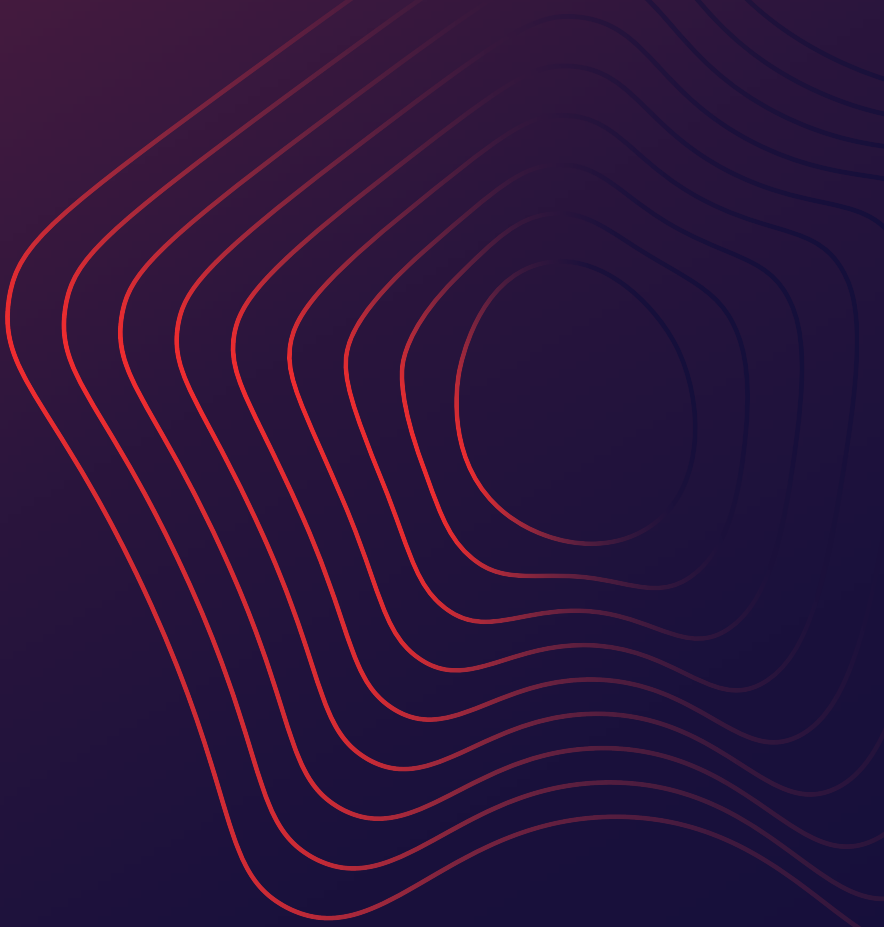
Innovation

Portfolio of INL technologies developed through Portugal´s Recovery and Resilience Plan



powered by INL INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

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Driving Innovation through Strategic Collaboration

The Portuguese Recovery and Resilience Plan (PRR) has been a key instrument in accelerating the country's economic transformation, fostering innovation, competitiveness, and collaboration between industry, academia, and research organisations. Through the mobilising and green agendas for business innovation, multidisciplinary consortia have come together to develop new products, services, and technologies with the potential to create lasting economic and societal impact.

As a research and technology organisation, INL participated in **16 PRR-funded Agendas**, contributing **scientific excellence**, **advanced technological capabilities**, and specialised **infrastructure to support innovation across multiple sectors**. While each Agenda pursued broader consortium-wide objectives, INL's role focused on advancing research, developing enabling technologies, validating solutions, and supporting the translation of knowledge into market-ready innovations.

This publication presents INL's contribution to each Agenda, **highlighting the activities, expertise, and outcomes** delivered by our teams as part of these collaborative national efforts.



INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY

INL is where nanoscale **science becomes impactful at the macro-scale, with a Lab-to-Fab mindset.**
Established as an intergovernmental research organisation, INL combines the collaborative power of international partnership with Portugal's growing **innovation ecosystem**.

We conduct fundamental and applied research in **nanotechnology**, developing solutions at the atomic and molecular level that address challenges in **ICT (Information and Communication Technology), Life Sciences, and Energy & Environment.**



€50M
specialised research infrastructure.



+300
researchers, engineers, and support staff from 40+ countries.



Active portfolio of patents, licenses, and spin-out companies.

Our Commitment

With our Lab-to-Fab capabilities, we bridge the gap between discovery and deployment. Through our Technology Transfer Office and comprehensive innovation support services, we ensure that scientific excellence translates into economic value and societal benefit in Portugal and globally.

The Portuguese Recovery and Resilience Plan (PRR) represents a historic opportunity to accelerate innovation and build a more sustainable economy. As a leading international research institution located in Portugal, INL actively participated in 16 PRR Agendas, spanning critical sectors from health and diagnostics to renewable energy, circular economy, and advanced manufacturing.

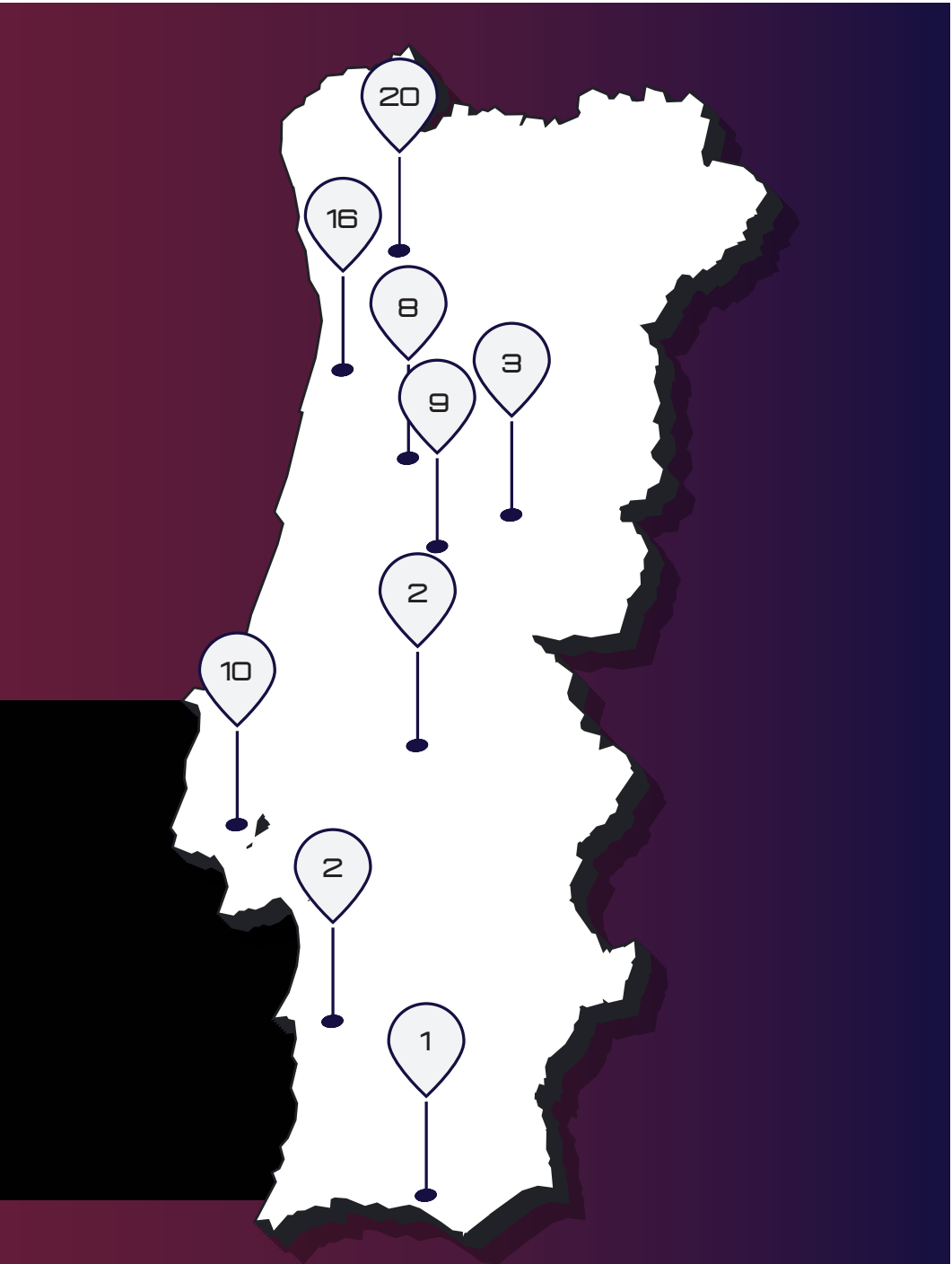
Our role goes beyond research. We facilitate the transition from prototype to scale up.

Our Partners

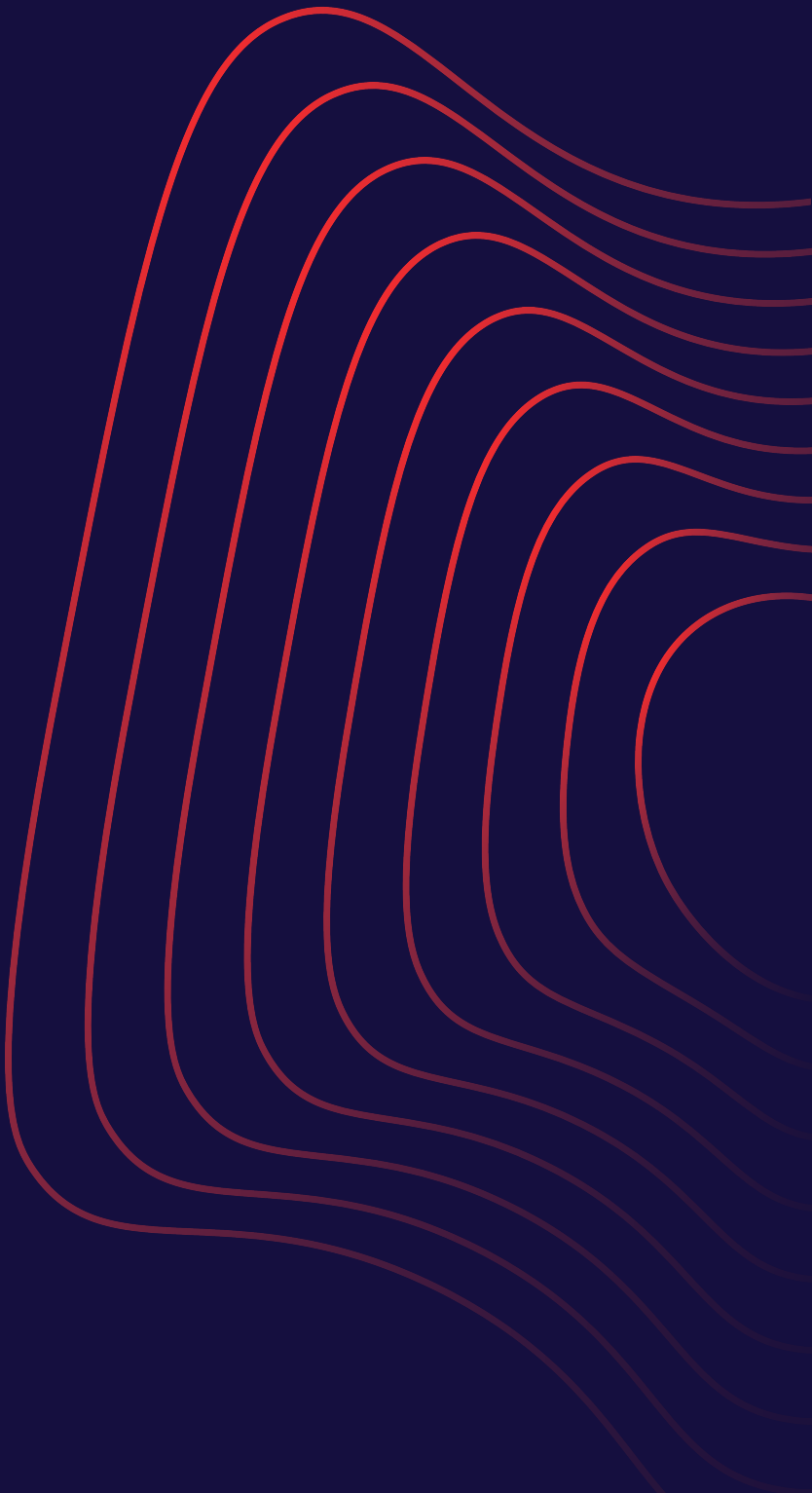
+70
Industrial Partners

42
RTO & Associations

4
Testing Facilities



Thank you to all our partners. Full list available at the end of the booklet.



Our representation in the PRR Agendas

AGENDAS

Life Sciences · Energy and Environment · ICT · Testing Facilities at INL for technology exploitation

Bioeconomia Azul

Aimed to foster reindustrialisation through the blue bioeconomy by creating new economic models based on the use of marine bioresources and products, in line with the principles of circularity, zero waste, inclusivity, sustainability and decarbonisation.

InsectERA

Brought alternative food and nutritional solutions to respond to the sector's new needs, such as world population growth, climate change and food waste. In doing so, it contributed to the green transition towards environmental sustainability, based on a circular economy.

VIIAFOOD

Aimed to promote the structural transformation of the agrofood sector, in line with the objectives of the Sectoral Pact for the Competitiveness and Internationalisation of the Agrofood Sector. VIIAFOOD focused on creating a national platform for the development and scale-up of innovative products, processes and services.

H2 GreenValley

Identified a set of projects to achieve a fully decarbonised energy system, benefiting the green economy and the sustainability of the planet. It set out to create the country's first green hydrogen (H_2) hub in Sines, promoted by several key companies along the energy value chain. The Agenda was critical to decarbonising the Sines industrial area and to leveraging decarbonisation across the entire energy system.

SMARTgNOSTICS

Aimed to develop fast, miniaturised devices for use in decentralised settings. These devices were designed to maximise connectivity and to function as point-of-care (POC) solutions, operating as lab-on-a-chip (LOC) systems combined with AI-based data acquisition and processing. They were intended to provide reliable predictive analyses of emerging antibiotic-resistance genes and pathogenic microorganisms, and to support the prevention of their spread across the four pillars of the antimicrobial resistance (AMR) cycle: human health, animal health, environment and food safety.

New Generation Storage

Brought together 54 partners to develop a complete, fully circular battery ecosystem in Portugal. The consortium's strategy was to develop a new generation of storage systems across the entire value chain, focusing on high-value, environmentally friendly products and processes.

R2U Technologies | Modular Systems

Aimed to develop and industrialise a new concept of modular construction, shifting the Portuguese construction sector from a labour-intensive paradigm to a knowledge-based one. Its seven work packages covered the full construction value chain, from design to building operation and maintenance, and the Agenda set out to deliver 28 new products, processes and services, such as modular façade systems, high-performance HVAC units and flexible BIPV modules for modular buildings.

Be.Neutral

Aimed to position Portugal as an exporter of cyber-physical, zero-carbon mobility products to cities around the world. It arose from an opportunity to develop, industrialise and operate new mobility products and services (physical devices, connectivity and data science platforms) able to quantify avoided emissions in real time, accelerating carbon neutrality by 2030.

Health from Portugal

Aimed to make Portugal a leading global hub for designing, developing and producing advanced solutions for the healthcare industry, using innovation and technology. The Agenda focused on four main areas: smart health solutions, a national health data repository, the expansion of clinical studies, and data collection and benchmarking.

Moving2Neutrality

Mobilised a group of entities that shared the ambition to tackle the challenges of meeting the decarbonisation goals set out in the European Green Deal, mainly the energy transition in the transport sector, particularly in aviation, maritime and long-distance heavy road transport, for which there was no clear technological roadmap for electrification.

ATE

Aimed to place Portugal at the forefront of the decarbonisation of society, taking advantage of the country's unique availability of renewable energy sources and its technological and scientific know-how in the power and energy domain. A well-balanced consortium of more than 90 partners designed a structured approach across the most relevant vectors of the energy system, creating solutions along the whole value chain: generation, transport, distribution and end use of energy.

ILLIANCE

Focused on the design, development and industrialisation of new technologies for electrifying the economy and harnessing sustainable, renewable electrical energy; the use of green hydrogen as an energy source; new intelligent technological platforms for energy management; and intelligent solutions for the efficiency, functionality and performance of buildings.

CInTech

Set out to establish the first technological hub dedicated to the innovation, translation and industrialisation of complex injectable drugs. By integrating research, scale-up and GMP manufacturing activities in a single hub, and by bringing together highly qualified scientific teams from the Universidade de Coimbra and INL, the specialised technical capabilities of SMEs, and the expertise and track record of a well-established pharmaceutical company, CInTech aimed to give its partners a competitive advantage, at business and innovation level, over companies that act only as manufacturers.

Agenda Microelectronica

Closely aligned with the European IPCEI on Microelectronics and Communication Technologies, the Agenda addressed the challenges of unlocking the full potential of the semiconductor industry and bringing added value to European society, through a set of structural investments to strengthen the productive capacity and innovation of the semiconductor industry.

PRODUTECH R3

Aimed to bring about a structural change in the Production Technologies Sector, enabling it to capitalise on the significant investments the industry was making in the green and digital transition, reducing external technological dependence, increasing the value added generated in the country and contributing to a change in the specialisation of the Portuguese economy.

Green Auto

Aimed to transform the national automotive sector in the context of the transition to low-emission vehicles. The Agenda comprised the development, implementation and industrialisation of new vehicles and their components, as well as production technologies used by automotive original equipment manufacturers (OEMs).

Impact as of 2026

The PRR Agendas have had significant impact on INL, Portugal, and abroad, with significant outcomes described in this collection of technologies.

