammability and leakage. Gel electrolytes have been in the market for many years, but are mostly used in portable electronic devices, not yet in power LIBs. The main reason is that like polymers, gel electrolytes have lower ionic conductivity than liquid electrolytes, with difference by more than an order of magnitude. This limits the application of gel or polymer electrolytes

in power LIBs. NAEPE (Networked Amide Epoxy Polymer Electrolyte) is a quasi-solid state, non-flammable and low-cost electrolyte with high ionic conductivity and high voltage stability. NAEPE is a key material for the next generation of solid-state Li-batteries and especially suitable for a variety of applications that operate at high voltage and temperature.



NAEPE is a key material for the next generation of solid-state Li-batteries and is especially suitable for electric vehicle applications because liquid electrolyte leakage could be avoided, and the safety of LIBs substantially improved.

The next generation of solid-state Li-batteries

Non-flammable and low-cost NAEPE is an electrolyte material with high ionic conductivity and voltage stability, which can greatly improve the safety and cycle life of LIBs. NAEPE is achieved through the polymerisation of liquid electrolytes with the addition of a cross-linking agent and an initiator at ambient temperatures. The state of the electrolyte depends on the extent of the polymerisation and can be controlled by the amount of the cross-linking agent (i.e. Amide Epoxy Oligomer, AEO) added. When the AEO amount is below 5%, the electrolyte behaves like a gel, and when superior to 5 wt%, a significant cross-linking reaction occurs and the electrolyte becomes a quasi-solid. NAEPE can also be blended with inorganic ceramic electrolyte materials to form an organic/inorganic composite solid-state electrolyte that can replace not only the liquid electrolyte but also the separator.

High safety, low-cost and easy processing

NAEPE can be applied in LIBs for electric vehicles, energy storage systems, and mobile electronic devices. NAEPE has the following advantages that are confirmed by several cell manufacturers in Taiwan:

1. High safety (non-flammable, leak- and impact-proof batteries),
2. Low-cost and easy processing (AEO can polymerise at ambient temperatures to absorb liquid electrolytes),
3. Excellent cyclability at high voltage ($>4.5V$) and temperature,
4. Multi-applications (from portable electronic devices to vehicles),
5. Enhancing the energy density of cells by 3.5% (by saving usage of the electrolyte by 10 wt%).

New opportunities for electric vehicles

LIBs are the most common battery type in electric vehicles, and their amounts are growing drastically over the recent years. The goal of ITRI is to increase the cycle life and recycling efficiency of LIBs. NAEPE technology can provide not only a long cycle life, but also an easy recycling process to collect high value metal elements (Co, Ni, Cu) of the LIBs. NAEPE is a non-toxic and non-flammable material that improves the safety and the efficiency of the composition breakdown of LIBs. The quasi-solid-state electrolyte of NAEPE is suitable for large format batteries (25Ah~40Ah) evaluated by cell manufacturers, and saves many containers of materials where 18,650 or 21,700 cylindrical cells are wasted.

RTOs
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NRC

Suspension Vero cell culture technology is transforming vaccine manufacturing

The NRC is at the intersection of academia, industry and government. Commitment to research and innovation underpins everything NRC does. As Canada's largest federal research and development organisation, NRC spurs economic prosperity by delivering technology development programs and specialised national facilities and services, with an eye to boosting industrial R&D. NRC is Canada's engine for industrial innovation, with a focus on translating research and technology into prosperity.



TRADITIONAL ADHERENT
VERO CELL TECHNOLOGY
HAS BEEN USED TO MANUFACTURE
5 OF **15** AUTHORISED/APPROVED
COVID-19 VACCINES, AND AT LEAST
8 OTHER HUMAN VACCINES



SUSPENSION ADAPTED
VERO CELLS DOUBLE
IN **24** TO **30** HOURS IN THE
EXPONENTIAL GROWTH PHASE,
AND GROW TO A MUCH HIGHER
CONCENTRATION



SUSPENSION ADAPTED
VERO CELLS CAN PRODUCE
UP TO **10** TIMES MORE DOSES
PER LITRE OF CELL CULTURE,
WHICH SIMPLIFIES THE PROCESS
AND LOWERS THE COST



