



XARXA d'R+D+I  
ENERGY FOR SOCIETY

**PRODUCTS  
SOLUTIONS  
SERVICES**

---

# CATALOGUE

Current energy challenges require innovative solutions.

The Energy for Society Research, Development and innovation Network (XRE4S) is an ecosystem that groups the expertise of researchers in Catalonia working in the energy field. It gathers 41 groups from 14 universities and research and technological centers, involving more than 500 researchers. It aims to transform research knowledge into solutions to improve the quality of life of the society.

The technological solutions, products and services by the XRE4S are summarized in this catalogue. It offers licensing and commercialization opportunities for companies, creates a basis for common projects to boost valorisation and tech transfer and welcomes investors who can support technology development and proof of concepts, or investments in spin offs.

## MEMBERS OF THE NETWORK



- Subsurface exploration tools for geothermal purposes (BSC)
- A geographical benchmarking tool (Bee Geo) (CIMNE)
- Massive photovoltaic optimization (BeePV) (CIMNE)
- Light absorption metamaterial for energy applications (CNM-IMB-CSIC + ICN2)
- Selective deposition of thin films on microdevices (CNM-IMB-CSIC)
- Biodrying for animal manure valorization into biofuel (CTBETA-UVic)
- Energetic valorization of cheese whey and manure (CTBETA-UVic)
- Direct formic acid fuel cell (EURECAT)
- Electra: Self-supported electrodes comprising metal oxides (ICIQ)
- Polymers made from carbon dioxide and biomass (ICIQ)
- Electroanodes for hydrogen production (ICIQ)
- Organic semiconductor type n by UV-VIS irradiation (ICMAB-CSIC)
- Biobutanol separation from ABE fermentation mixtures (ICMAB-CSIC)
- High throughput superconducting conductors (ICMAB-CSIC)
- Advanced fabrication of nanocarbon-based supercapacitors (ICMAB-CSIC)
- Ceramic complex geometries by 3D printing (IREC)
- Electrochemical ceramic cells by 3D printing (IREC)
- Nanostructured flexible fabrics for thermoelectrics (IREC)
- Micro-oxygen sensor (IREC)
- Solid-state micro oxygen battery (IREC)
- Solid state ionics-based transistors (IREC)
- Manufacture of catalysts for synthetic gas production (IREC)
- FowApp- The floating offshore wind assessment App (IREC)
- Versatile and resilient power converter (IREC)
- Gridwatch- Analyzes risk of electrical network failure (IREC)
- Optimization tool for self-healing of electrical grids (IREC)
- CASE- the demand aggregator (IREC)
- Smart Energy Management Solution - SEMS (IREC)
- Flexible heating and cooling solutions (IREC)
- Building reduced energy models (IREC)
- Business model for residential retrofits at district scale (IREC)
- Stochastic model of occupancy behaviour, electric consumption and domestic hot water demand (IREC)
- FusionCAT- ACDPT tool (IREC)
- Recycling steel byproducts into energy efficient building materials (UB+UdL)
- Data driven methods to provide enhanced energy services (UdG)
- Membrane housing device for sustainable water treatments (UdG)
- Reperov - Reliable perovskite solar cells (UdG)
- Electro-bioremediation (UdG)
- Automatic real-time control system for membrane bioreactors (UdG)
- Woodtricity: On-demand renewable heat & power generator for ZEB (UdG)
- A dynamic thermal system for minimizing energy demands in buildings (UdL)
- Production or commercialization of bio-based PCMs (UdL)
- Radiative collector and emitter (UdL)
- Uniscool: Universal smart cooling (UdL)
- Dual active bridge isolated bidirectional DC-DC converter (UPC-CITCEA)
- AI applied to the energy sector (UPC-CITCEA)
- Artificial neural network based distribution grids state estimation (UPC-CITCEA)
- Electronic controller for electrical mobility (UPC-CITCEA)
- Energy management system for intelligent buildings or households (UPC-CITCEA)
- HESS- The hybrid energy storage solution (UPC-CITCEA)
- Software tools to analyze and control power systems (UPC-CITCEA)
- VeggieTherm- Vegetal thermal insulation panels (UPC)

## TECHNOLOGY BY:

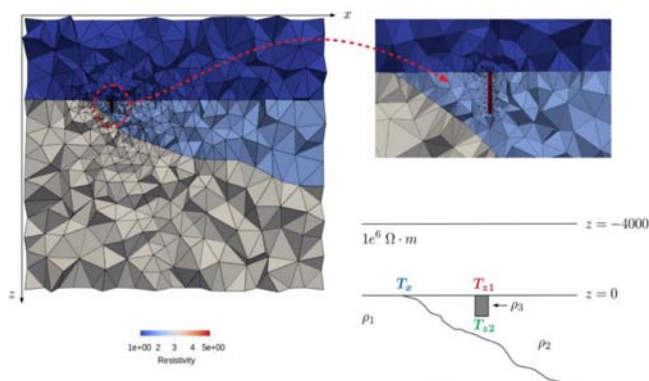


## CHALLENGE

Democratization of HPC for geothermal exploration

## APPLICATIONS

Geothermal energy  
Geological carbon storage



## DESCRIPTION

It consists in several **software-based technologies** used to **explore** and **monitor the subsurface**. They use **geophysical data** and produce accurate **maps** of complex subsurface structures.

The technologies are developed for very economically intensive businesses, such as **hydrocarbon exploration**.