58
new products/processes/ services

12
patent applications

+20
new projects or partnerships

1
start-ups generated

9
exploited technologies

14
invention disclosures

2
new R&D pathway

3
specific granted PhD projects

31
Validated R&D lines

+382
dissemination activities

SUSTAINABLE DEVELOPMENT GOALS

Multiple developments are gearing towards industrial transfer with clear potential for start-up creation or licensing. These address SDGs such as:




TECHNOLOGY
TECHNOLOGY
TECHNOLOGY



TRL Technology Readiness Level

Scientific Publication

Inventions and Patents

Opportunities Generated



LIFE SCIENCES



Health Portugal
Agenda HfPT

Otitest

A non-invasive diagnostics tool for real-time ear infection detection that uses a connected thermometer to evaluate ear health without discomfort.

Identifies otitis media by analysing colour changes in the tympanic membrane, enabling early and accurate diagnosis.

Integrates with digital platforms for data tracking, remote monitoring, and potential integration into telehealth systems.

Potential market: Healthcare providers, pediatric clinics, telemedicine platforms, and home healthcare device manufacturers.

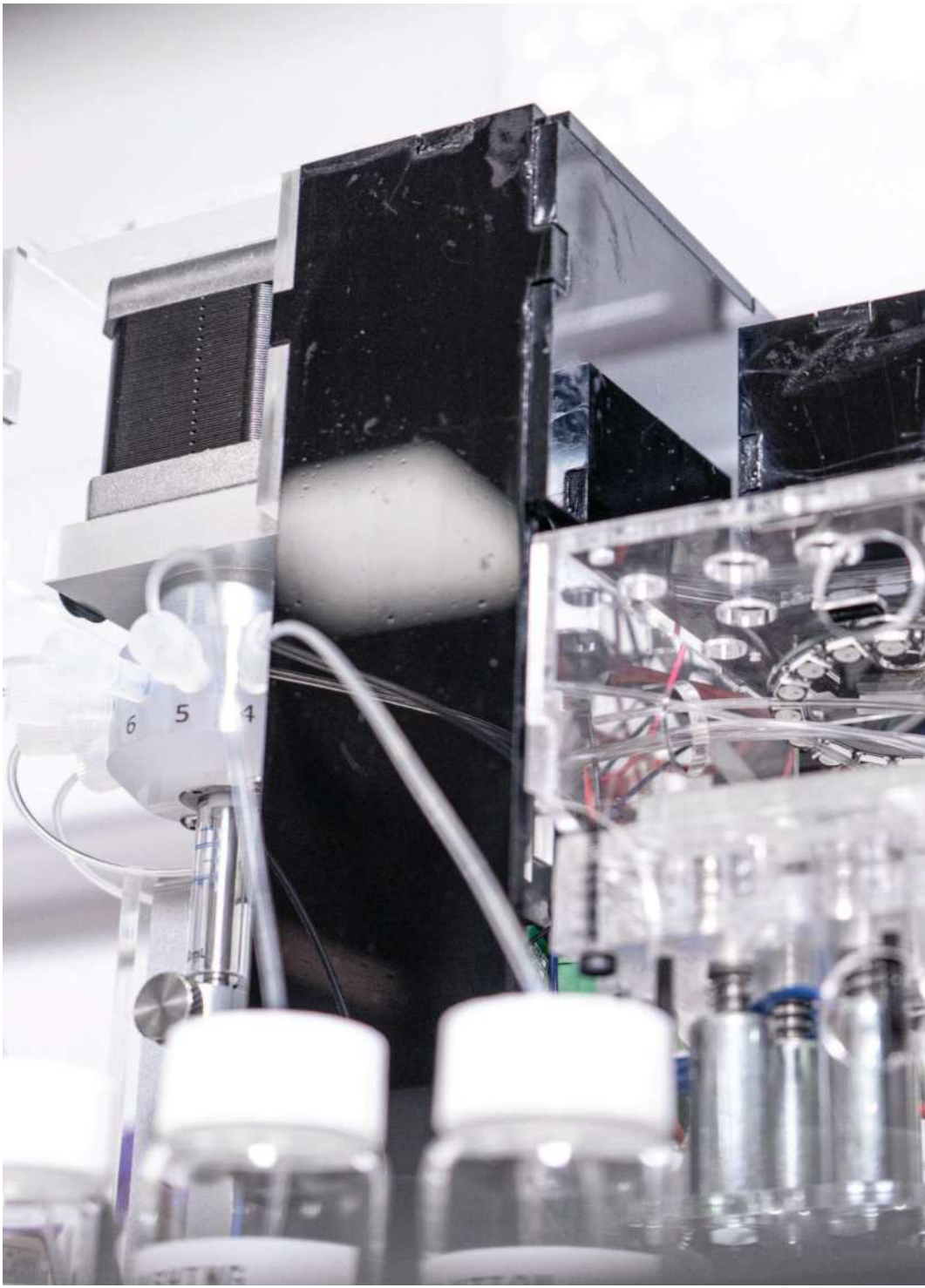
Partners: Metablue Solution, EVERYTHINK, WSLF - Wiselife, Centro Clínico Académico - Braga, Associação (2CABraga)

Industrial Uptaker: Metablue Solution

"INL's support was essential to advance the Otitest technology. The INL team optimized the optical signal acquisition from the Otitest probe and helped redesign its electronic board, enabling the creation of a lighter device with real autonomy for daily use. With this technology, we believe that any family or caregiver will be able to screen for early signs of otitis at home, initiating simple measures and, when needed, facilitating remote access to medical care. For healthcare professionals, Otitest will help reduce emergency visits, support faster decision-making, and improve diagnostic quality by providing more information, earlier and in a more accessible way."

Ricardo Moura, CEO, Metablue Solution

6 TRL


6
5
4



SMARTgNOSTICS

InviDx Plus AMR detection device

A lab-on-chip device for the detection and monitoring of bacteria and anti-microbial resistance (AMR) genes in the context of infection

Enables real-time diagnostics at the site of care, without the need for a centralised lab infrastructure.

Simultaneously identifies bacterial pathogens and AMR genes, offering a comprehensive view of the infection and resistance profile.

Supports targeted treatment decisions, reducing the misuse of antibiotics and helping combat the global rise of antimicrobial resistance.

Potential market: Testing laboratories, hospitals, clinical laboratories, healthcare providers, biotech companies, water quality companies, regulatory agencies, and public health organisations.

Partners:
ALS, INEGI

Industrial Uptaker:
ALS

"The collaboration with INL within the SMARTgNOSTICS project reinforces ALS's commitment to developing truly innovative technologies with an impact on society. INL stands out as a highly innovative institute with genuine proximity to industry, which is a decisive strength, since this direct link to the business community accelerates the translation of technology from the laboratory into concrete market solutions, generating greater value and impact for our clients."

Josué Carvalho, SMARTgNOSTICS Coordinator







SMARTgNOSTICS

InviPath™ – A phage-based device for the detection of bacteria

A rapid, non-invasive diagnostic platform that uses bacteriophages to detect specific bacterial strains with high accuracy, reducing false positives and enabling targeted monitoring.

Provides automated and multiplex detection of bacterial pathogens, delivering actionable results in a compact, easy-to-use format.

Supports real-time contamination monitoring while reducing reliance on centralised laboratory infrastructure.

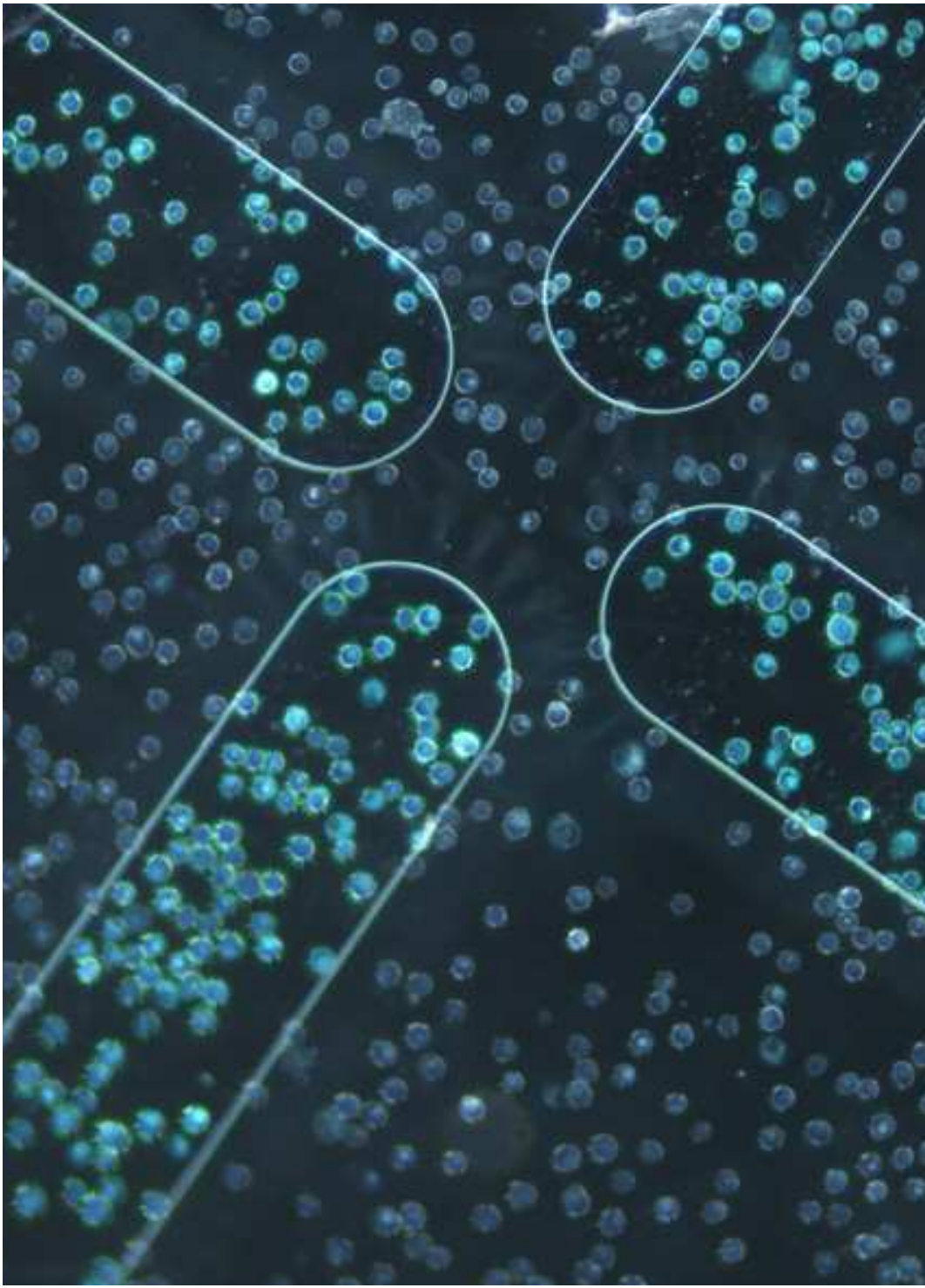
Combines portability, sustainability, and simplified sample-to-answer workflows, offering a scalable solution for food safety, environmental monitoring, and healthcare applications.

Potential market: Food producers, food processing companies, testing laboratories, hospitals, clinical laboratories, healthcare providers, biotech companies, water quality companies, regulatory agencies, and public health organisations.

Partners: ALS, INEGI, INESC TEC, Universidade do Minho, SPMAQ.

Industrial Uptaker: ALS

2 5/6 TRL





Health Portugal
Agenda HfPT

Label-Free Electrorotation Platform for Extracellular Vesicle Characterisation

An advanced analytical platform for the label-free characterisation of extracellular vesicles (EVs) and other nanoscale particles in biological samples. By combining electrorotation with optical detection, the system provides detailed insights into particle structure and dielectric properties without the need for fluorescent markers or surface modification.

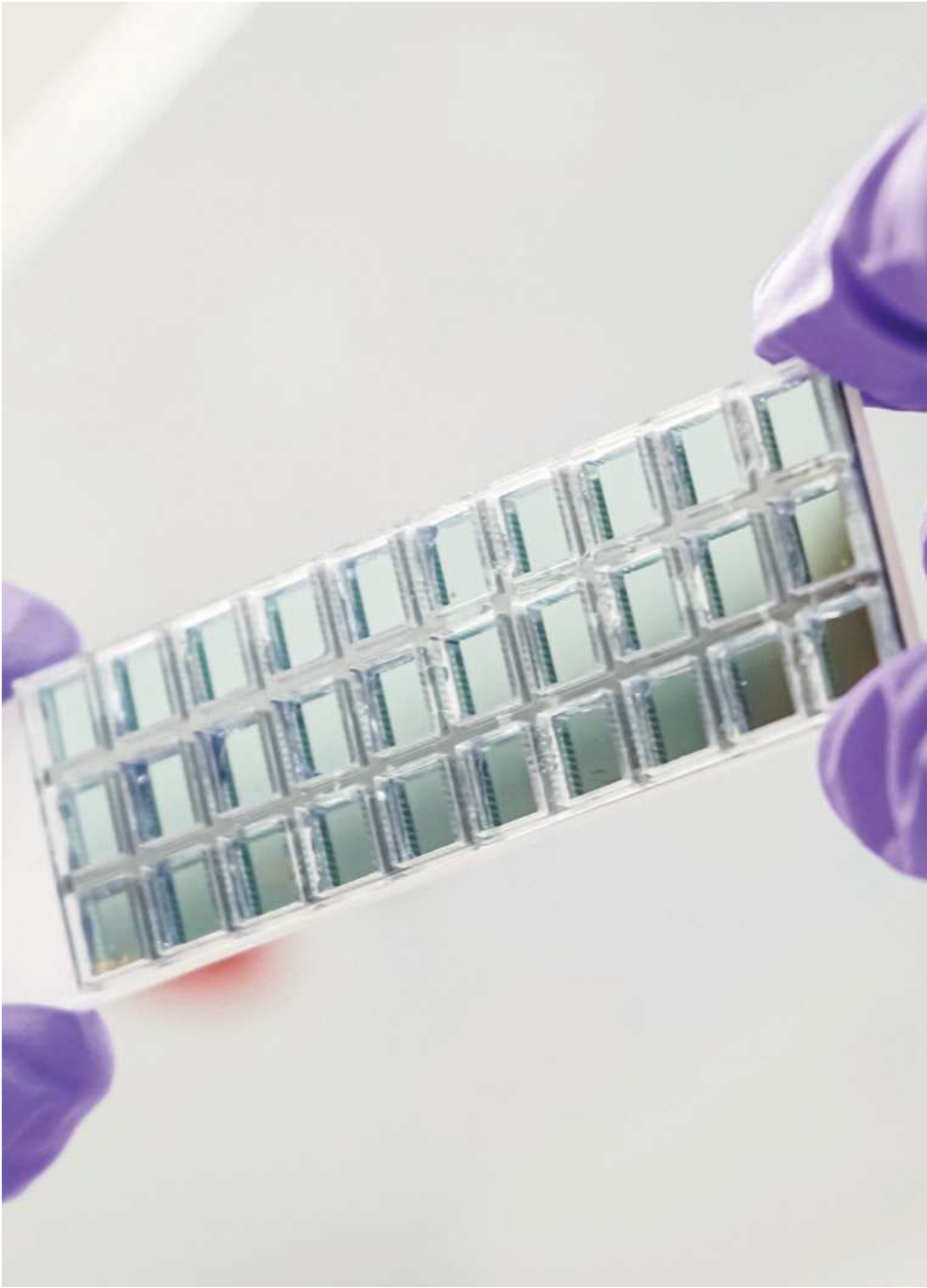
Supports the characterisation of vesicle morphology, membrane composition, and lamellarity.

Performs simultaneous measurement of multiple particles with minimal sample volumes, offering a cost-effective and scalable approach for biomedical research and diagnostics.

Provides a powerful tool for next-generation liquid biopsy applications, enabling deeper understanding of disease-related biomarkers in blood, plasma, and serum samples.

Potential applications: Extracellular vesicle characterisation, nanoparticle analysis in biological fluids, liquid biopsy development, biomarker discovery, clinical diagnostics, and biomedical research.

4
TRL



Health Portugal
Agenda HfPT

AlzERS - Blood-Based Detection of Alzheimer's Markers

An advanced platform for the detection and classification of Alzheimer's disease biomarkers from blood samples, enabling a minimally invasive approach to disease assessment.

Combines extracellular vesicle analysis, Surface-Enhanced Raman Spectroscopy (SERS), and machine learning to identify disease-associated molecular signatures with high sensitivity.