THE NRC'S SUSPENSION
VERO CELL TECHNOLOGY HAS BEEN
TRANSFERRED TO **15** ORGANISATIONS
FOR COLLABORATIVE PROJECTS
AIMING AT LOWERING COST
OF VACCINE PRODUCTION

Canada
National Research
Council Canada
Conseil national de
recherches Canada

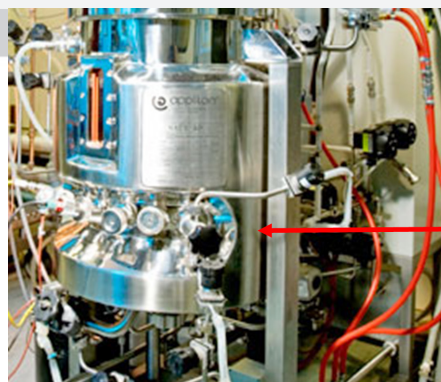
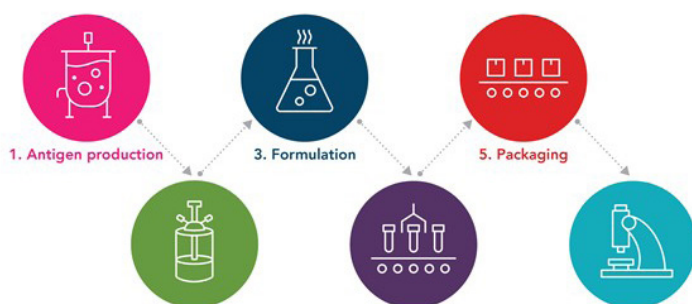
www.nrc.canada.ca

The NRC of Canada's ground-breaking cell adaptation technology improves yield and lowers cost of viral vaccine production

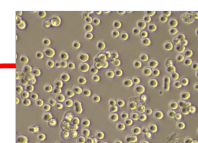
The COVID-19 pandemic has highlighted the importance of efficient and effective vaccine production, but the production process remains complex, time consuming and expensive. The Vero cell line is considered a robust living cell platform and is widely accepted by regulatory authorities to manufacture vaccines for rabies, polio and COVID-19. It has been a successful technology platform for developing vaccines for MERS-CoV, Lassa fever and others. However, adherent cells, like Vero cells, grow only on the surface of culture

vessels or microcarriers, which limits their scalability and productivity per unit volume of bioreactor in the vaccine manufacturing process. The National Research Council of Canada (NRC) developed a technology to adapt Vero cells to grow in suspension and reach higher cell density. This unique, highly advantageous manufacturing platform is set to transform the viral vaccine manufacturing field and contribute solutions to global pandemics, making a significant long-term impact on human health.

COMPLEX VACCINE MANUFACTURING PROCESS



Suspension Vero cells



The NRC's ground-breaking suspension Vero cell adaptation technology helps simplify the complex vaccine manufacturing process, improving yield and lowering the cost of vaccine production.

A decades-old vaccine manufacturing challenge

Vaccination is a safe and effective way to fight infectious diseases and has eradicated smallpox and restricted polio and measles from much of the world. However, the complexity and time required to produce a vaccine, often at a low yield, makes vaccine development expensive. While Vero cells are increasingly used as a source to produce vaccines against viral infections, the challenge has always been that adherent Vero cells only grow on the surface of culture vessels or microcarriers, making scale-up of manufacturing complex and labour-intensive. Despite significant efforts by laboratories over the past two decades, a suspension Vero cell culture technology has not been available... until now.

Innovations in cell technology

Researchers with the NRC's Human Health Therapeutics Research Centre modified the growth process of Vero cells, including modulation of growth conditions using optimised media to creatively adapt the Vero cell line to grow in suspension. The team also fully characterised and traced the history of the cell line, creating a suspension Vero cell line of the earliest passage. The NRC's scientists then developed an advanced culture process allowing Vero culture to reach a higher cell density. The NRC is the only organisation in the world to have this advanced suspension Vero cell line technology where scale-up feasibility has been demonstrated in a bioreactor.

Transforming the viral vaccine manufacturing field

The NRC's suspension Vero cell technology significantly increases product titre, simplifies the vaccine production process and significantly reduces the production cost. This breakthrough in Vero cell culture technology will have a long-term impact on reducing the cost of manufacturing vaccines and contribute to making vaccines affordable worldwide. Many industrial clients are collaborating with the NRC or licensing the novel technology to mitigate their manufacturing costs and improve the safety of their vaccine candidate. Pharmaceutical companies, research organisations and universities are using the NRC's novel Vero cell technology to test their vaccine candidates. This new technology is expected to be successfully implemented in future commercial vaccine manufacturing.