These technologies are nowadays becoming more affordable due to the increase in computing capacity of current computer clusters, and can start to be applied to less intensive fields such as **geothermal exploration** or **geologic carbon storage**.

## NOVELTY

We take full advantage of the best imaging algorithms for the subsurface, thus mitigating future risks related to exploitation.

## FURTHER DEVELOPMENT

We look for collaboration with the geothermal and carbon storage ecosystem. We wish to apply to grants and also transfer know-how to industrial users.

## DESIRED PARTNERS

Mostly industrial partners and R&D centers. Our goal is to bring our products closer to real environments.

## CURRENT TRL

4

## TIME-TO-MARKET

1-2 years

## IP PROTECTION

Industrial secret/open source, depending on application.

## TECHNOLOGY BY:

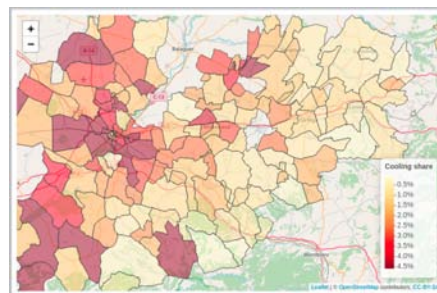
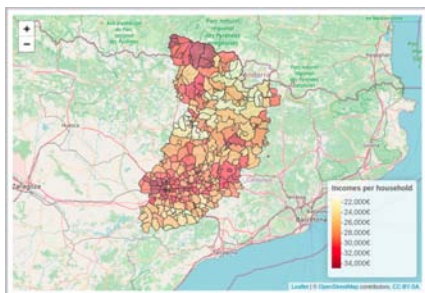


## CHALLENGE

Mapping of energy consumption  
for decision-makers

## APPLICATIONS

Demographic studies and trends  
Interactive visualization plot  
Geographical interactions



## DESCRIPTION

BEE Geo provides **geographical analysis by regions**, enabling characterization and benchmarking of multiple variables for each postal code: detailed **electricity consumption**, disaggregation by **tariff** and **economic sector**, relation between **consumption** and **weather** conditions, **calendar** seasonality and cadaster information. It provides 'KPIs correlation' to detect relationships between different variables in the map.

BEE Geo uses **several data sources** via API for the most recent data available: energy (Datadis), buildings features (Cadaster), social conditions (INE) and weather. It can incorporate other sources of information if required.

## NOVELTY

The visualisation allows to understand major differences between regions to detect and quantify those differences in to provide useful information for decision makers.

## FURTHER DEVELOPMENT

- Introduce new data sources
- Amplify geographical coverage
- Implement new requirements or needs

## DESIRED PARTNERS

Local, regional or national administrations.

## CURRENT TRL

5

## TIME-TO-MARKET

1-3 years

## IP PROTECTION

Transferred to Beedata  
Analytics S.L Technologies

## TECHNOLOGY BY:



## CHALLENGE

Massive photovoltaic  
prospection for utilities

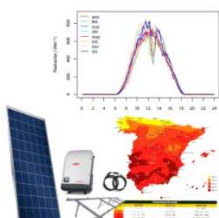
## APPLICATIONS

Residential sector  
Tertiary sector

### 1 Set of clients



### 2 Definition of scenarios



### 3 Previous report of results



### 4 PV oriented campaign



## DESCRIPTION

BeePV can provide a **personalised hourly analysis** for thousands of users and for all **photovoltaic kits** determined in record time.

BeePV uses a **Big Data architecture** (based on Hadoop) that allows millions of calculations to be iterated in parallel, in which a photovoltaic system **simulator**, an **economic-financial analysis** engine and the optimisation algorithm that identifies the optimal kit according to the best returns on investment or the best combination of variables considered relevant have been integrated.

## NOVELTY

- 20% project conversion rate
- Direct data loading from the utility
- Optimisation with the hourly electricity consumption profile

## FURTHER DEVELOPMENT

Scale up in the Spanish market

## DESIRED PARTNERS

Any company in the utilities sector that tests the algorithm and public administrations to promote photovoltaic systems among citizens.

## CURRENT TRL

7

## TIME-TO-MARKET

1-3 years

## IP PROTECTION

Transferred to Beedata  
Analytics S.L Technology



## TECHNOLOGY BY:

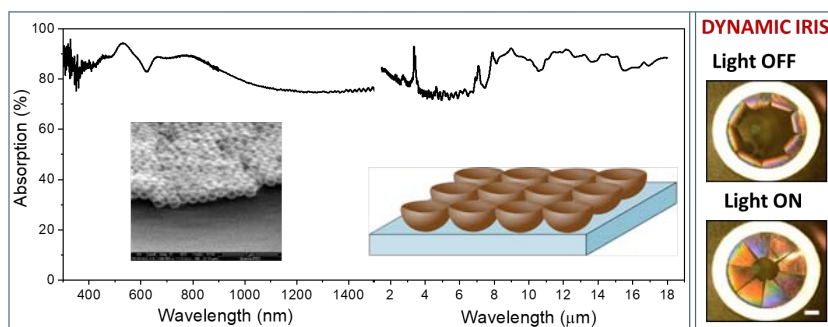


## CHALLENGE

Materials for efficient  
photothermal conversion

## APPLICATIONS

Energy harvesting, catalysis,  
photodetectors, actuators, self-  
regulated and dynamic pupil/iris



## DESCRIPTION

This is a novel cost-effective and scalable metamaterial showing an angle-independent and efficient ultrabroadband optical absorption range (average 84% within 300 to 18000 nm), which results in an excellent photothermal conversion efficiency. The developed metamaterial exploits the highly damped plasmonic properties of abundant, cost-effective and scalable nanostructured metals (Fe, Ti, Ni...) in combination with plastic films to achieve the ultra-broadband absorption range from the UV to the far infrared. The flexibility of the metamaterial enables its straightforward attachment to any flat or curved surface. The fabrication method can also be adapted to complex 3D surfaces.