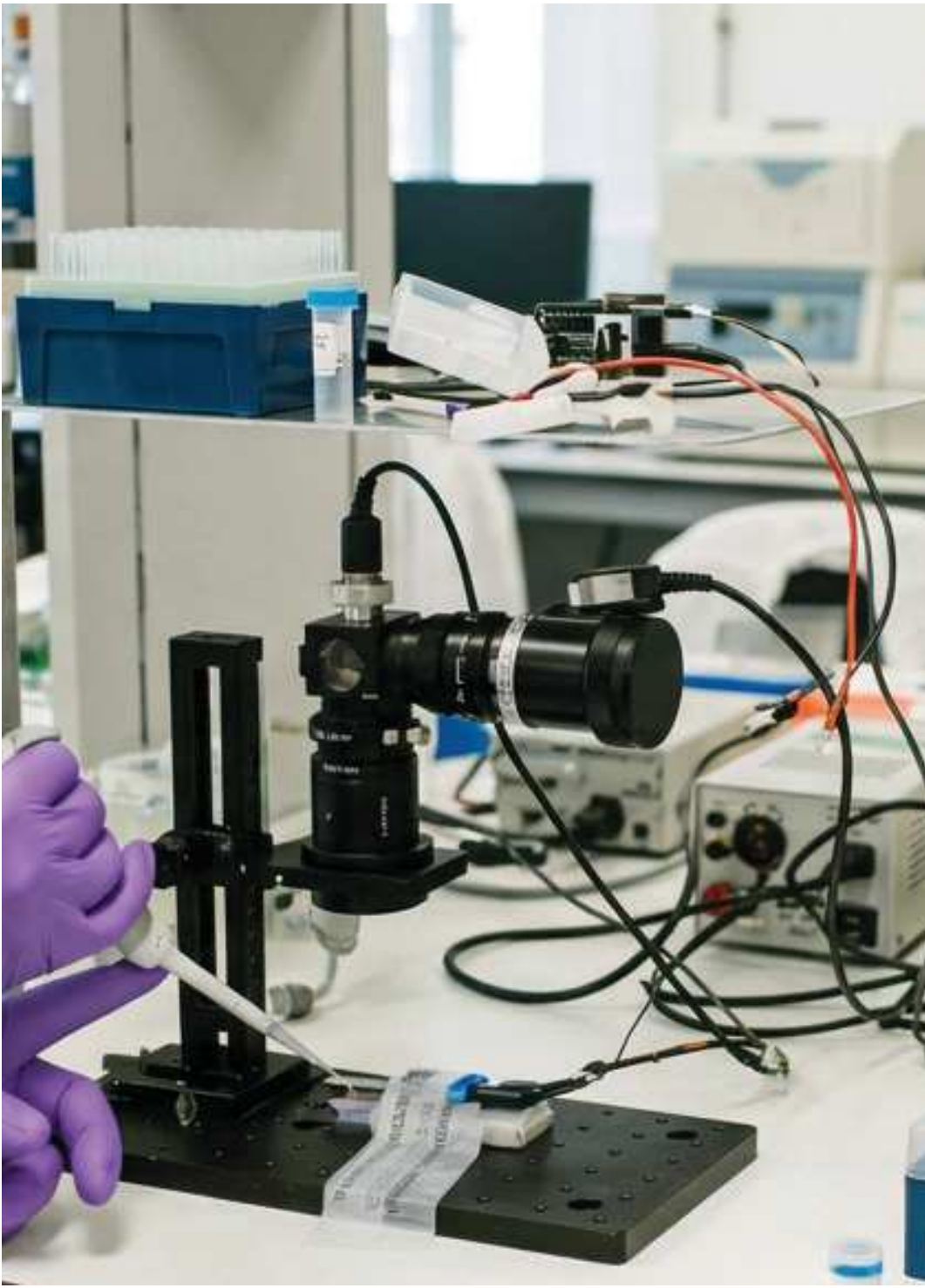
Supports automated, high-throughput processing and analysis, reducing the complexity of traditional diagnostic workflows.

Provides a scalable platform for earlier and more accessible detection of neurodegenerative diseases through liquid biopsy approaches.

Potential market: Clinical diagnostic laboratories, hospitals, neurology clinics, healthcare providers, and pharmaceutical companies developing neurodegenerative disease treatments.

Partners: iLoF, ICVS, INESC TEC

5/6
TRL





Health Portugal
Agenda HfPT

IMPAct-L2 - Multiplex Platform for Acute Myeloid Leukaemia Diagnosis

An integrated diagnostic platform designed to improve the diagnosis and classification of acute myeloid leukaemia (AML), supporting earlier detection of Minimal Residual Disease (MRD) and personalised treatment strategies.

Combines microfluidic isolation of leukaemic blasts from peripheral blood with advanced molecular analysis through SERS and photoelectrochemistry, enabling patient monitoring through blood testing instead of standard bone marrow invasive sampling.

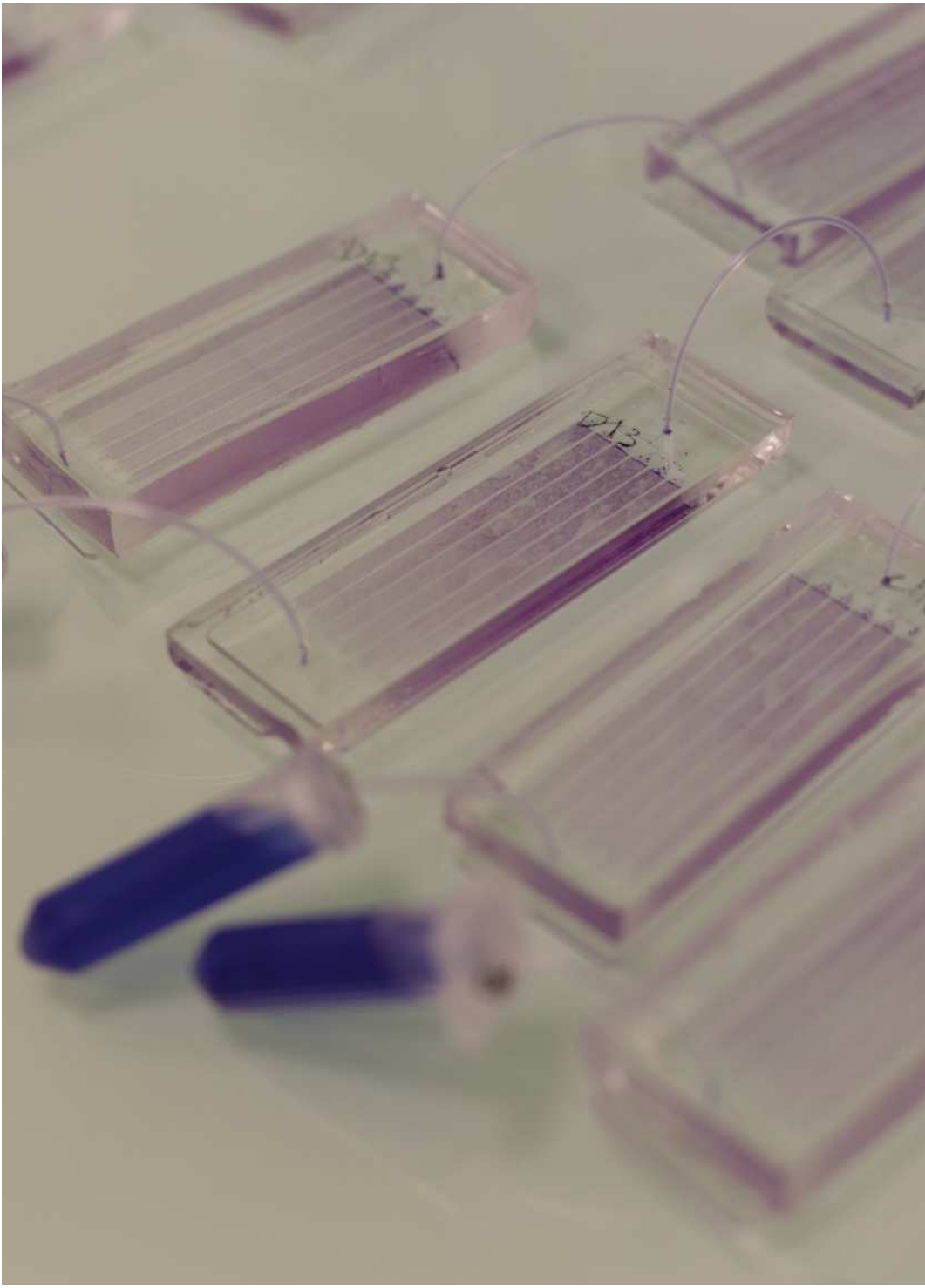
Facilitates non-invasive early detection of MRD and multiplex detection of disease-specific genetic alterations associated with AML heterogeneity.

Provides a foundation for precise patient follow-up and stratification, through minimally invasive and high-sensitivity analysis.

Potential market: Hospitals, haematology and oncology centres, clinical laboratories, precision medicine providers, and cancer diagnostics companies.

Partners: ICVS, 2CA Braga, B.acis

5/6
TRL



Health Portugal
Agenda HfPT

EVOLVING - Extracellular Vesicle Biomarkers for Metabolic Diseases

An innovative integrated platform for the identification of extracellular vesicle biomarkers associated with lysosomal storage disorders and other chronic inflammation-related conditions.

Uses microfluidic technology to isolate extracellular vesicles from blood samples, and highly sensitive SERS substrates for biomarker classification, enabling access to disease-relevant molecular information through minimally invasive procedures.

Integrates advanced biosensing approaches, including nanoparticle-enhanced detection methods, to improve diagnostic sensitivity and specificity.

Supports the development of next-generation diagnostic tools for disease detection, patient stratification, and treatment monitoring.

Potential market: Clinical laboratories, hospitals, diagnostic developers, biomedical research organisations, and companies focused on rare diseases and metabolic disorders.

Partners: ICVS, 2CA Braga, B.acis

5/6
TRL



Health Portugal
Agenda HfPT

Smart Hydrogel Wound Dressing

An advanced hydrogel wound dressing designed to support the treatment of chronic wounds, including early-stage diabetic foot ulcers, through the controlled release of anti-inflammatory and antimicrobial compounds.

Promotes wound healing while helping prevent infection and wound progression, improving patient care and quality of life.

Integrates embedded pH and temperature sensors that enable real-time monitoring of wound status, supporting early detection of complications and more informed clinical decisions.

Combines innovative sensing capabilities with naturally derived bioactive compounds to provide a smart and patient-centred approach to wound management.

Potential market: Patients with diabetic foot ulcers, wound care clinics, hospitals, healthcare providers, and medical device companies specialising in chronic wound management.

Industrial Uptaker: BH4U







Health Portugal
Agenda HfPT

Smart Textile for Atopic Dermatitis

An innovative smart textile designed to help alleviate the symptoms of atopic dermatitis through the controlled release of anti-inflammatory and antimicrobial bioactive compounds.

Combines advanced and naturally derived textile materials to provide comfort, skin compatibility, and sustained therapeutic action.

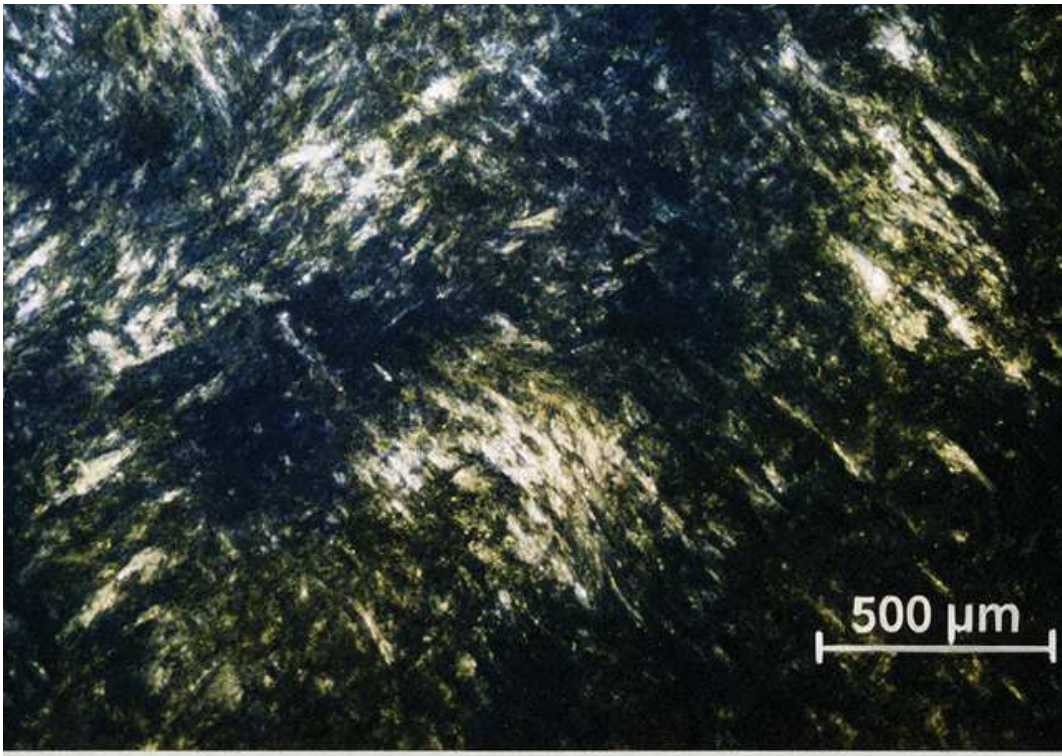
Supports skin protection and symptom management while helping reduce irritation and the risk of microbial contamination associated with compromised skin barriers.

Offers a functional and aesthetically appealing solution that integrates textile innovation with natural bioactive systems for improved dermatological care.

Potential market: Dermatologists, paediatricians, allergy and eczema foundations, textile manufacturers, healthcare providers, and patients with atopic dermatitis.

Industrial Uptaker: TINTEX Textiles, S.A.

5
TRL


500 µm







VIIA FOOD

Beyond Palm: Next-Generation Spreads

An innovative oleogel technology that enables the replacement of palm oil in chocolate and nut-based spreads, delivering improved nutritional profiles while maintaining the texture, stability, and sensory qualities consumers expect.

Structures liquid vegetable oils into spreadable formulations with lower saturated fat content.

Tunable phytosterol–lecithin–water system adaptable to different food applications.

Supports incorporation of bioactive ingredients, including phytosterols with potential cholesterol-lowering benefits.

Combines advanced rheology and tribology expertise with product prototyping and sensory validation.

Bridges research, product development, and industrial transfer through a research-to-market approach.

Potential markets: chocolate spreads, nut-based creams and confectionery fillings; food manufacturers and ingredient suppliers seeking palm oil alternatives; functional food and health-oriented product developers.

6
TRL





Fluorescent tagging technology for safer products

Transparent under visible light and fluorescent under UV, this innovative film incorporates carbon dots derived from marine biopolymers, enabling invisible tagging for product authentication.

Enhances product traceability and consumer safety by offering covert identification solutions, designed to address the global issue of food fraud.

Applicable across industries, this technology meets growing demands for secure, non-invasive anti-counterfeiting methods, poised for development and integration into commercial packaging and labelling systems.

Potential markets: food industries, pharmaceuticals, and high-end goods (e.g., haute couture)

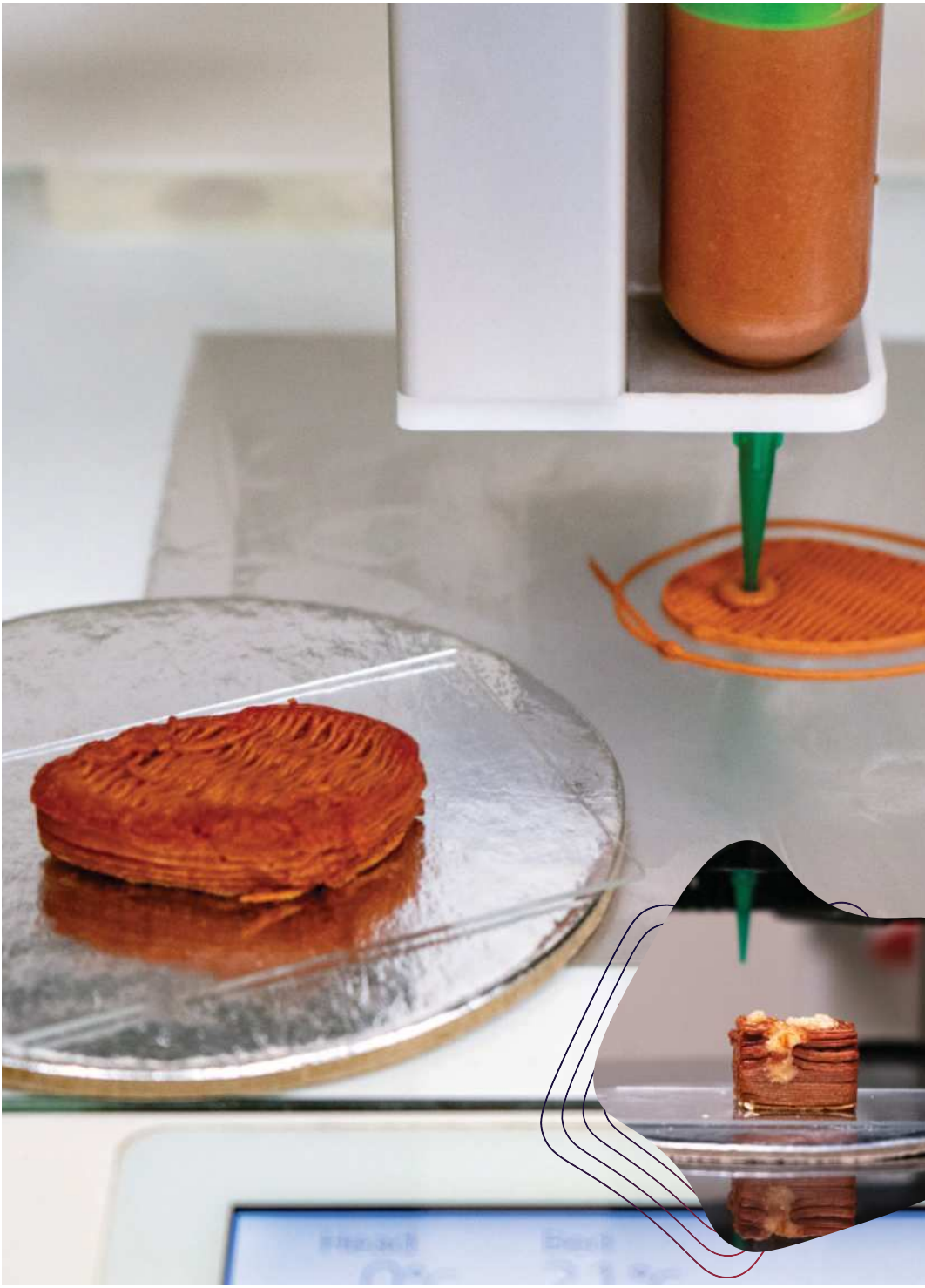
Partners: Silvex, MC Sonae

Industrial Uptaker: Silvex, MC Sonae

"Fluorescent markers can also drive a shift in the paradigm of food-to-food recyclable materials by enabling selective separation of food-contact packaging in sorting centers. This capability will allow the polyethylene industry to reintroduce plastics from food packaging back into new food-grade applications—much like what already happens with PET—without compromising food safety or consumer health.
At Silvex, we believe that a truly circular economy for food packaging is both possible and necessary. We are actively working toward this vision, investing significantly in R&D with the ambition of helping usher in a new era of plastic recycling."

Graça Brotas, Head of R&D, Silvex

5 TRL





Insectera

3D Printed meat analogue with customisable marbling

A novel 3D printed meat analogue using insect-derived ingredients, offering a sustainable and realistic alternative to conventional meat.

Provides a customisable, meat-like sensory experience with sustainable protein sources, replicating the appearance and texture of marbled meat.