RTOs
INTERNATIONAL
NETWORK

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NST

Designing petrochemical process for energy efficiency and carbon abatement innovations

The National Research Council of Science & Technology (NST) supports, fosters and manages Government-funded Science and Technology Research Institutes (GRIs). It represents 20,000 employees working in 25 GRIs across Korea.

The Center for Convergent Chemical Process (CCP) is a research group of four GRIs under NST. It investigates a large-sized chemical process for economic production of basic chemical materials and stable energy supply.



CCP'S TECHNOLOGY WILL
CONTRIBUTE TO **20% ENERGY
REDUCTION** AND **CO₂ EMISSION
IN LIGHT OLEFIN PRODUCTION**



ABOUT **40WT% IMPROVEMENT OF
LIGHT OLEFIN YIELDS** CAN BE ACHIEVED
THROUGH A **NEWLY DEVELOPED CATALYST**

KRICT Korea Research Institute of
Chemical Technology
KIMM KOREA INSTITUTE OF
MACHINERY & MATERIALS

KIST Korea Institute of
Science and Technology
KIER KOREA INSTITUTE OF ENERGY RESEARCH
한국에너지기술연구원

nst
National Research Council
of Science & Technology

www.nst.re.kr

Development of large-scale chemical processes for the economic production of basic chemical materials and energy sources

The National Research Council of Science and Technology (NST) has run a Convergence Research Center Program in order to address contemporary national issues and large-scale technical challenges through cooperation among its 25 Government-funded Research Institutes (GRIs) since 2014. Under this program, the Korea Research Institute of Chemical Technology (KRICT), the Korea Institute of Science and Technology (KIST), the Korea Institute of Machinery and Materials (KIMM), and the Korea

Institute of Energy Research (KIER) have organised a joint research group dubbed the Center for Convergent Chemical Process (CCP), consisting of 139 researchers - 61 from four institutes and 78 from companies and entrusted institutes. As one of the representative projects of the Program, the CCP has contributed to maximisation of fossil fuels efficiency and carbon dioxide abatement in line with the Korean New Deal for the period of the project (2014-2020).



State-of-the-art of chemical process embracing the chemical, energy, and steel industries.

Contributed to sustainable growth and CO₂ reduction in petrochemical industry through convergence technology

The most commonly used energy sources today are still fossil fuels. According to the British Petroleum Energy Outlook 2030, oil, coal and gas will still be the major fuels in 2030, accounting for 80% of global energy consumption. However, CO₂ emission is a big burden and for sustainable growth, the reduction of energy consumption and carbon dioxide is inevitably required. To maximise fossil fuel efficiency, hybridisation of catalytic naphtha cracking (K-COTTM) and MTO (methanol to olefin) has been tried firstly by four institutes under NST (KRICT, KIST, KIMM, and KIER).

Strengthened cost competitiveness of petrochemical products by stabilising supply of chemical feedstock

The production of light olefins requires a large amount of energy and the separation of olefins and paraffins is one of the most challenging and energy-intensive processes. The CCP has developed a hybridised catalytic cracking process (Naphtha-Methanol To Olefin, or NMTO): Hybridisation of endothermic reaction (Naphtha Cracking) and exothermic reaction (MTO). 20% less energy consumption can be achieved by NMTO in comparison to conventional thermal cracking. In addition, separation of olefins and paraffins through a new porous hybrid adsorbent (MOF) could further reduce energy consumption by up to 10%, compared to conventional olefin separation processes.

Secured future energy resources by adding value to the heavy oil and opportunity crude

The CCP has developed a slurry hydrocracking process of converting low-grade crude oil having high asphaltene, metal, and sulphur impurities. Through high-efficiency slurry hydrocracking catalyst and process, more than 95wt% of asphaltene can be converted and coke level can be reduced to less than 5wt%. In addition, by applying membrane contactor technology, hydrogen (99.9%-H₂) needed for hydrocracking can be successfully supplied from carbon steel off-gas (LDG). The developed process was demonstrated successfully in continuous bench system.



**European Association of Research
& Technology Organisations**

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