## NOVELTY

- Higher conversion efficiency (x2) than typical materials
- Much lower cost
- Flexibility to adapt to flat/curved surfaces
- Possibility of in situ fabrication

## FURTHER DEVELOPMENT

Proof of concept, validation of the material in industrial products, and feasibility of projects

## DESIRED PARTNERS

Manufacturing companies working in solar thermal energy, energy harvesting, or mechanical actuators.

## CURRENT TRL

2

## TIME-TO-MARKET

5 years

## IP PROTECTION

PCT filed

## TECHNOLOGY BY:

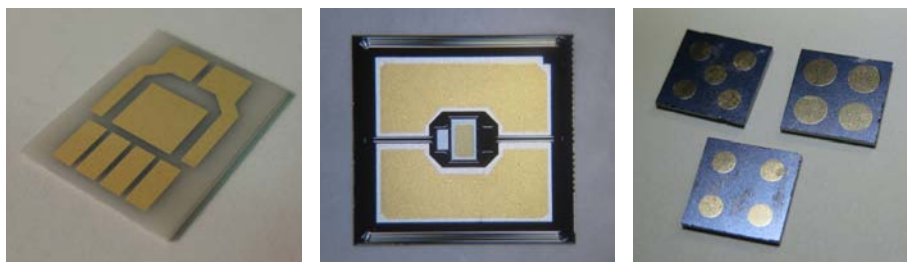


## CHALLENGE

Selective deposition of materials on microelectronic devices

## APPLICATIONS

Microelectronics  
Deposition of metals  
Thin films



## DESCRIPTION

A new **shadow-masking method** based on a set of **self-aligned metallic masks** allows the **selective metallization of microelectronic substrates and devices** for the implementation of tracks and pads. It is based on a set of masks that doesn't need photolithographic process or complex alignments. These are self-aligned by rods matching with corresponding orifices, defining the deposition patterns. A frame on the top allows fixing the masks and the substrates.

This technique can be used, for example, to: remetalize the Al pads of power devices allowing their topside brazing or chip-embedding techniques, define pads and tracks in ceramic substrates or define contacts in piezo substrates.

## NOVELTY

- Avoids photolithographic or chemical processes
- Cheap and fast method
- Easy to implement
- Provides a good resolution (tens of microns)

## FURTHER DEVELOPMENT

This technological process is completely developed and can be used with standard deposition equipment.

## DESIRED PARTNERS

Industrial partners mainly working on deposition of metals, and thin layers in general, for the implementation and exploitation of this technology.

## CURRENT TRL

>7

## TIME-TO-MARKET

This technological process is currently available.

## IP PROTECTION

European granted patent (2019-11-06)



## TECHNOLOGY BY:



## CHALLENGE

Valorization of  
low-value agrowaste

## APPLICATIONS

Biofuel production,  
adaptation of composting plants



## DESCRIPTION

Biodrying is a novel technology to valorize organic waste highly moisture into a biofuel (LHV > 2500 kcal/kg), which can be used in conventional biomass boilers.

Biodrying is similar to a composting process, although the final objective is different: the metabolic heat produced by the biologic activity is used to remove the water content of the matrix in the shortest time, minimizing the organic matter degradation and keeping the heat value of the material.

At the same time, this technology is a solution for phosphorus recovery from the ashes obtained after the biofuel combustion in order to be transported and applied as fertilizer in an easy way.

## NOVELTY

- Easy integration
- Valorization of low value animal manure
- Increased energetic self-sufficiency of the farms

## FURTHER DEVELOPMENT

Continue the optimization of the technology at lab and pilot scale to achieve a better implementation at full scale, mainly through the adaptation of composting plants operating under real conditions.

## DESIRED PARTNERS

Industrial partners, Dairy industry

## CURRENT TRL

6

## TIME-TO-MARKET

<5 years

## IP PROTECTION

n/a

## TECHNOLOGY BY:

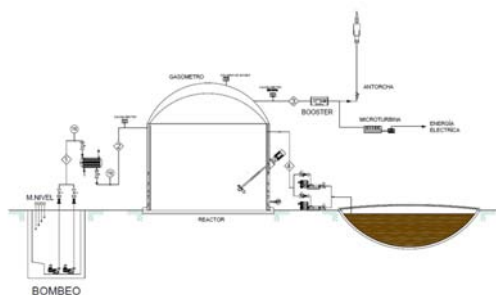


## CHALLENGE

Valorization of  
low-value agrowaste

## APPLICATIONS

Biogas production,  
management of dairy sub-  
products



## DESCRIPTION

Anaerobic digestion of manure is a common practice; however, the low biogas yield of manure can hamper the profitability of systems in small to medium farms. **Optimal co-digestion of manure** and cheese whey at full-scale systems is a promising technological-based practice to achieve **energetic self-sufficient dairy farms**.

A **techno-economic assessment** of **anaerobic co-digestion** of animal manure and cheese whey (cow, goat and sheep) has shown that the co-digestion of manure with 30% of cheese whey showed a **good economic performance** and **positive returns**.