Precision and realism are driven by enhanced printing techniques, including double-nozzle settings and G-code optimisation.

Supports innovation in food technology with scalable, eco-conscious solutions for plant- and insect-based protein products.

Potential market: Food tech companies, alternative protein startups, and environmentally conscious consumers.

Partners:
Thunder Foods, Sense Test, NOVA FCT

Industrial Uptaker:
Thunder Foods, Ingredient Odyssey

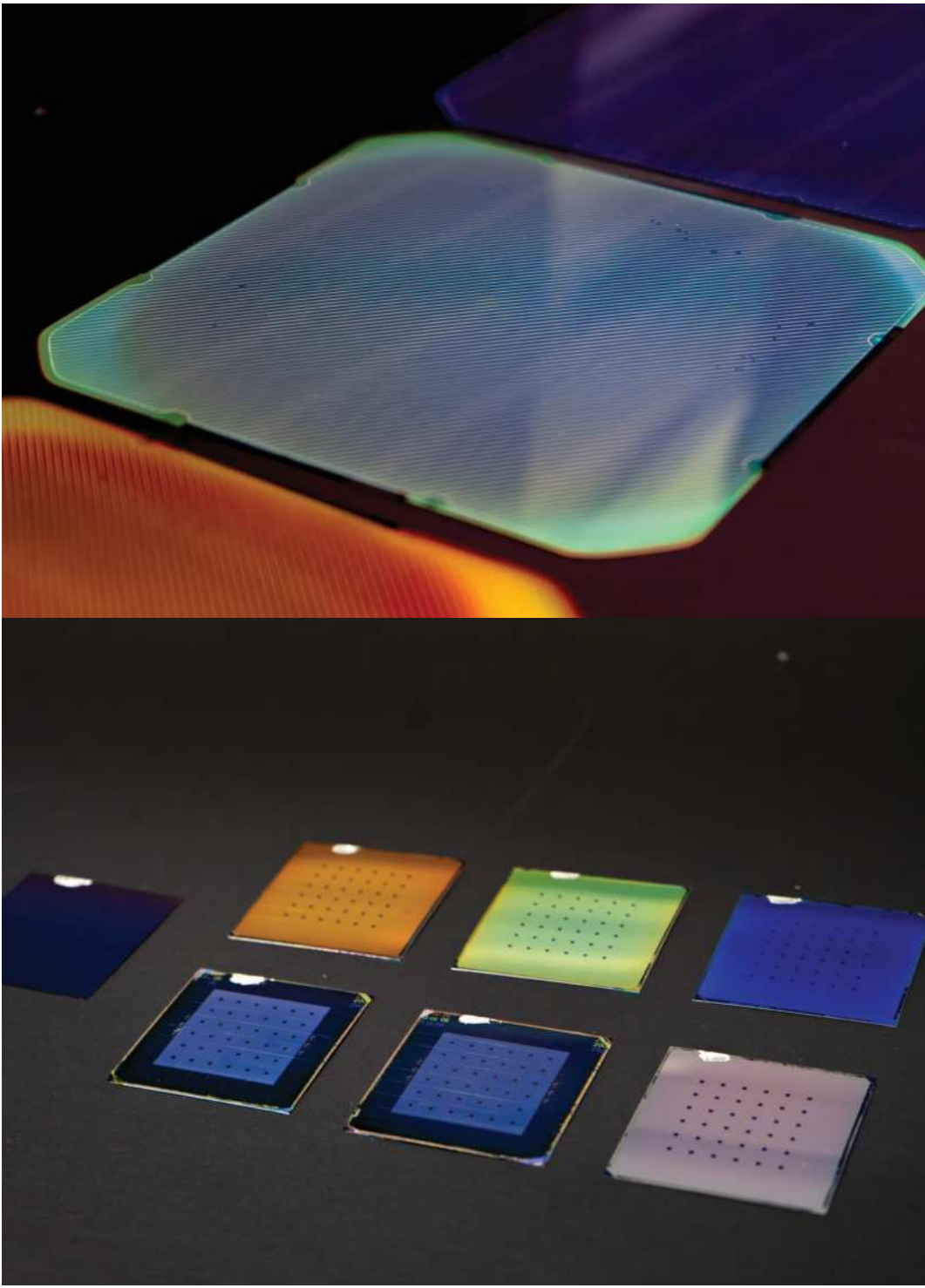
"At Thunder Foods, we work to ensure that insect protein becomes a viable and scalable solution for the food industry. This 3D-printed meat analogue shows how our ingredients can integrate into advanced technologies, opening new possibilities for sustainable protein applications. It highlights the potential of innovation to diversify food systems and create alternatives that reduce pressure on traditional resources."

Marisa Santos, R&D Director, Thunder Foods

5
TRL



ENERGY AND ENVIRONMENT





r2u modular systems

Flexible solar cell architectures for integrated photovoltaics

Two next-generation Cu(In,Ga)Se_2 solar cell architectures:

1. interface passivation/ rear light management ;
2. a breakthrough in aesthetic integration of solar technology into buildings, vehicles, and consumer products by developing coloured solar cells.

Currently achieving 12–13% efficiency at the cell level, this solution addresses interface losses that hinder performance in conventional CIGS cells.

Designed to meet the growing demand for lightweight, cost-effective, and high-efficiency photovoltaic technologies.

A new concept based on Red-Green-Blue (RGB) and microfabrication allows the colouring of Solar Cells without compromising efficiency. RGB and Pseudo-White Solar Cells are some of the examples produced in this project.

Potential market: Renewable energy companies, solar panel manufacturers, and R&D centres.

Partners: dstsolar, bysteel FS, dte, CeNTI

Industrial Uptaker: bysteel FS




CR2032
SPRINGS



New Generation Storage

Advanced battery electrode materials

Advanced electrode materials that significantly enhance energy density, charging speed and lifespan.

By supporting the global shift towards electrification and renewable integration, these materials meet the growing demand for high-performance batteries that target a sustainable battery value chain in Europe.

Potential market: Battery manufacturers, electric mobility companies, and energy storage developers.

Partners:
Bondalti, dstsolar, CeNTI

Industrial Uptaker:
Bondalti

5 4 TRL





Hydrophobic Protective Textile Sleeve for Painting Robots

An advanced protective textile sleeve designed for industrial painting robots, featuring a hydrophobic surface that enhances durability and resistance to paint exposure in demanding manufacturing environments.

Extends sleeve service life, reducing replacement frequency, operational downtime, and maintenance costs.

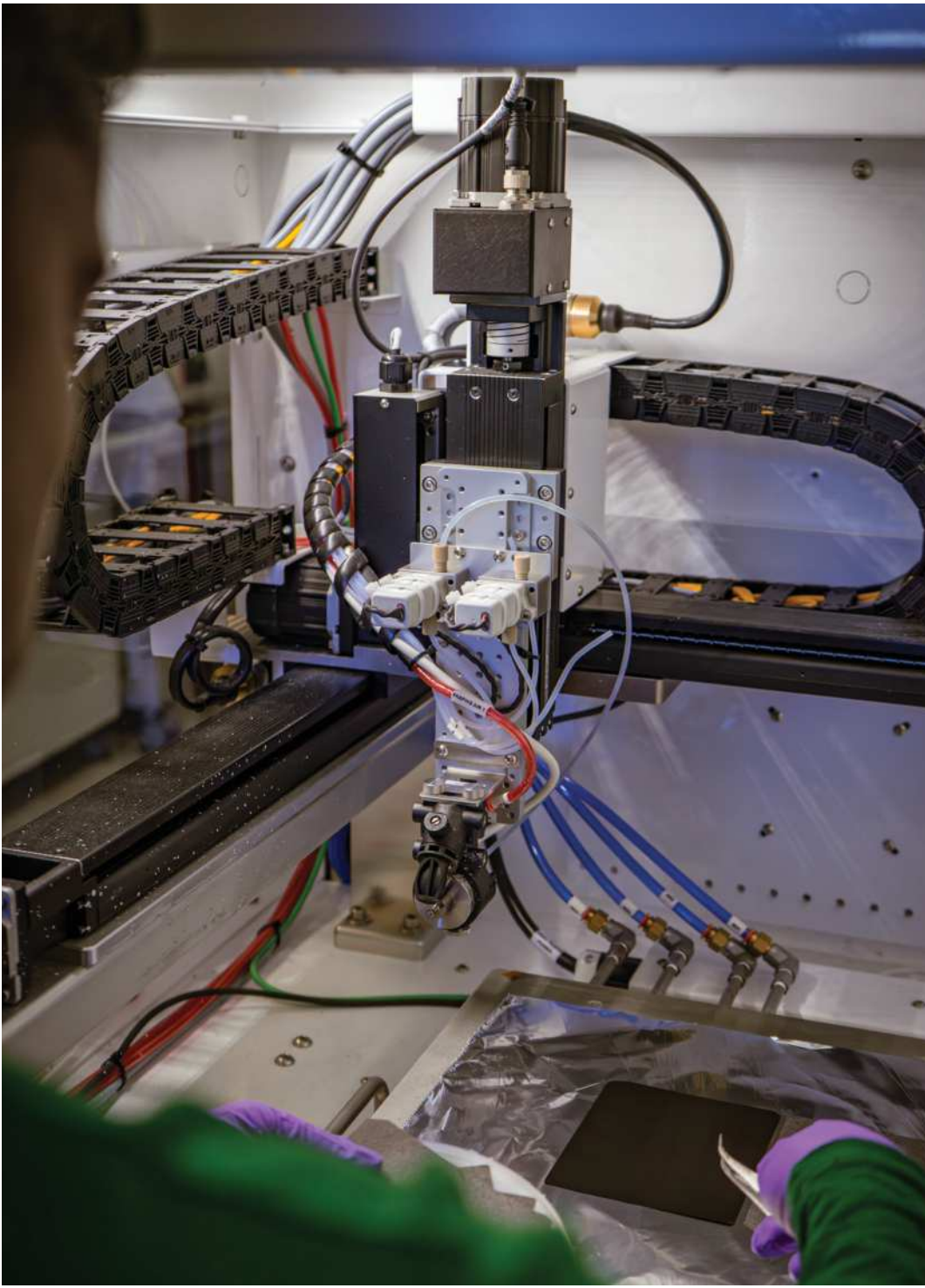
Minimises material waste and supports more sustainable manufacturing practices by promoting longer product lifecycles and resource efficiency.

Offers a novel solution with no directly comparable alternatives currently identified on the market, helping improve productivity and support circular economy objectives.

Potential market: Manufacturers and suppliers of protective textile sleeves, robotic painting system manufacturers, industrial coating companies, and automated manufacturing facilities across multiple sectors.

Partner: 4ITEC Lusitânia

2 5 TRL





PFAS-Free Catalyst Ink

A sustainable catalyst ink formulation developed for membrane electrode assemblies in electrolyser systems, delivering high-performance dispersion, adhesion, and electrochemical functionality without the use of PFAS-based binders.

Provides a cost-effective alternative to Nafion®, reducing material costs while maintaining the performance required for efficient hydrogen production.

Uses naturally derived materials to support more sustainable manufacturing and improve supply chain resilience.

Enables scalable production of catalyst-coated electrodes, helping accelerate the deployment of next-generation electrolyser technologies.

Potential markets: Electrolyser manufacturers, hydrogen technology developers, membrane electrode assembly (MEA) producers, catalyst suppliers, and companies developing electrochemical energy conversion systems.



Wind-Driven CO_2 Capture System for Buildings

An innovative building-integrated carbon capture solution that uses metal-organic framework (MOF) filters and wind-driven airflow to remove CO_2 directly from ambient air with low energy consumption.

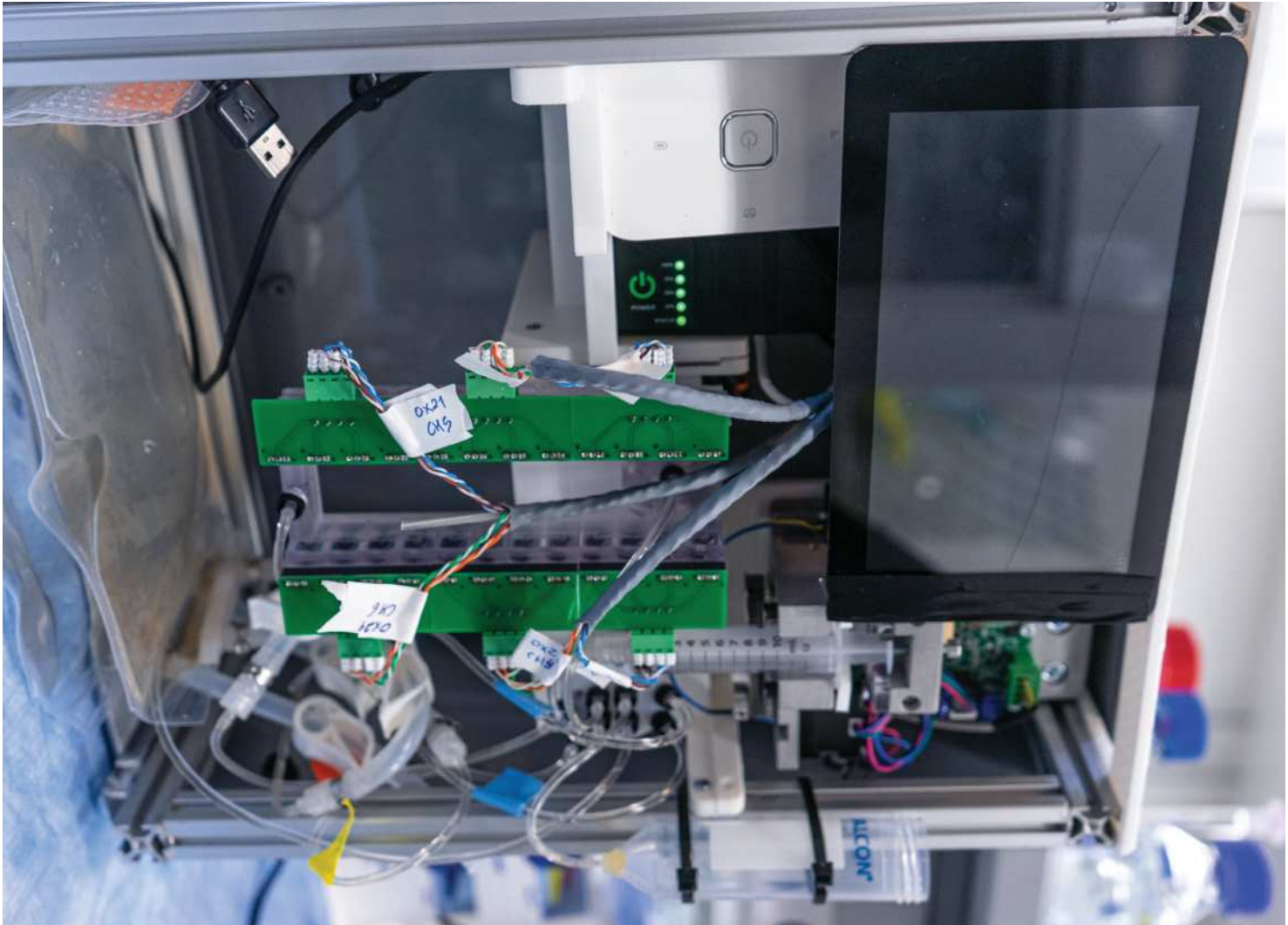
Designed for seamless integration into existing building infrastructure, enabling decentralised carbon capture in urban environments without major modifications.

Combines highly selective adsorption materials with an amine-free approach, reducing energy requirements and avoiding the chemical handling challenges associated with conventional carbon capture technologies.

Provides a compact and modular pathway for lowering the carbon footprint of buildings while supporting more sustainable and climate-resilient cities.

Potential market: Property developers, building owners, facility managers, HVAC system manufacturers, and smart building solution providers.







New Generation Storage

iBatSens - Autonomous Monitoring System for Battery Recycling

An autonomous sensing platform for the real-time monitoring of lithium and sodium concentrations in battery recycling processes, enabling tighter process control and improved recovery of valuable materials.

Provides continuous in-situ measurements directly within recycling streams, reducing reliance on slow and labour-intensive laboratory analyses.