## NOVELTY

- Enhancement of biogas productivity;
- Co-digestion of dairy farms and industry wastes;
- Energetic self-sufficient dairy farms;
- Economically feasible valorization of manure.

## FURTHER DEVELOPMENT

Implementation of a full-scale co-digestion unit under real conditions.

Techno-economical assessment optimization for replication purposes.

## DESIRED PARTNERS

Industrial partners, Dairy industry

## CURRENT TRL

8

## TIME-TO-MARKET

<2 years

## IP PROTECTION

n/a

## TECHNOLOGY BY:

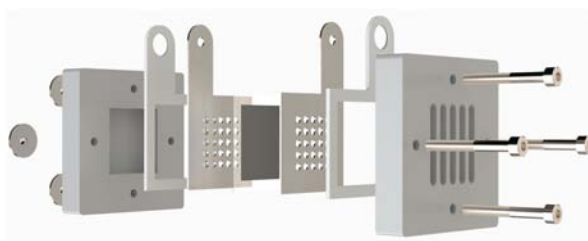


## CHALLENGE

Carbon dioxide capture and conversion

## APPLICATIONS

Automotive sector and renewable energy storage solution



## DESCRIPTION

This technology is composed of two modules:

1) an **artificial leaf**: captures carbon dioxide and transforms it into formate/formic acid. This unit requires external energy to produce the fuel.

2) **Direct Formic Acid Fuel Cell (DAFC)**: produces energy from the reduction of formate or formic acid thanks to the development of a catalyst.

When operated together, the 1st unit feeds the DAFC with the necessary fuel to operate. When used in stand-alone mode, the fuel is provided externally as a consumable in a tank.

## NOVELTY

- Efficient carbon capture and conversion
- Fuel (liquid formic acid) is easily stored and compressed
- Greater energy density than common Li-batteries
- Continuous feed to the battery, which operates off-grid

## FURTHER DEVELOPMENT

Develop and commercialize a standalone DAFC, ideal for a niche market like auto-caravaning, followed by the development prototypes and their validation.

## DESIRED PARTNERS

Industrial partner for the industrialization and commercialization of the modules.

## CURRENT TRL

4

## TIME-TO-MARKET

2 years

## IP PROTECTION

Patent granted (ES2673492)  
Trade secret

## TECHNOLOGY BY:

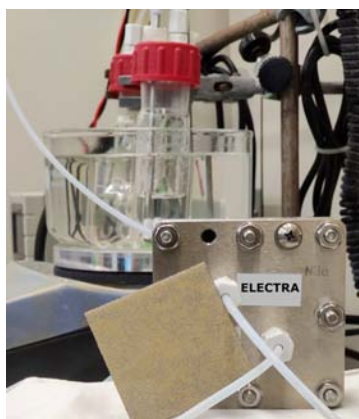


## CHALLENGE

Improved electrodes for energy storage and conversion

## APPLICATIONS

Hydrogen technologies, batteries, chemical industry, transportation



## DESCRIPTION

This solution describes a new process to **manufacture extremely robust electrodes** for the **hydrogen market**, including **fuel cells** and **electrolysers**.

It involves a revolutionary **coating** technology to produce electrodes that provide a 25% saving in traditional manufacturing CAPEX and up to 20% saving in existing OPEX for the production of hydrogen and the operation of electrolysers.

## NOVELTY

- Energy efficiency gain (>10-20%)
- Self-supported electrocatalyst (no need for a binder)
- Reduction of alkaline waste
- Low-cost and abundant materials
- Better electrode performance compared to commercial ones

## FURTHER DEVELOPMENT

Electrode composition optimization and scalability, long term operation and stress testing.

Business model development (*via* The Collider programm).

## DESIRED PARTNERS

Investors to create a spin-off company and industrial partners (manufacturers of electrolysers/batteries and electrodes).

## CURRENT TRL

3

## TIME-TO-MARKET

2 years

## IP PROTECTION

Transferred to the spin-off  
Jolt Green Hydrogen  
Solutions

## TECHNOLOGY BY:

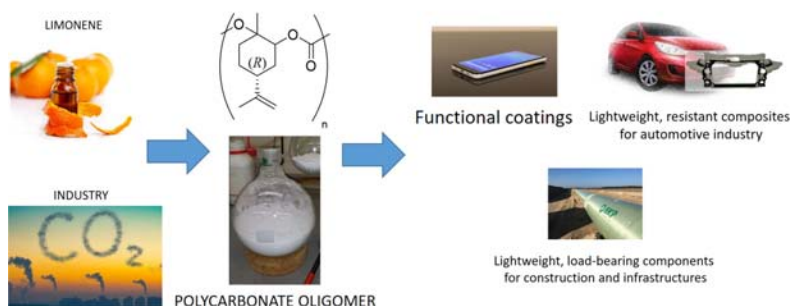


## CHALLENGE

CO<sub>2</sub> capture and valorization  
Renewable materials

## APPLICATIONS

Advanced materials  
Functional coatings  
Adhesives and packaging



## DESCRIPTION

The technology relates to a method for the production of a new class of **polycarbonate materials** (PLC) which can serve as a platform in the development of **functional coatings**, **packaging ingredients** and other **advanced materials**. The polycarbonates are made by co-polymerization of limonene oxide with carbon dioxide, both cheap, accessible and renewable ingredients.

## NOVELTY

- Renewable feedstock (non-edible biomass and CO<sub>2</sub>)
- Possibility to use the material as a platform to reach a plethora of applications
- Potential alternative to BPA-based PC
- Functionality on-demand: Due to the pendant double bond various functionalities can thus be introduced

## FURTHER DEVELOPMENT

- Scale-up the process
- Develop niche high performance applications of product (with industrial partners)

## DESIRED PARTNERS

Companies developing new polymer materials who could incorporate these products in their final product formulations, eventually after further functionalization.  
Biorefineries for PLC production

## CURRENT TRL

4-5  
(PLC limonene product)

## TIME-TO-MARKET

3 years

## IP PROTECTION

In-house know-how  
US patent application filed

## TECHNOLOGY BY:

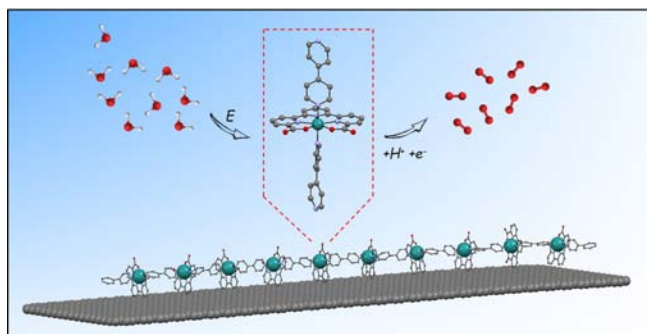


## CHALLENGE

Cheap and sustainable production of hydrogen.  
Water splitting

## APPLICATIONS

Green hydrogen, solar fuels, artificial photosynthesis, photo-electrochemical cells



## DESCRIPTION

The technology relates to a highly performant **water oxidation electroanode** useful in **water hydrolysis** for the oxidation of water and **production of hydrogen**. The electroanode comprises a coordination oligomer of a molecular catalyst strongly attached to an electrode surface via supramolecular interactions with **no need for a binder** to fix the catalyst to the electrode. Such an electrode can be used in water hydrolyzers for hydrogen generation. The production of hydrogen is **high-yielding** even when water hydrolysis takes place at neutral pH.

## NOVELTY

- High current density even at neutral pH and low potential
- No binder required to fix the catalyst to the electrode
- Large surface coverage
- Prepared anode is robust

## FURTHER DEVELOPMENT

- Long term testing and pre-pilot validation
- Pilot testings (incorporation of anode in electrolyzers and PECs)

## DESIRED PARTNERS

Companies or technology centers operating in the electrodes/electrolyzers fields, partner for demonstration and/or commercialization.

## CURRENT TRL

3

## TIME-TO-MARKET

5-6 years

## IP PROTECTION

European Patent application filed (2020)



## TECHNOLOGY BY:

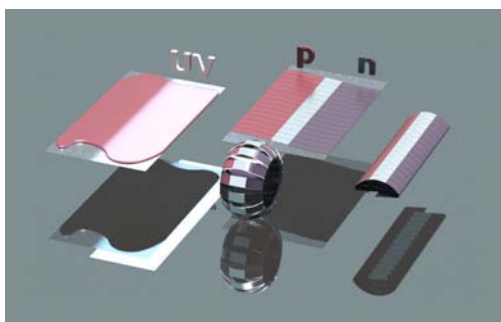
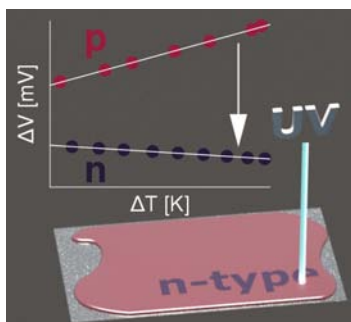


## CHALLENGE

Cheap, non toxic  
thermoelectric generators

## APPLICATIONS

Organic thermoelectric  
generators for distributed  
sensor applications



## DESCRIPTION

The **fabrication processes** of n- or p-type semiconducting devices usually requires the deposition of both n- and p-type materials, which have different processing requirements. In the proposed method, **only one solution** of a p-type material has to be deposited. Subsequently, it can locally be **irradiated with light** to convert the material to n-type according to the needs. Application to thermoelectricity has been **demonstrated**, using a **large-scale, roll-to-roll coating** compatible in-plane geometry that showcases the convenience of the developed method, while also using the inherent advantages of **flexible substrates** to their fullest.

## NOVELTY

Focus on simple processing, leveraging the expected advantages of organic semiconductor technology (roll-to-roll processing, large area fabrication, cheap, scalable, sustainable...

## FURTHER DEVELOPMENT

Validation of the technology for specific applications. Currently running 2 projects to extend this technology: (i) Sensoraïm (AGAUR Producte) and (ii) Orgivine (ERC Proof of Concept).

## DESIRED PARTNERS

Industrial partners

## CURRENT TRL

4

## TIME-TO-MARKET

5 years

## IP PROTECTION

European patent granted  
(EP3381069B1)

## TECHNOLOGY BY:

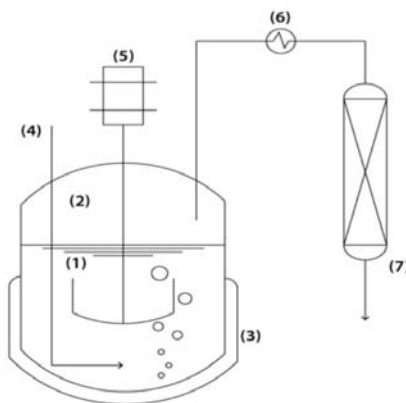


## CHALLENGE

Fabrication of sustainable and cost-efficient biofuels

## APPLICATIONS

Biorefineries, chemical industry - renewable chemicals, transport fuel



## DESCRIPTION

The current industrial process for the production of biobutanol includes the ABE (acetone-butanol-ethanol) fermentation process from biomass; the resulting fermentation broth has a butanol concentration of no more than 2 wt% (the rest is essentially water). Therefore, the development of cost-effective butanol separation processes from dilute aqueous solutions is highly desirable as this corresponds to 50 to 80% of final cost. We describe a novel technology based on a porous and hydrophobic material mCB-MOF-1 and an integrated gas stripping and vapor phase sorption separation for biobutanol recovery from the ABE fermentation process.