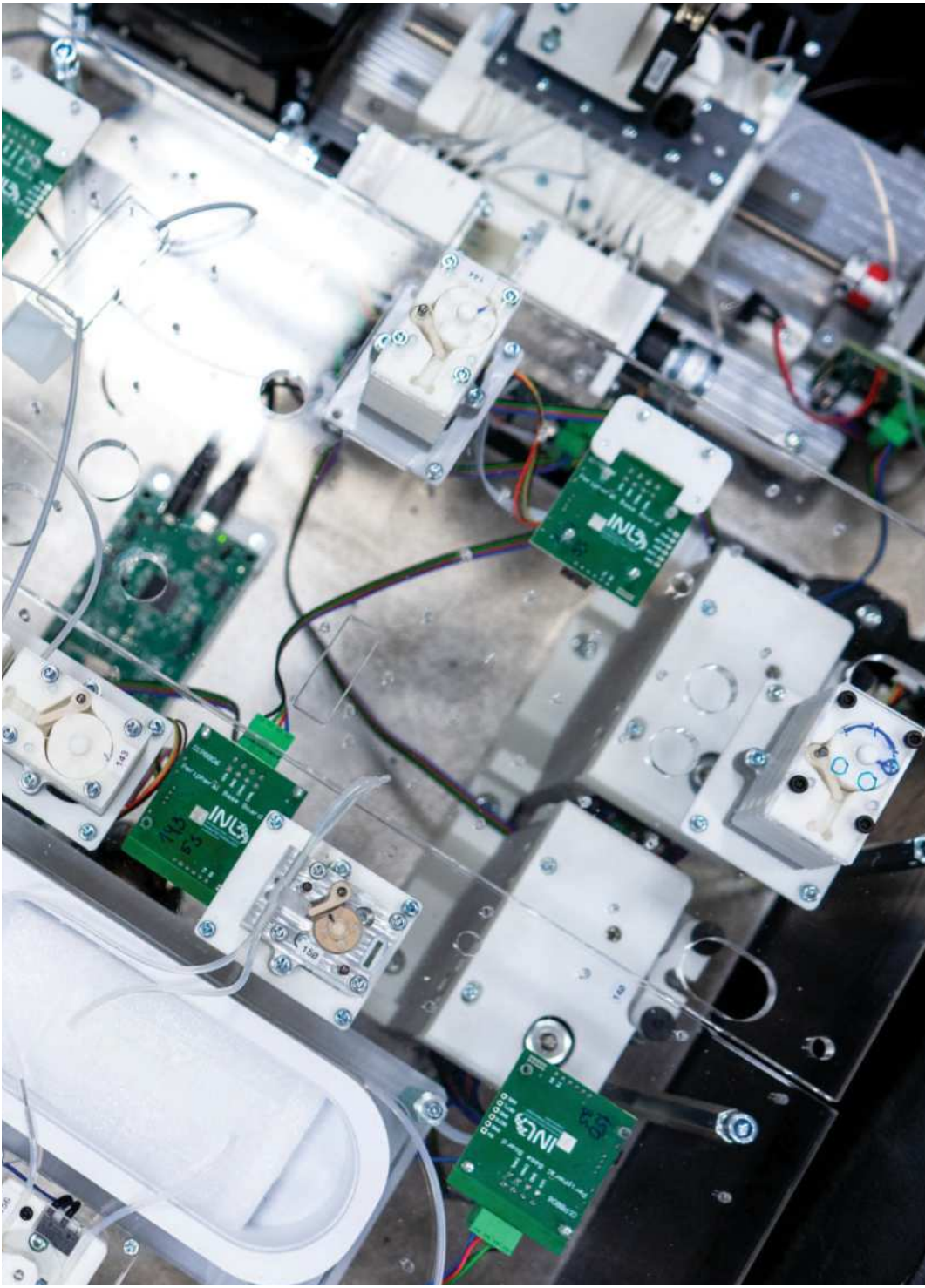
Combines automated sampling, data analysis and processing with integrated cleaning and recalibration, and seamless digital connectivity to support data-driven process optimisation.

Features a scalable, modular architecture that is easy to integrate into existing recycling infrastructure, delivering lower operating costs and a reduced environmental footprint.

Potential market: Battery recycling companies, process technology providers, OEMs, instrumentation companies, and organisations developing advanced recycling and resource recovery solutions.

Partners: dst, Universidade do Minho, CeNTI

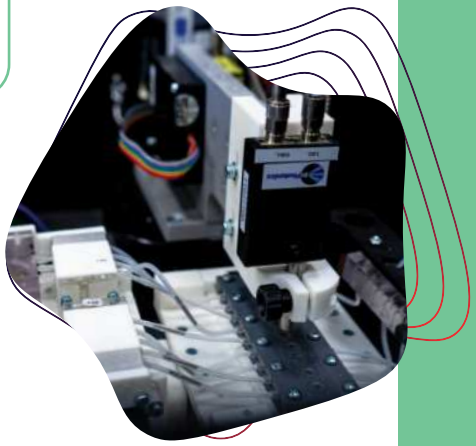
2 2 5/6 TRL





In-situ detection of HAB toxins in marine waters

An *in-situ* real-time monitoring solution for marine environments to safeguard aquaculture and public health, enabling a timely response to contamination events of harmful algae bloom (HAB).



Protects aquaculture operations from economic losses and ensures safe seafood consumption, reducing risks to human health.

Incorporates novel composite materials, enhancing durability and sensitivity.

Strategic collaborations with Oceano Fresco, MARE, and the University of Lisbon have further strengthened partnerships within the blue bioeconomy ecosystem.

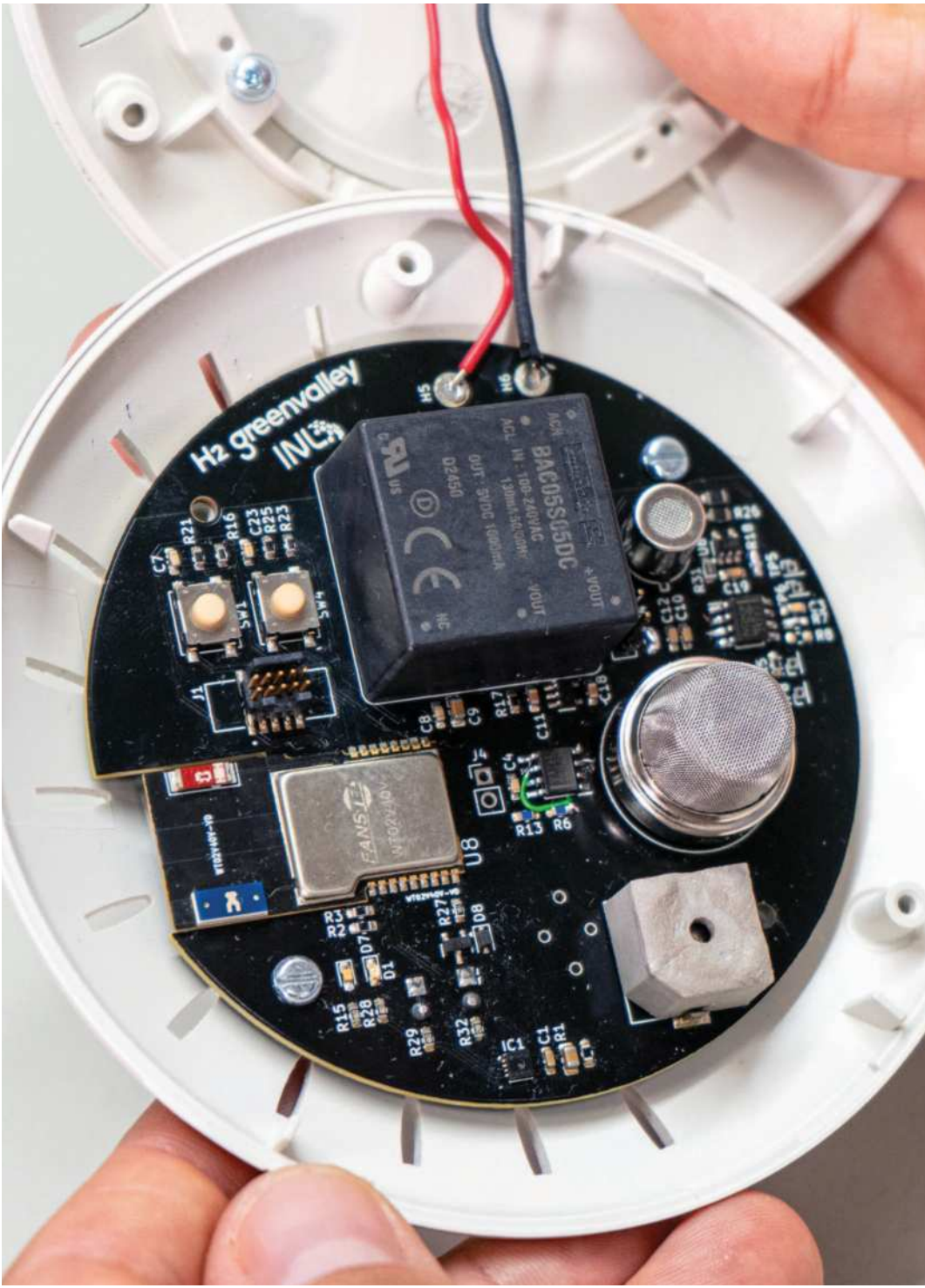
Potential market: Aquaculture companies, environmental monitoring agencies, and marine research institutions

Partners:
Oceano Fresco, IPMA, NOVA FCT

"The project developed by INL will enable Oceano Fresco to predict biotoxin contamination in bivalves, allowing for more efficient management of harvesting operations and ensuring a high-quality, food-safe product for consumers."

Andreia Cruz, R&D Senior Manager, Oceano Fresco

3 1 4 TRL


H2 greenvalley
INL
BAC05S05DC
SW1
SW2
J1
J4
U8
IC1
R13
R6



H2 greenvalley

Hydrogen leak sensor

Provides real-time detection of hydrogen leaks in household appliances for reliable safety systems.

Capable of detecting very small hydrogen leaks, down to 9 ppm, ensuring early warning and enhanced safety in domestic environments.

Incorporates a defined microfabrication process, enabling scalable production and integration into various appliance types.

As hydrogen energy adoption grows, this sensor provides a critical safety layer, encouraging consumer confidence and regulatory compliance.

Potential market:
Appliance manufacturers, smart home integrators, and hydrogen infrastructure companies.

Partners:
REN Gás, REN Gasodutos, Bosch Termotecnologia, Dianagás (Floene), HyLAB, Instituto Superior Técnico

Industrial Uptaker:
Gas infrastructures and facilities

"Contributions of R&D institutes, as INL, with the capacity for developing innovative technologies at competitive costs, as this H_2 sensor, are critical for creating the conditions for wide spreading consumer adoption and confidence on hydrogen."

Pedro Carola, Head of Renewable Gas Planning, REN

"The work developed by research institutes, such as INL, allows the increase of know-how on new technologies for the industry looking for decarbonization and boosts the confidence on the usage of new green energy sources, such as hydrogen."

Jorge Cardoso, Product Owner FP Gas Water Heaters, Bosch Termotecnologia

5
TRL





SMARTgNOSTICS

InviDetect™- SERS sensor

An automated device for rapid detection of antibiotic residues using surface-enhanced Raman spectroscopy (SERS).

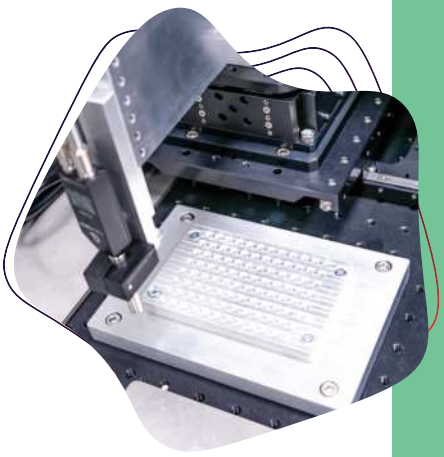
Transportable and automated device ideal for routine testing with minimum sample preparation in agricultural, veterinary, food safety, or environmental monitoring contexts.

Detects trace levels of antibiotic residues with exceptional sensitivity and specificity.

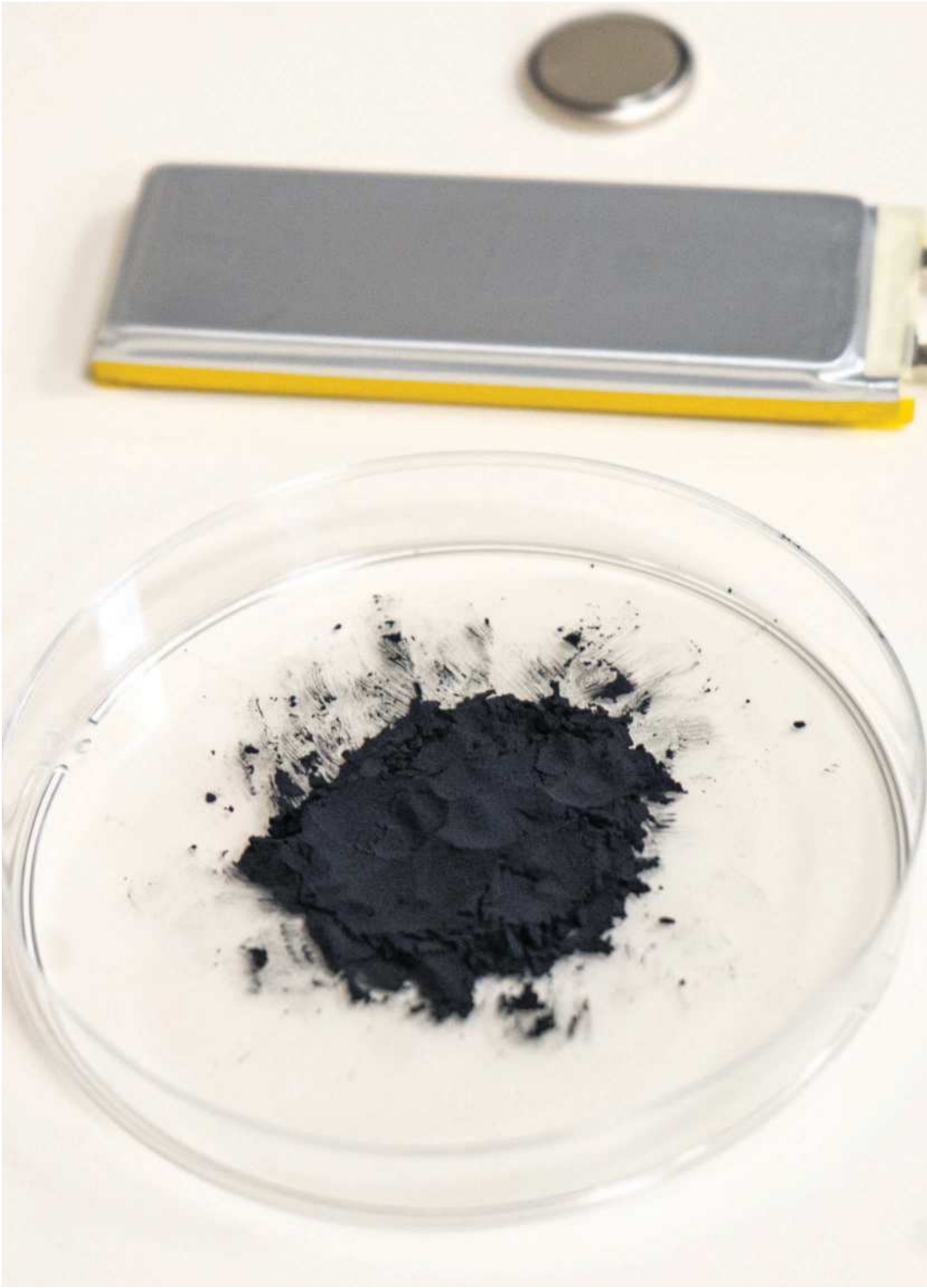
Potential market: Food safety regulators, veterinary testing labs, and pharmaceutical quality control teams.

Partners:
ALS, INEGI, SPMAQ, Fresenius, Kabi, INESC TEC, ISPUP, INSA, INIAV

Industrial Uptaker:
ALS



1 5/6 TRL



New Generation Storage

Support tools for battery recycling processes

Advancing battery recycling through the development of robust support tools, including a validated black mass characterisation protocol.

Battery degradation modelling and new measurement capabilities that pave the way for reliable battery health prediction and standardised recycling practices.

Facilitates regulatory compliance and environmental responsibility in battery recycling operations.

Empowers industry partners with actionable data for process optimisation and material recovery.

Enhances predictive capabilities for battery health, supporting circular economy models.

Potential market: Recycling companies, battery manufacturers, and sustainability regulators.

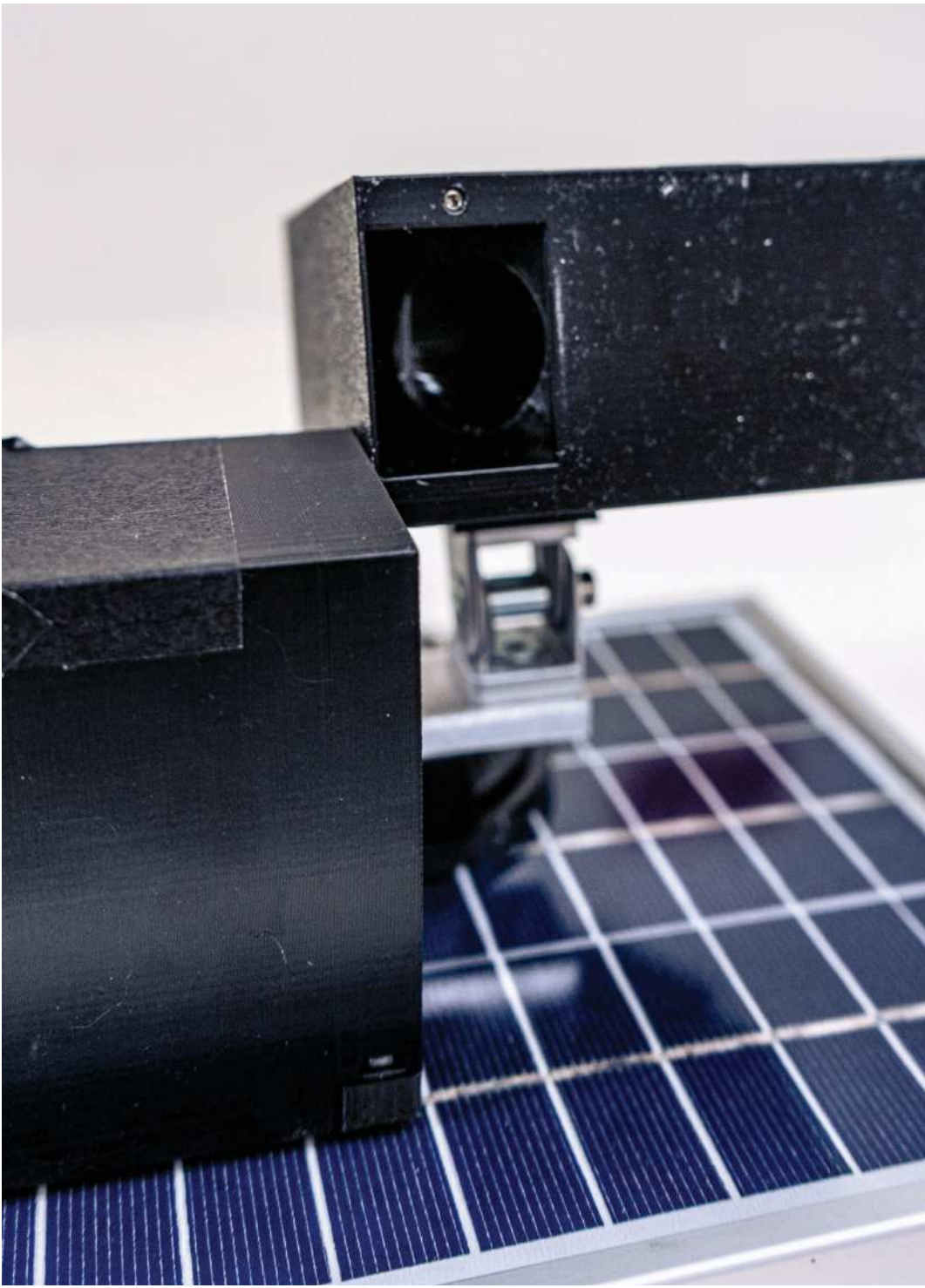
Partners:
b.again, dstsolar, LNEG, Instituto Superior Técnico, CeNTI

Industrial Uptaker:
b.again

"The work conducted by INL on degradation processes and the multi-scale characterization of end-of-life batteries provides a fundamental scientific basis for the development and optimization of advanced battery recycling processes. By establishing robust, validated analytical methodologies, this research enhances the accuracy of material recovery assessments and supports the design of efficient, reproducible separation and valorization strategies. These contributions are expected to facilitate higher recyclability rates of critical raw materials and to strengthen the technical resilience and sustainability of the battery value chain."