## NOVELTY

- Employment of an efficient adsorbent for butanol recovery
- Easily integrated within fermentation reactors
- Technically and economically viable

## FURTHER DEVELOPMENT

Include process design, simulation, experimental validation and analysis of the operation involving heat, mass balances, economics and life cycle analysis for the proposed hybrid butanol separation process for a bench scale unit.

## DESIRED PARTNERS

Pilot sites or industrial partners with the engineering and R&D capabilities for experimental validation at pilot plant scale.

## CURRENT TRL

3

## TIME-TO-MARKET

>5 years

## IP PROTECTION

n/a

# HIGH THROUGHPUT SUPERCONDUCTING CONDUCTORS

## TECHNOLOGY BY:

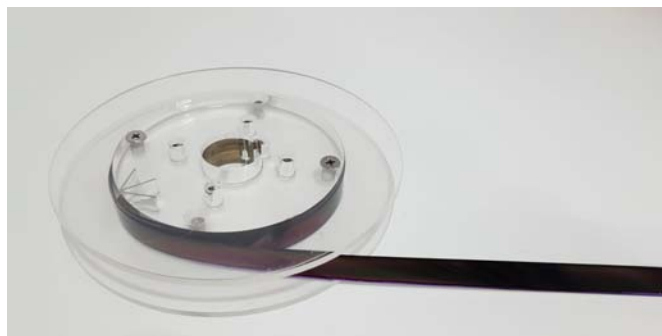


## CHALLENGE

High cost of coated conductors production

## APPLICATIONS

Power grid (FCL, cables, transformers...), generation (Wind generators, fusion...), transport



## DESCRIPTION

We propose a high throughput superconducting conductor technology with a huge impact on the industrial scale-up of **Coated Conductors** (CCs). Based on a disruptive Transient Liquid Assisted Growth process combined with Chemical Solution Deposition (TLAG-CSD) enables **ultrafast growth** of  $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$  films (100-1000 nm/s, a level required for industrial scale-up) on metallic substrates by using **printing deposition methods** (inkjet printing, slot-die coating) and nanocomposites, obtained by stabilizing preformed nanoparticles in the initial precursor solution. TLAG-CSD is low cost (uses simple reactors), has high growth rates and is environmentally friendly.

## NOVELTY

- Ultrafast growth rates (x100 conventional methods)
- High performance at high magnetic fields
- Worldwide unique low cost, high throughput, high performance scalable method for CC production

## FURTHER DEVELOPMENT

Validate the technology for scaling up processes and develop a viability plan to build a business case.

## DESIRED PARTNERS

High temperature Superconducting manufacturers and technology developers, including nanoparticles and ink manufacturers, end-users and Venture Capital firms.

## CURRENT TRL

3

## TIME-TO-MARKET

3-5 years

## IP PROTECTION

Trade Secret  
Patent application filed

## TECHNOLOGY BY:

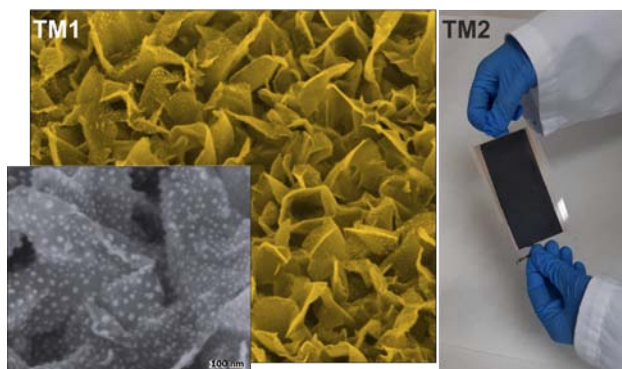


## CHALLENGE

Cost-effective fabrication of supercapacitors

## APPLICATIONS

Electronic devices, batteries, power supply systems, electric vehicles or smart grids



## DESCRIPTION

Two innovative **technological methods** are proposed for the **fabrication of supercapacitor electrodes** based on **carbon nanostructures - metal oxide hybrid composites**. Both technologies show high potential for the cost-effective, high-throughput and scalable manufacturing of high-performing supercapacitors.

The methodology is based on **laser processing** and **chemical vapour deposition** technologies for the fabrication of highly performing supercapacitors composed of hybrid graphene-based electrodes.

## NOVELTY

- High power density and high energy density
- Environmentally-friendly and cost-effective
- High throughput fabrication method
- Easy to industrialize

## FURTHER DEVELOPMENT

Validation of the technology and tests in real electric conditions.

## DESIRED PARTNERS

Manufacturers of laser processing and vacuum systems. Precursor materials suppliers. Industrial partners in areas related to electronics, smart grids, or electric/hybrid vehicles.