João Gomes, CEO, b.again







Soiling sensors for portable PV monitoring systems

Portable, custom-built sensor enabling real-time quantification of dust and particulate deposition on photovoltaic (PV) models.

Ideal for on-site diagnostics and field campaigns, and design systems improvement.

Measures optical transmission loss and surface contamination to assess soiling impact on module efficiency.

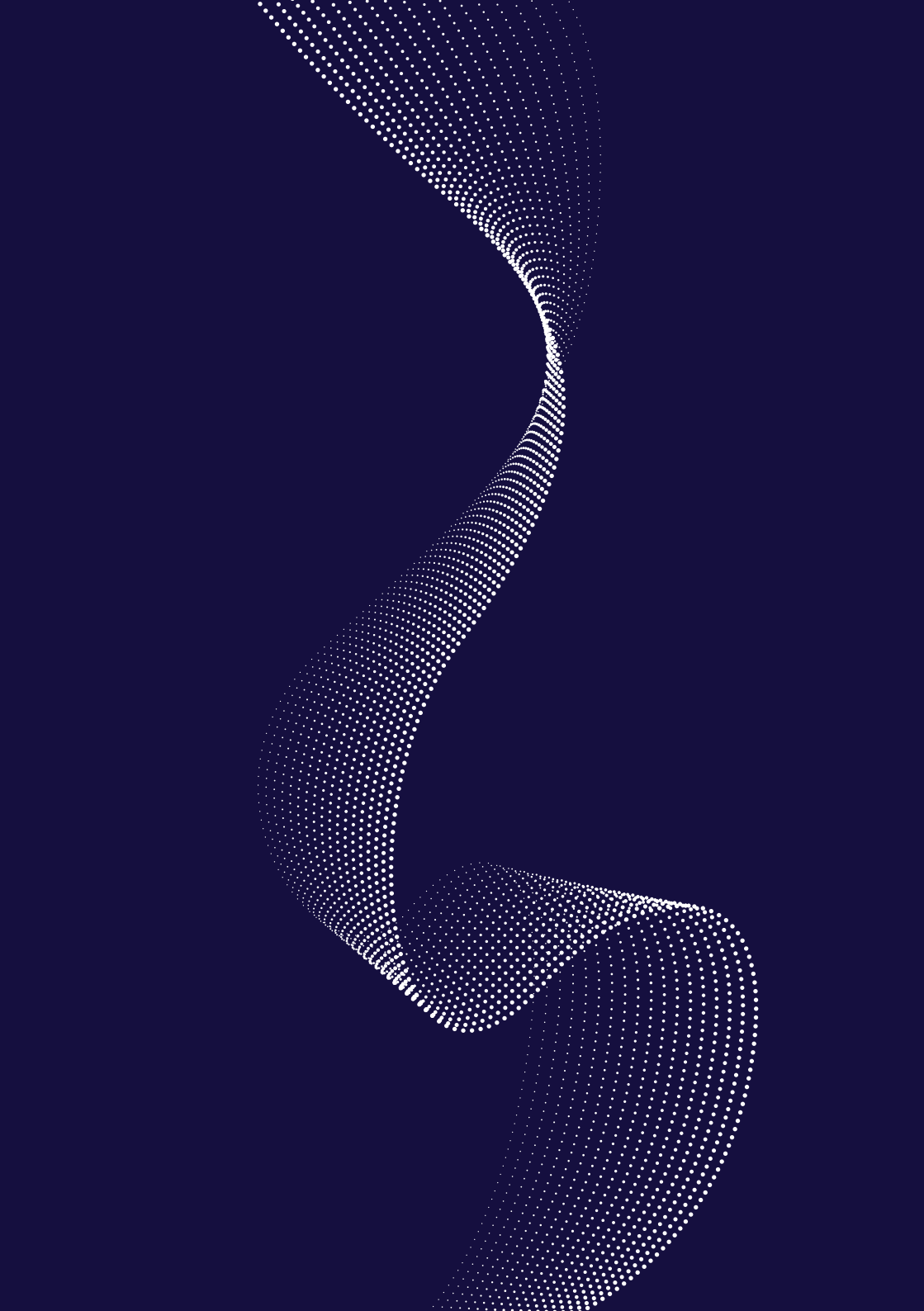
Facilitates correlation of environmental conditions with performance degradation, supporting predictive maintenance and operational optimisation.

Provides valuable input for improving PV system design, siting, and durability assessment, supporting the development of smart monitoring solutions for renewable energy infrastructures.

Potential market:
Large-scale PV Plants, Agri-PV

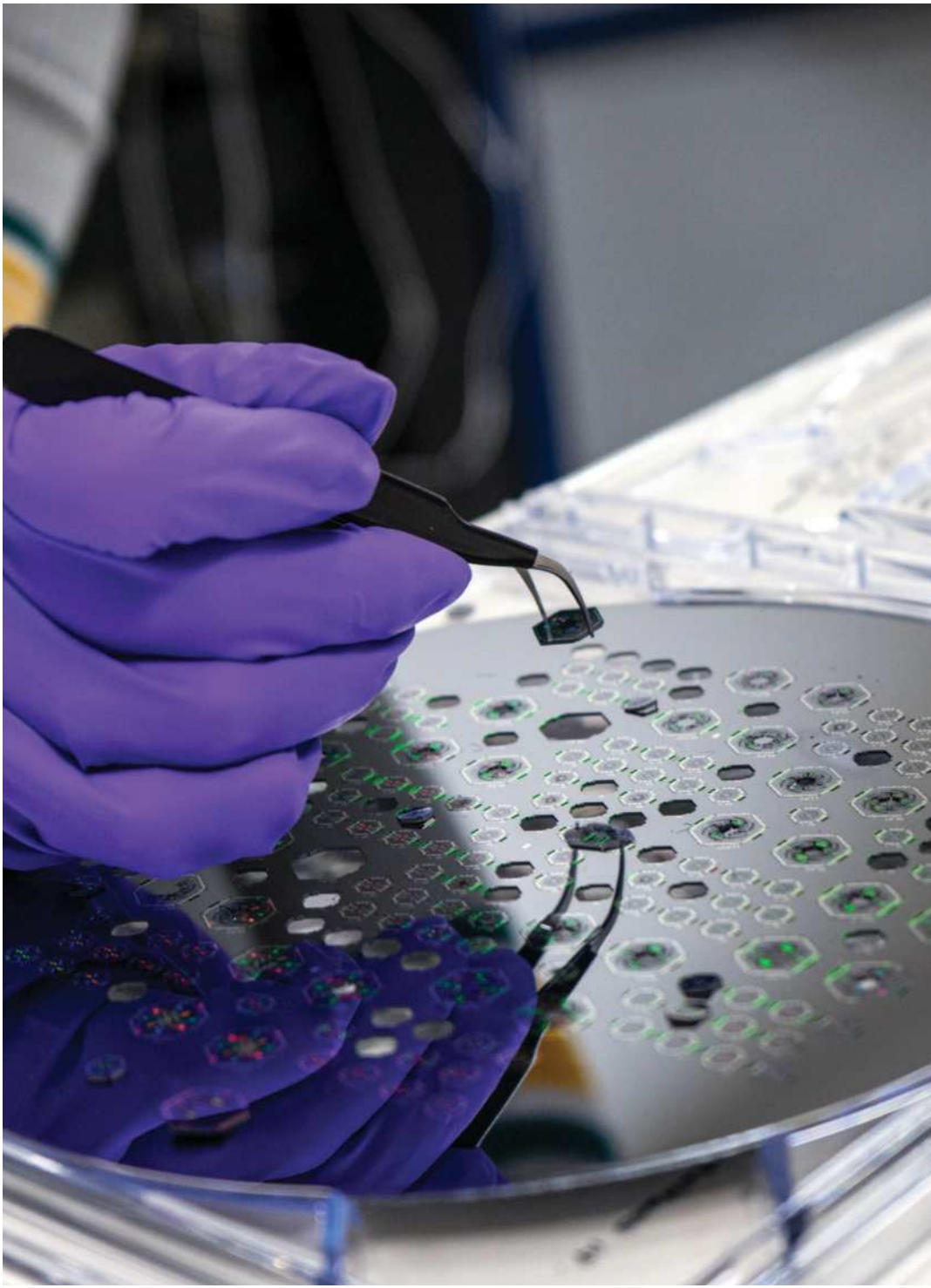
Industrial Uptaker:
INL (Ray Sense Technologies, Lda)

4 TRL



ICT

Information and Communication Technologies



BeNeutral

Near zero-power devices

A novel near zero-power device which includes a MEMS inertial switch and an acceleration logger.

With event-based data collection, the sensor acts as a trigger for power management units with multiple threshold settings, which consumes no energy, making it ideal for battery-powered vehicles like bicycles, scooters, and other connected mobility devices.

When coupled to a mechanical memory, it records maximum acceleration events, unlike single-use sensors. This logger can be reset and reused, offering long-term value and adaptability across different mobility platforms.

Addresses the growing need for low-power sensors in smart cities and mobility networks, helping reduce environmental impacts and operational costs.

Potential market: Electric bike manufacturers, IoT device developers, and mobility-as-a-service providers.

Partners:
CEiiA, NOS Comunicações

Industrial Uptaker:
CEiiA



1 5 TRL



BeNeutral

Smart sensing for automotive applications

Non-invasive automotive sensing platforms that combine TMR magnetic sensors with AI-driven signal processing

Combining high-sensitivity TMR magnetic sensors with AI-driven signal processing and machine learning, the platform extracts valuable vehicle information from weak magnetic field signatures without physical contact or access to onboard systems.

Externally mounted sensors enable non-invasive monitoring of vehicle parameters, such as electric motor rotational speed (RPM), while roadside sensing platforms leverage AI-driven magnetic signature analysis to identify vehicle make and model without requiring access to onboard systems, vehicle modifications, or changes to existing infrastructure.

By combining non-invasive sensing with artificial intelligence, the platform addresses the growing demand for data-driven mobility solutions while reducing installation complexity, maintenance requirements, and deployment costs.

Potential markets: Intelligent transportation systems, smart mobility, traffic management, smart infrustructure, car manufacturers, EV chargers manufacturers.

Partner: CEiiA





Presence Detection and Face Recognition System

An intelligent presence detection and face recognition solution designed to enhance energy efficiency, home automation, and occupant comfort in residential environments.

Optimises the use of lighting, heating, and other connected systems by accurately detecting occupancy and recognising authorised users in real time.

Enables personalised automation scenarios, improving convenience while supporting reduced energy consumption.

Serves as a customisable building block within a broader monitoring platform, allowing tailored integration and expansion according to household needs.

Potential market: Households, smart home solution providers, residential property developers, and home automation integrators.

Industrial Uptaker: Bandora

7 TRL





r2u modular systems

Smart Parking Occupancy Sensor

A wireless, battery-powered sensor that detects vehicle presence in individual parking spaces, enabling real-time occupancy monitoring for smarter parking management.

Combines an always-on low-power magnetometer with on-demand radar confirmation to reach a detection accuracy of about 99.9%, with up to 10 years of battery life.

Designed for outdoor surface installation, with a rugged IP67 enclosure that withstands loads above 5 tonnes, and LoRa communication for wide-area coverage without local wiring.

Feeds occupancy data into a cloud platform for live availability, usage analytics and guidance services, at a target unit cost below €100 for large-scale deployment.

Serves as a building block within a broader smart building and smart city monitoring platform, allowing integration with existing infrastructure and expansion as needed.

Potential market: Municipalities and smart city operators, parking operators, shopping centres, corporate and university campuses, hospitals, residential and commercial property developers, and smart mobility solution integrators.

7 TRL





r2u modular systems

Edgebox

A daisy-chain sensor ecosystem.

A plug-and-play sensor bus with power over Ethernet (PoE) and gateway integration allows seamless expansion and customisation for diverse environments.

Capable of combining multiple sensing capabilities - air quality, light, UV, temperature, humidity, volatile organic compounds (VOCs), particulate matter, sound levels, and presence detection – into a single, interoperable system.

With remote control and data analytics capabilities, it replaces disconnected sensor systems with a unified ecosystem that can be integrated with building management systems, enabling real-time environmental monitoring, occupancy tracking, and energy optimisation.

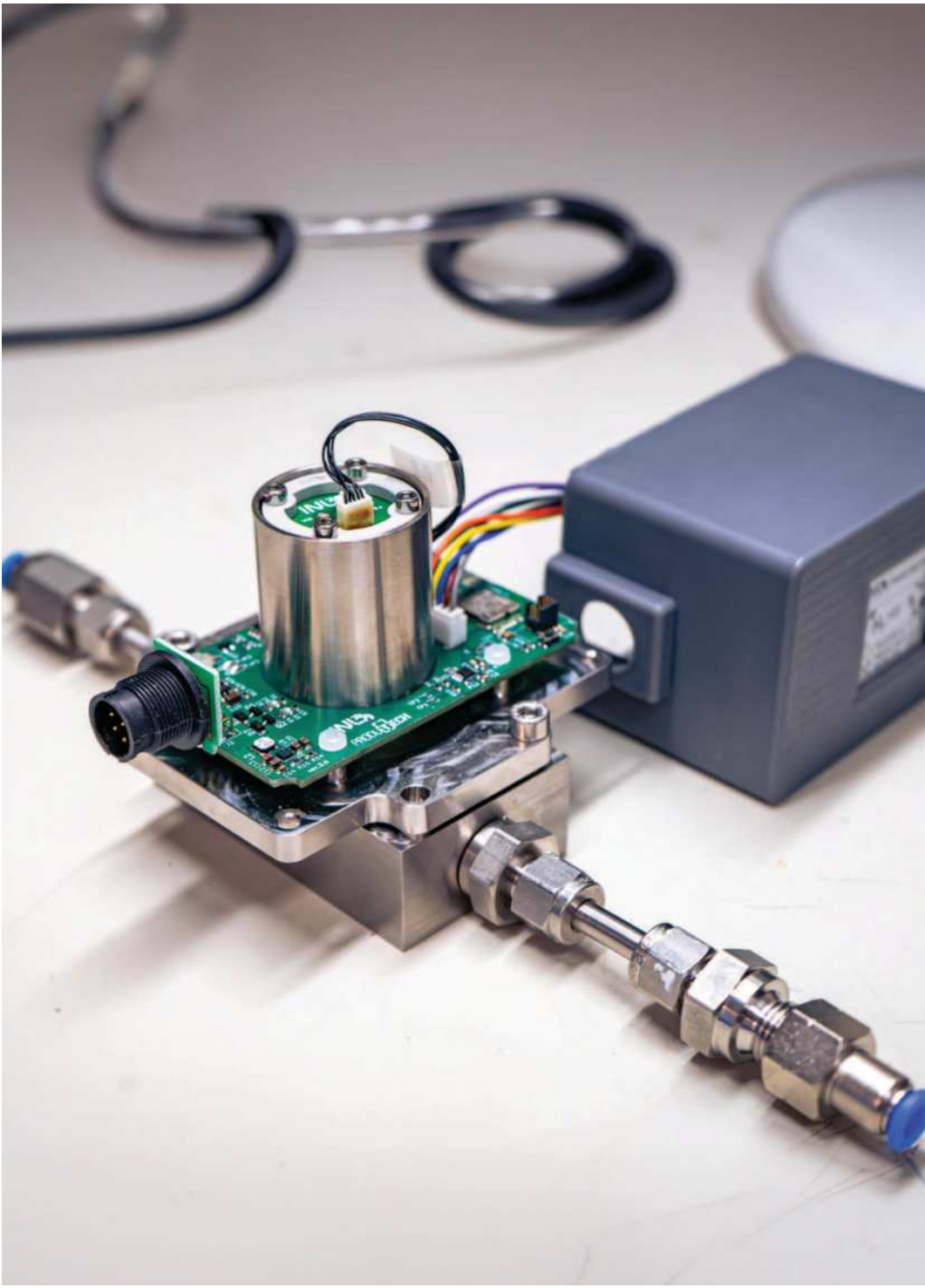
Potential market: Smart city planners, construction companies, and IoT solution providers.

Partners:
Innovation Point, bysteel FS, DTx CoLAB

Industrial Uptaker:
Innovation Point



6 TRL





PRODUTECH R3
recuperação-resiliência-reindustrialização

Natural Gas+H_2 Blend Gas Sensor System

A scalable, ultra-compact, and cost-effective sensing system for real-time measurement of hydrogen concentrations (5% to 100% H_2) in natural gas pipelines, supporting the transition towards cleaner energy networks. Based on standard semiconductor thin-film technology, it enables low-maintenance mass production.

Enables continuous and autonomous monitoring of hydrogen-natural gas blends within a sealed enclosure, providing the data required for safe grid operation via seamless Modbus RTU integration with industrial monitoring platforms and comes with a dedicated software tool for real-time graphical visualisation of H_2 levels and sensor testing in development environments.