## CURRENT TRL

3

## TIME-TO-MARKET

3 years

## IP PROTECTION

To be filed

## TECHNOLOGY BY:

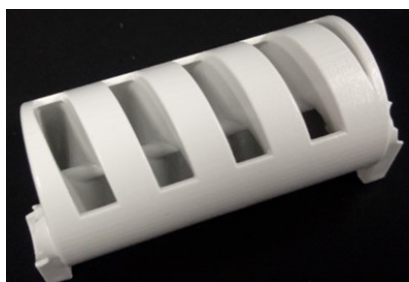


## CHALLENGE

Fabrication of customized  
ceramic structures

## APPLICATIONS

Solid oxide cells fabrication, high  
temperature packaging, customized  
testing setups and autonomous  
vehicles



## DESCRIPTION

This original **3D printing process** is able to fabricate **customized ceramic structures** in a **single step**.

It allows the fabrication of **monolithic ceramic complex geometries**, while it reduces cost of implementation and raw materials of the related technologies.

The process allows the integration of all functionalities by customizing the final product features, such as enhanced active surface area.

## NOVELTY

- Feasible complex structures, improving performance
- Monolithic, leakage-free, ceramic pieces
- Reduces waste of critical raw materials
- Reduces cost of the final product

## FURTHER DEVELOPMENT

Integration of the printed devices in real systems and generation of first prototypes.

## DESIRED PARTNERS

System integrators, investors and final users.

## CURRENT TRL

3

## TIME-TO-MARKET

3 years

## IP PROTECTION

Patent granted EP3754768

## TECHNOLOGY BY:

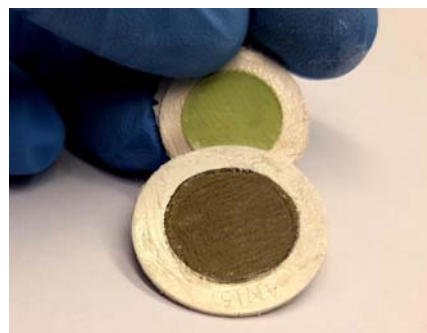
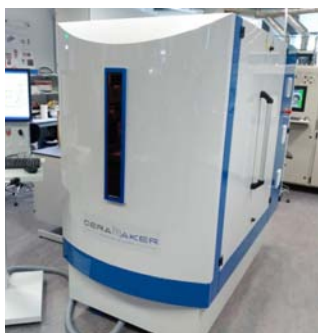


## CHALLENGE

Fabrication of monolithic,  
leakage-free solid oxide cells

## APPLICATIONS

Solid oxide fuel cells  
Solid oxide electrolyzers



## DESCRIPTION

This novel fabrication method provides an all-ceramic monolithic **solid-oxide cell stack** by **3D printing**. The process is done in a **single-step** by merging more than 60 steps.

It allows the manufacturing of electrochemical ceramic devices without gas leakages **avoiding weak structural points**, which are very difficult to repair by traditional processes. The final multilayered material body has all the standard stack functionalities.

The method allows easy customization of size, shape and power, providing higher flexibility and lower time-to-market.

## NOVELTY

- Simplified fabrication method
- Minimised gas leakages though weak structural points
- Reduces waste of raw materials
- Reduces overall cost

## FURTHER DEVELOPMENT

Integration of the printed solid oxide cell devices in real systems. Generation of first stack prototypes for system integration.

## DESIRED PARTNERS

System integrators, investors and final users.

## CURRENT TRL

3

## TIME-TO-MARKET

5 years

## IP PROTECTION

Patent application filed



## TECHNOLOGY BY:

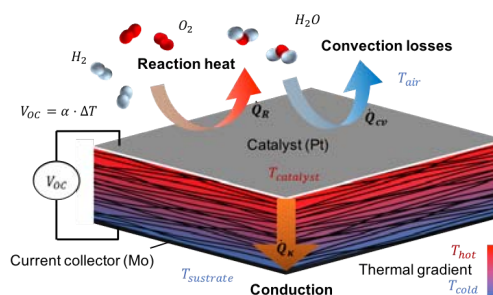


## CHALLENGE

Reducing the cost and toxicity, while adding flexibility, in thermoelectric devices

## APPLICATIONS

Energy harvesting for industrial IoT and industry 4.0, hydrogen sensing



## DESCRIPTION

This technology is a revolutionary new **high-performing cost-effective** and **environmentally friendly thermoelectric material**. The approach centers around **nano-enabled** easy-to-handle **flexible fabrics** made of thin-walled **microtubes**. The fabric-like thermoelectrics **adapt to any hot surfaces** (such as round chimneys, unlike conventional flat batteries or TEGs), leading to a **high performance** and **mechanical properties**. In addition, the capacity of mass-production of TEG fabrics at low-cost provides access to **new markets**.

## NOVELTY

- Self-powered devices: no need of maintenance
- Low-cost, large area production: automated and cheap
- Flexible material: adaptable to the substrate
- Environmentally friendly: reduction of hazardous waste
- Adaptable to any surface

## FURTHER DEVELOPMENT

Development the industrial prototype, testing and scaling-up oriented to the target market.