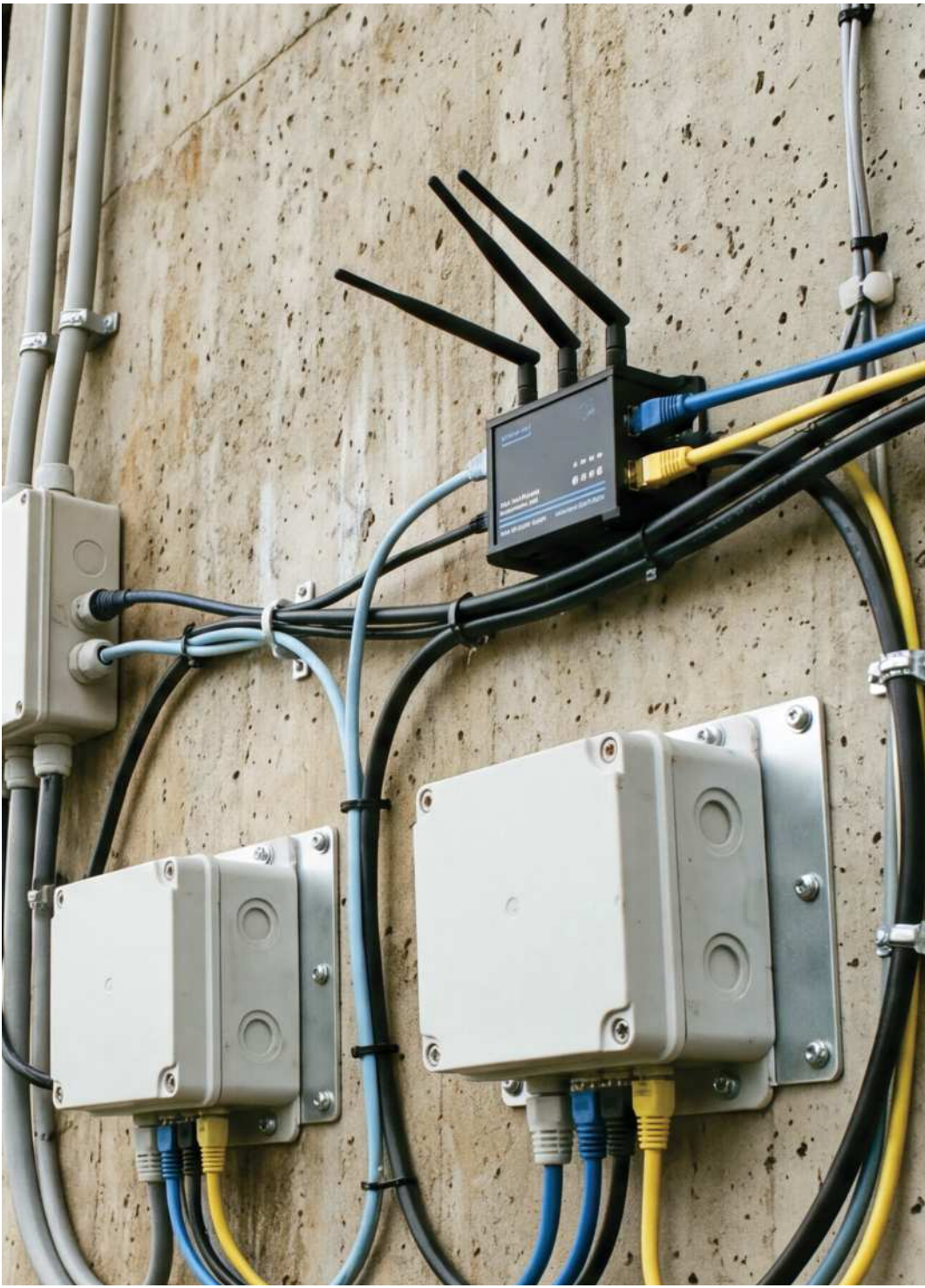
Supports decarbonisation strategies by helping utilities and industrial operators manage hydrogen integration into existing infrastructure.

Currently at TRL 5, the system has been tested and validated with calibrated gas standards (CATIM).

Potential market: Industrial gas consumers, gas network operators, energy utilities, and companies involved in hydrogen production, distribution, and integration.

Partners: COLEP Packaging, OnControl

1 5 TRL





r2u modular systems

IoT-Enabled Structural Health Monitoring

An advanced sensing platform for real-time seismic and structural vibration monitoring, designed to support the safety, resilience, and maintenance of critical infrastructure.

Combines high-fidelity sensing with IoT connectivity to deliver continuous monitoring and rapid detection of structural changes in demanding environments.

Integrates custom MEMS and ASIC technologies with scalable communication architecture, enabling reliable data acquisition, real-time alerts, and remote infrastructure assessment.

Supports fast deployment across large infrastructure assets through integrated power and data transmission, helping asset owners improve maintenance planning and reduce operational risks.

Potential market: Infrastructure operators, civil engineering firms, smart city developers, transportation authorities, construction companies, industrial facilities, and organisations responsible for bridges, tunnels, dams, buildings, and heritage structures.

TPRied1
TPRied1
INL

SMARTgNOSTICS

Graphene Biosensing Platform for Real-Time Healthcare

An advanced graphene-based biosensing platform combining GFET sensor arrays with custom CMOS electronics for real-time healthcare monitoring and analysis.

An advanced graphene-based biosensing platform combining GFET sensor arrays with custom CMOS electronics for real-time healthcare monitoring and analysis.

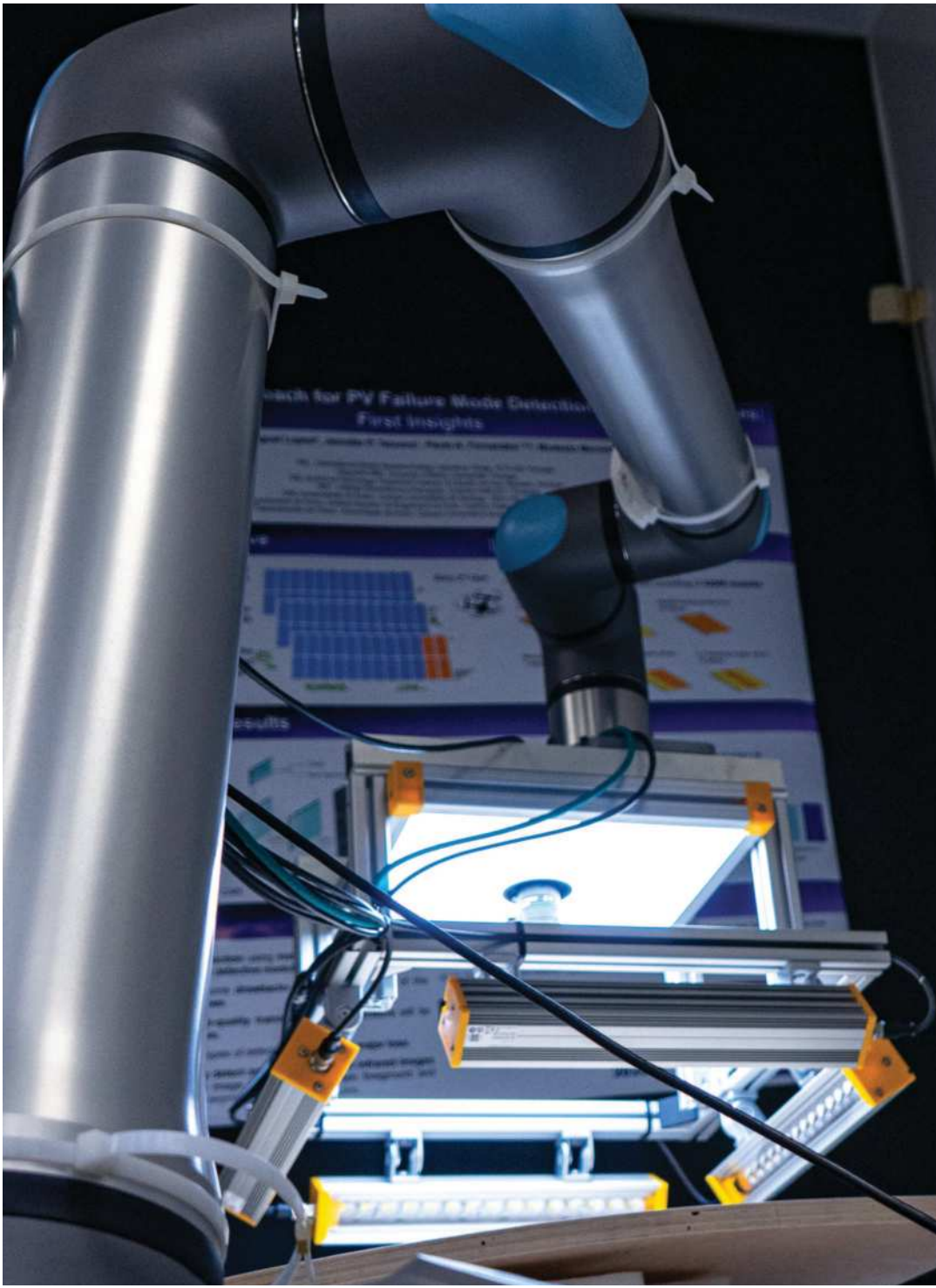
Enables detection of biological signals and molecules, supporting applications such as brain spatial mapping, neurotransmitter detection, and DNA sequencing.

Delivers fast, low-power, and scalable sensor readout, enabling real-time monitoring across dense sensor arrays with high spatiotemporal resolution.

Supports flexible integration into next-generation diagnostic and biomedical research systems, accelerating the development of precision healthcare technologies.

Potential market: Medical device manufacturers, healthcare technology companies, biomedical research centres, neuroscience laboratories, diagnostics developers, and genomics organisations.

4 TRL


First insights



r2u modular systems

AI-driven robotic panel inspection system

An intelligent robotic inspection system that integrates 3D and 2D vision performing fast, precise, and repeatable quality control on panels with variable geometries.

Based on the 3D data, the robot positions a high-resolution 2D camera equipped with an adaptive dome and grazing illumination to ensure optimal lighting for all surface conditions, from glossy to textured.

A deep learning model performs real-time defect detection and classification, identifying scratches and surface irregularities with high confidence.

By combining robotic automation, computer vision, and artificial intelligence, the system provides comprehensive inspection coverage, reduces human error, and significantly enhances throughput and reliability in quality assurance.

Potential market: Manufacturing industries, construction firms, and robotics integrators.

Partners: bysteel FS, PIEP

Industrial Uptaker: bysteel FS

6 TRL



r2u modular systems

SmartTap

SmartTap is an IoT-enabled water tap control system.

Enables real-time sensing, control, and actuation of water taps, reducing unnecessary water usage.

Designed with energy-efficient components, allowing long-term operation with minimal power consumption.

Includes wireless interfaces and a gateway for the dashboard and back-office interfaces, enabling remote monitoring, data logging, and seamless integration with building management systems.

Supports retrofit installation, enabling integration with existing faucet infrastructure.

Potential market: Sanitaryware manufacturers, green building developers, and hospitality sector.

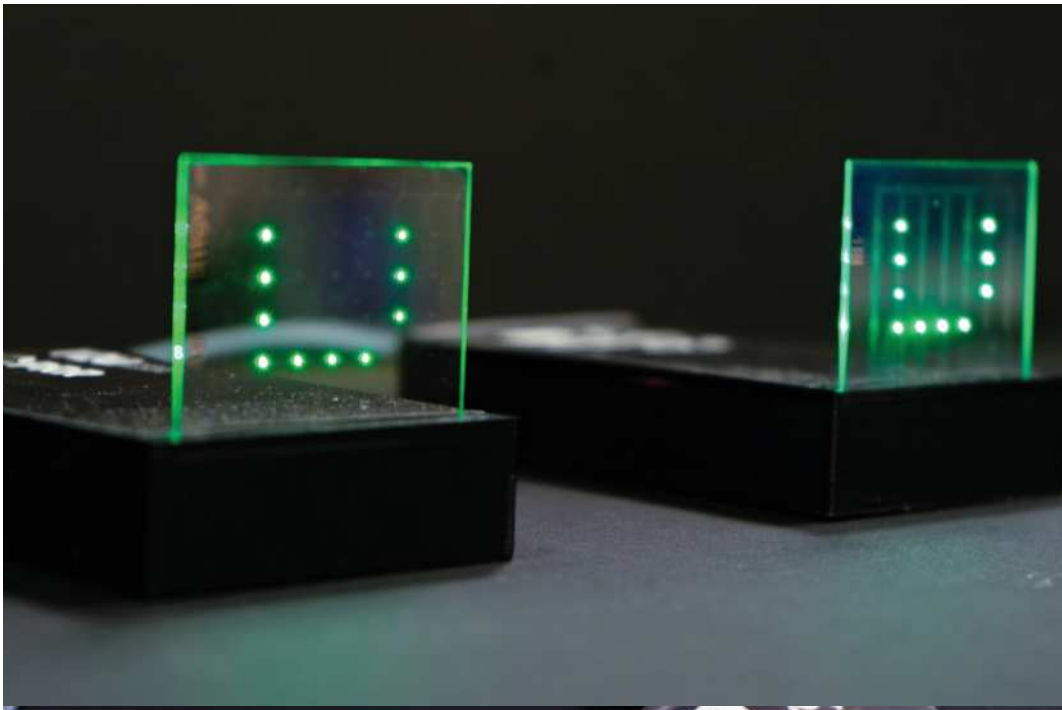
Partners: MCT, ARCH Valadares, bysteel FS

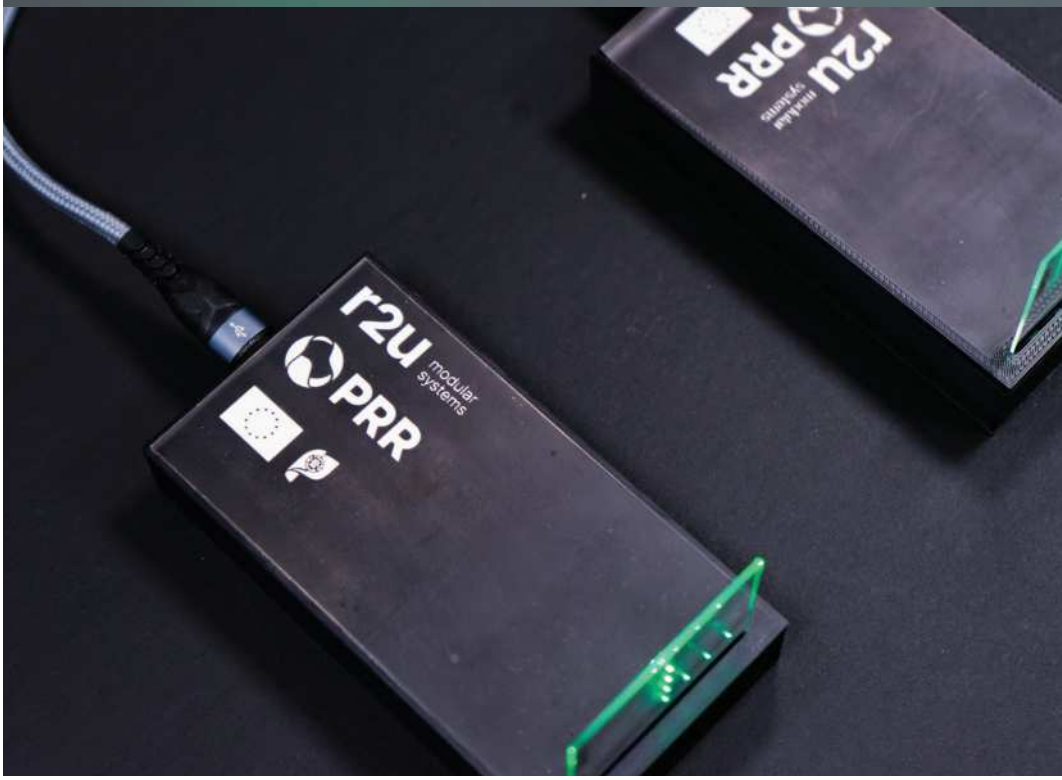
Industrial Uptaker: MCT



Trade secret licensing

6 TRL




r2u
modular
systems
PRR



r2u modular systems

Transparent displays

A next-generation light tile demonstrating heterogenous integration of micro-LEDs into a transparent substrate.

Developments are on-going to process these solutions directly on flexible polymers that can be applied to several surfaces.

It demonstrates the capability to integrate complex devices onto the same substrate.

Potential market: consumer electronics, transparent applications

Partners:
bysteel FS, DISPLAX, CeNTI, NOVA FCT

Industrial Uptaker:
DISPLAX, bysteel FS

"INL plays a central role in the R2U Technologies project by, among several other contributions, advancing the integration of micro-LEDs into next-generation transparent substrates. Building on its expertise in nano-fabrication and materials engineering, INL is clearly contributing to the development of industrial processes that enable these light-emitting solutions, broadening their applicability across diverse use cases."

Pedro Marques, Chief Technical Officer, DISPLAX

5
TRL


r2u modular systems
PRR
Financiado pela União Europeia NextGenerationEU
REPUBLICA PORTUGUESA
Glass
Glass + UV Filter

r2u modular systems

Multilayer UV and Near -IR Optical Filters

Advanced multilayer optical coatings designed to selectively block ultraviolet (UV) and near-infrared (NIR) radiation while maintaining high visible light transmission.

Provides a cost-effective alternative to conventional optical filters by using scalable sol-gel processing and avoiding expensive coating materials.

Combines optimised optical performance, structural stability, and reproducibility through simulation-driven design and experimental validation.

Delivers performance comparable to commercial optical filters, supporting integration into a wide range of end-use systems.

Potential market: Smart windows, architectural glazing, automotive glass, optical devices, imaging systems, and energy-efficient building solutions.

Partners: dst, LNEG, CeNTI

Industrial Uptaker: dst



Solar Cloth
BOOST



PV MPPT Charge Controller System

An intelligent power management system that efficiently harvests solar energy to charge a vehicle's 12 V auxiliary battery, supporting more sustainable and energy-efficient automotive operation.

Maximises solar energy capture through continuous real-time Maximum Power Point Tracking (MPPT), ensuring optimal performance under changing weather and shading conditions.

Enhances battery lifespan and reliability with a smart three-stage charging strategy specifically designed for automotive lead-acid batteries.

Combines a flexible high-power architecture with integrated Power Line Communication (PLC), enabling advanced monitoring and telemetry while minimising system complexity and hardware costs.

Potential market: Automotive manufacturers, electric vehicle developers, fleet operators, renewable energy integration companies, and smart grid utilities.

Industrial Uptakers: Automotive industry OEMs, Automotive industry.

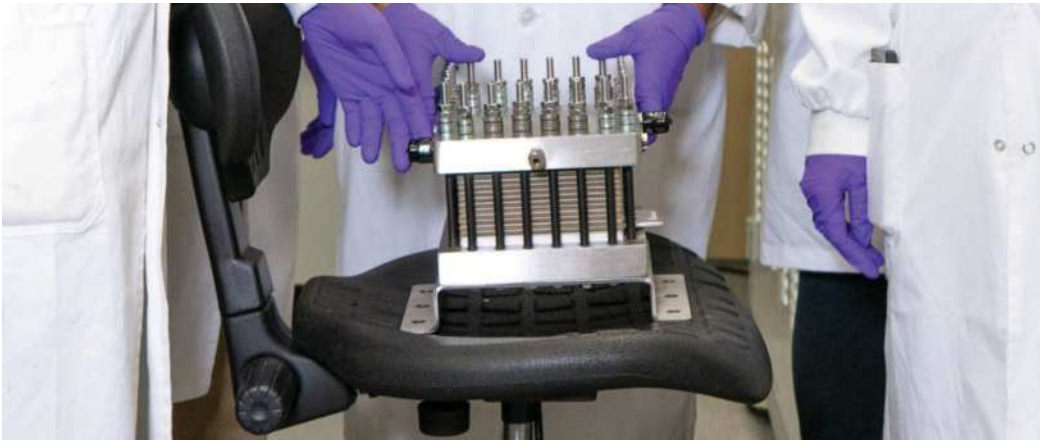
5
TRL

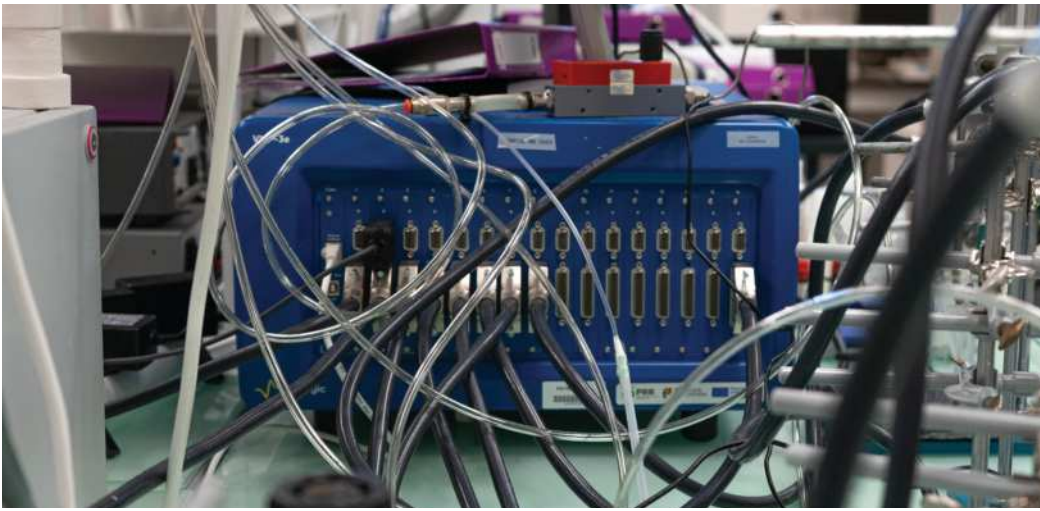


Testing Facilities

at INL for technology exploitation

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Moving2Neutrality

Electrolysers for hydrogen production

The advanced PEM (Proton Exchange Membrane) and ALK (Alkaline) electrolysers support scalable green hydrogen production, addressing the cost and efficiency limitations of current technologies.

Advance the development of unconventional nanomaterials free of critical raw materials and toxic compounds, key towards sustainable innovation.

Contribute to carbon neutrality and sustainable industrial practices.

The facility includes:

- 5kW PEM and ALK electrolyser platforms
- DEMS spectroscopy for mechanistic insights
- Industrial ultrasonic spray coating
- Parallel batch and flow reactors for catalyst synthesis
- Atomic Layer Deposition system for conformal catalyst distribution
- Multichannel VMP3-e potentiostats for electrochemical evaluation

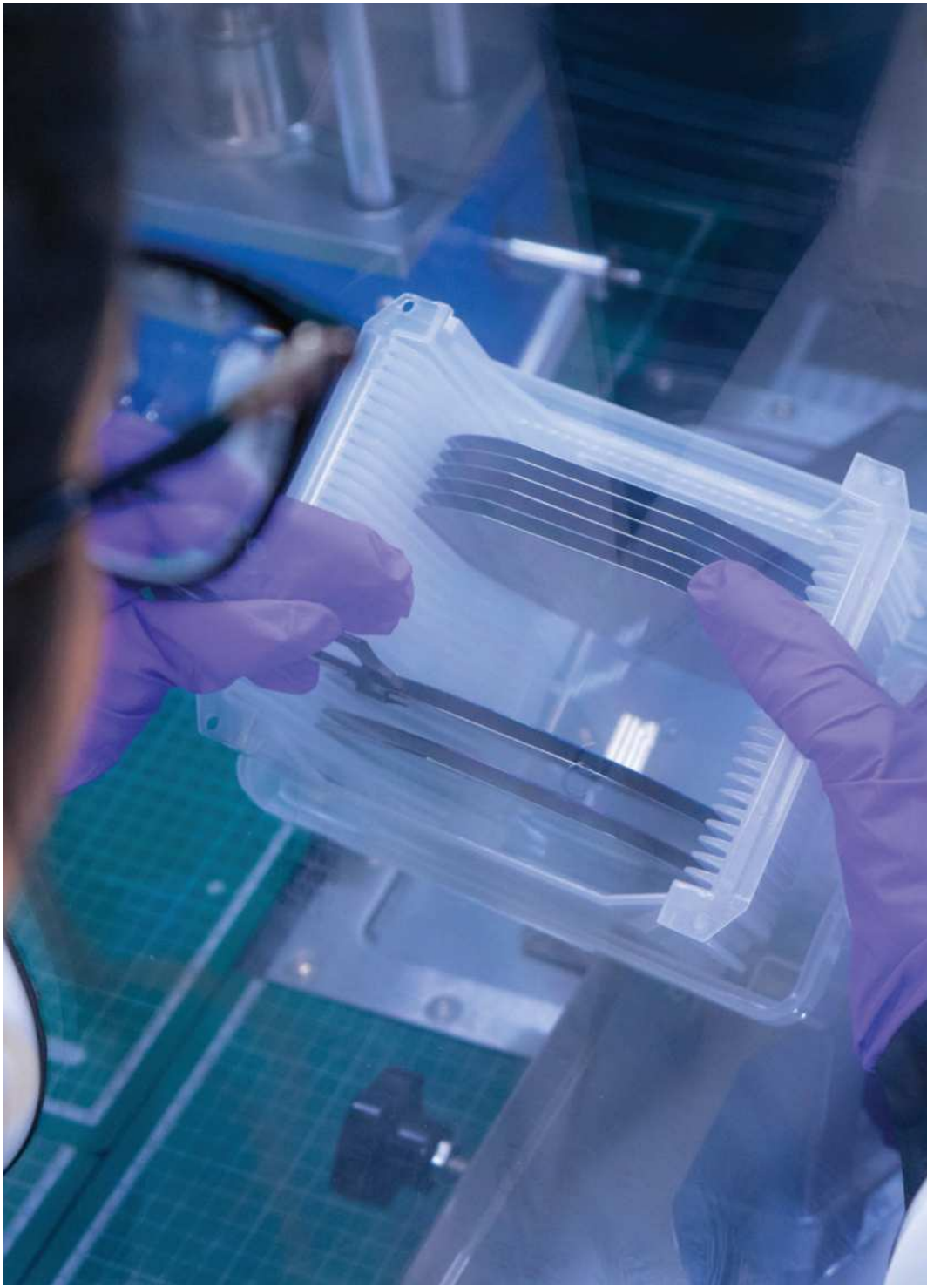
These efforts reinforce INL's strategic role in industrial decarbonisation and support national ambitions for gigawatt-scale electrolyser deployment.

Potential market: Energy utilities, hydrogen producers, and industrial decarbonisation projects.

"INL's team has been delivering outstanding and highly professional work in advancing next-generation alkaline and PEM electrolysis. Even at early TRLs, the results are very promising and highlight the potential impact these innovations may have on future, more efficient and sustainable hydrogen technologies. We value the opportunity to follow the progress of a partner with such unique capabilities in Portugal."

André Fonseca, Industrial Innovation Project Manager, Galp

1





New Generation Storage

Deposition system for solid-state batteries

An advanced deposition system equipped with a 6-inch-wafer-scale platform for growing ultra-thin solid-state battery layers, ideal for flexible, portable, and compact devices.

Delivers end-to-end capability to design, integrate, and optimise complete thin-film battery stacks at any form factor.

Overcomes limitations of conventional systems by enabling novel material pairings and architectures, supporting the heterogeneous integration with other technologies.

Accelerates the transformation from early research findings to functional prototypes and industrial demonstrators.

Fosters new R&D collaborations, building strategic expertise and manufacturing capacity in solid-state energy storage.

Empowers companies with a scalable solution to develop safer, smaller, longer-lasting batteries for wearables, IoT, and miniaturised electronics.

Potential market: Electronics manufacturers, R&D centers, and flexible device developers.

2


Porta



r2u modular systems

Thin-film solar cell deposition system

An advanced deposition system equipped with a 150 mm wafer-scale platform for depositing thin Cu(In,Ga)Se_2 solar cells.

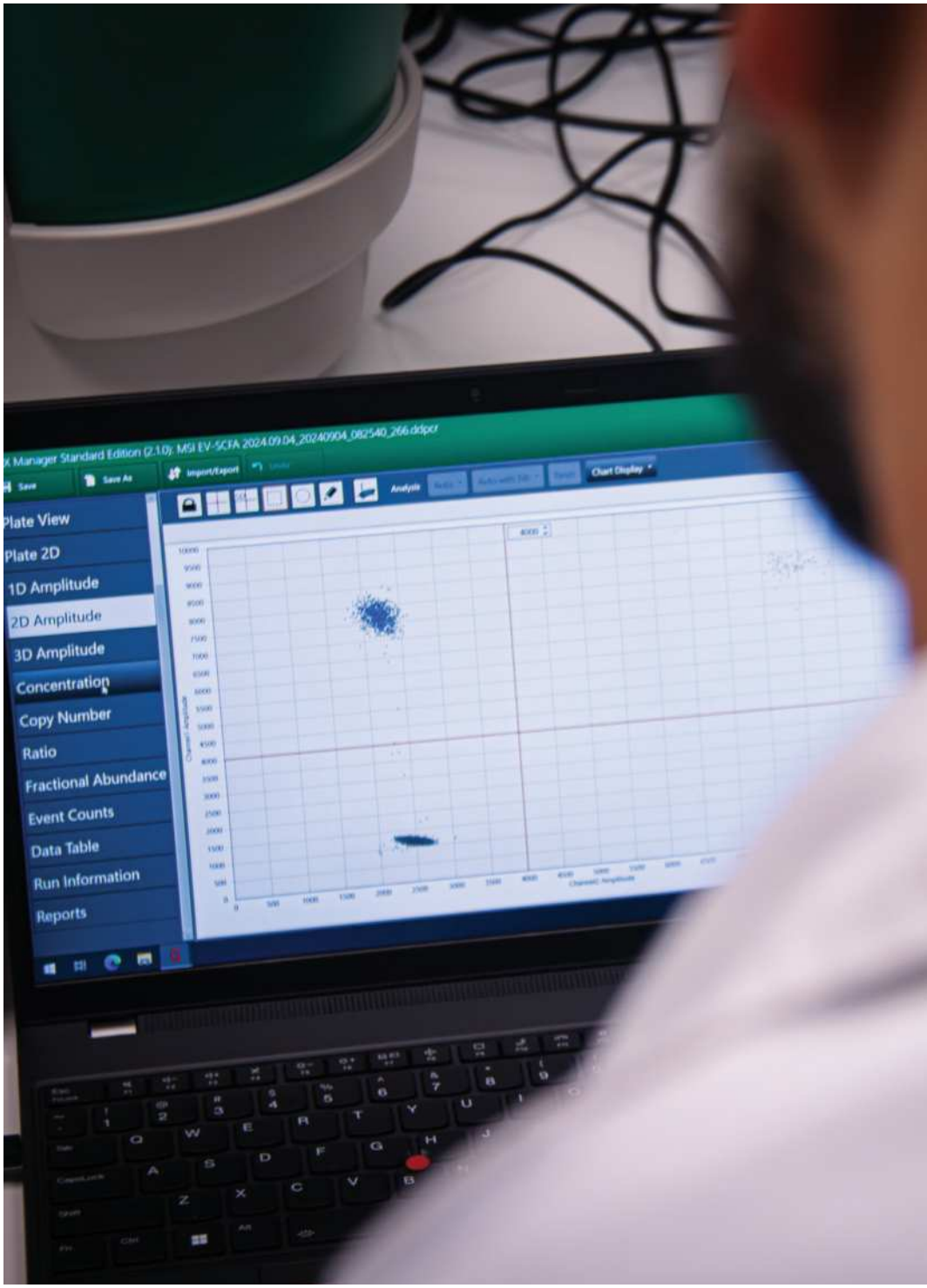
Enables multi-target DC/RF magnetron sputtering on both flexible and rigid substrates, offering versatility in recipe design and layer development.

Includes substrate heating, process monitoring, and ***in-situ*** parameter control.

Semi-industrial tool that uses the technology and type of substrates that enable developments to be easily adapted by industry.

Used for CIGS, transparent conductive oxides, and optical coating validation in photovoltaic device prototyping.

Potential market: Photovoltaic manufacturers, renewable energy companies.


Manager Standard Edition (2.1.0): MSI EV-SCFA 2024.09.04_20240904_082540_266.ddpcr
Save
Save As
Import/Export
Analysis
Chart Display
Plate View
Plate 2D
1D Amplitude
2D Amplitude
3D Amplitude
Concentration
Copy Number
Ratio
Fractional Abundance
Event Counts
Data Table
Run Information
Reports

Health Portugal
Agenda HfPT

Liquid Biopsy Unit

The Liquid Biopsy Unit is an integrated infrastructure connecting INL, 2CA-Braga, and RUBYnanomed to accelerate the development of next-generation non-invasive diagnostics in oncology.

Divided in three sites, INL's lab focuses on research and technology development, the lab at 2CA-Braga enables clinical trials, and RUBYnanomed's supports clinical testing in certified facilities. Together, they provide a complete pathway from innovation to clinical and market adoption.

Key Features:

- Advanced liquid biopsy R&D capabilities
- Single-cell isolation and analysis (CellCelector®)
- Extracellular vesicle isolation and characterisation
- High-sensitivity molecular analysis using ddPCR
- Integrated clinical validation and certification ecosystem

Potential Market: hospitals and clinical laboratories, biotech and pharmaceutical companies, precision medicine developers, cancer diagnostics and monitoring providers, translational research and healthcare innovation organisations.

A Foundation for Tomorrow

The partnerships formed, capabilities developed, and momentum built through the PRR framework will continue driving innovation long after these projects conclude. As these technologies mature and reach market scale, these will continue to create jobs, attract investment, and position Portuguese innovation on the global stage.

Interested in other INL technologies?
Visit us at inlint.portals.in-part.com

COMPETE 2030 PORTUGAL 2030 Cofinanciado pela União Europeia

Our Partners

Thank you to all our partners in the PRR Agendas.

COMPANIES

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Bandora Systems · BH4U · BIM+ · Bluepharma · Bondalti
Bosch Security Systems · Bosch Termotecnologia · BrightCity · bysteel
bysteel FS · CEVE · ChemiTek · CleanWatts Digital · COLEP Packaging
Copo Têxtil · Dianagás (Floene) · Dimas & Silva · DISPLAX · dst · dstsolar
dte · Edmtech · Enforce · EVERYTHINK · Extrusal · Fabridoce
Fresenius Kabi Pharma Portugal · GLN Plast · Ibersol · ICM-Pork · iLoF
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LUX Optimeyes Energy · MCT · Nasas Biotech · NOS Comunicações
Oceano Fresco · OnControl · Palmiresíduos · Petrogal · PICadvanced
PLUX Wireless Biosignals · Primor · PRIO Energy · REN Gasodutos · REN Gás
RUBYnanomed · Sarkkis Robotics · Sentron · Silvex · SonaeMC · Speculum
SPMAQ · Stellantis (Peugeot Citroën) · Thunder Foods · TINTEX Textiles · TMG
Vieira & Lopes · Vista Alegre · Voltalia · Watt-Is

R&D AND TECHNOLOGY CENTRES

CATIM · CEiiA · CENIMAT · CeNTI · CITEVE · Colab4Food · CTCV
DTx CoLAB · HyLAB · ICVS · IEP · INEGI · INESC TEC · INESC-MN · ISQ
ITeCons · MARE-ULisboa · PIEP · R&D Nester · VG CoLAB

HIGHER EDUCATION

FCUP · FEUP · Instituto Superior Técnico · IPVC · ISEP · NOVA FCT
Tecnológico de Monterrey · Universidade de Aveiro · Universidade de Coimbra
Universidade de Évora · Universidade do Minho

ASSOCIATIONS AND CLUSTERS

Battery Cluster Portugal · BETA-i · PACT · PortugalFoods · TecMinho
Valorcar

PUBLIC BODIES

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Some images were created with the assistance of AI
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Design
Patrícia Barroso
Photography
Rui Andrade

r2u modular systems

PRR Plano de Recuperação e Resiliência

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