## DESIRED PARTNERS

Industrial partners and IoT manufacturers

## CURRENT TRL

5

## TIME-TO-MARKET

5 years

## IP PROTECTION

Patented technology  
(EP3306685)

## TECHNOLOGY BY:

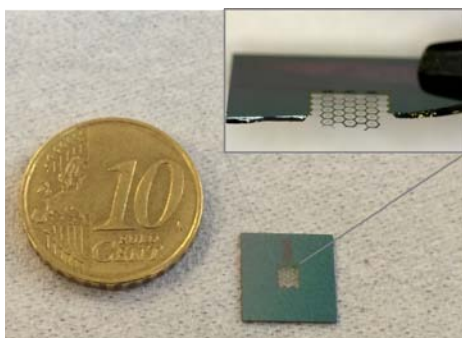


## CHALLENGE

Miniaturisation of oxygen sensor  
and integration on silicon  
technology

## APPLICATIONS

Industrial gas boilers  
Industrial combustion processes  
Automotive sector



## DESCRIPTION

A **customizable micro-fabricated zirconia-based sensor** which provides a **fast and stable response** to different **oxygen** concentrations.

It comprises a nanometric membrane and self-heating elements, everything integrated in less than 1 cm<sup>2</sup>.

Microfabrication techniques, added to the know-how of the group, allow to **adapt the design** of the sensor to any space constraint.

## NOVELTY

- Improve burners efficiency: reduction of harmful emissions
- Nanomembrane on silicon: small volume
- Microfabrication: large-scale low-cost production
- Response time: in the range of milliseconds

## FURTHER DEVELOPMENT

Complete integration of the system.

## DESIRED PARTNERS

- System integrators
- Boiler manufacturers
- Automotive sector distributors

## CURRENT TRL

4

## TIME-TO-MARKET

5 years

## IP PROTECTION

Spanish patent granted  
(ES2537587B1)

## TECHNOLOGY BY:

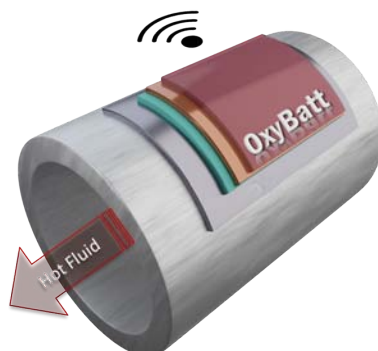


## CHALLENGE

Small sized energy storage  
stable in high temperatures and  
harsh environments

## APPLICATIONS

High temperature energy storage, IoT  
nodes, smart piping, oil and gas and  
heat exchanger



## DESCRIPTION

The invention is a rechargeable battery based on oxygen ions. Oxygen ions are accumulated and exchanged between two electrode layers which are separated by a solid electrolyte. The two electrode layers and the electrolyte are made of oxide ceramic materials that are stacked on top of each other. Thin film deposition techniques may be used for the fabrication of the battery. The working temperature of the device goes from 150 to 500 °C.

## NOVELTY

- Battery operating at high temperatures
- Enables IoT approaches in scenarios where monitoring was previously unfeasible
- Increase productivity and efficiency due to predictive instead of reactive/programmed maintenance

## FURTHER DEVELOPMENT

Miniaturization and introduction of scalable fabrication methods

## DESIRED PARTNERS

System integrators and end-users

## CURRENT TRL

3

## TIME-TO-MARKET

5 years

## IP PROTECTION

Patent application filed

## TECHNOLOGY BY:

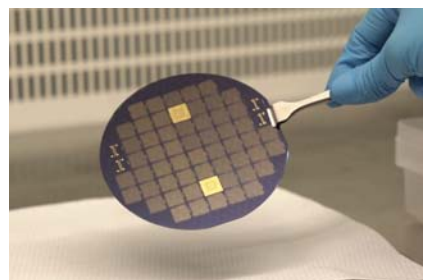
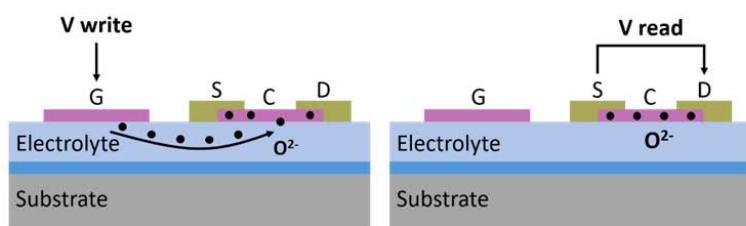


## CHALLENGE

Stable and Si-compatible  
synaptic transistors

## APPLICATIONS

Neuromorphic computing  
(autonomous driving, smart diagnosis  
or natural-language understanding)



## DESCRIPTION

The technology is a **synaptic transistor** or a **non-volatile memory** based on a solid oxide ion gating to be applied to **neuromorphic computing**.

This **new generation transistors** overcome Paul-Newmann architecture limitation of conventional CMOS technology and the limitations on stability and integration of current synaptic transistors.

The main disruption of this technology is the solid oxide thin film electrolyte able to **work at low temperature**. This feature opens the door to a full new range of applications in microelectronic sector, such as autonomous vehicles, diagnosis or security.

## NOVELTY

- Multilevel synaptic transistor and memory all-in-one
- Analog switching performance for neuromorphic computing
- Independent of atmospheric conditions
- Operation in low temperatures
- Compatible with mainstream microelectronic technology

Prototype testing in lab conditions

## FURTHER DEVELOPMENT

## DESIRED PARTNERS

Microelectronic integrator and the semiconductor industry. Integrated device manufacturers. SW and HW designers, Silicon intellectual property and design houses.

## CURRENT TRL

4

## TIME-TO-MARKET

3 years

## IP PROTECTION

Patent application filed

## TECHNOLOGY BY:

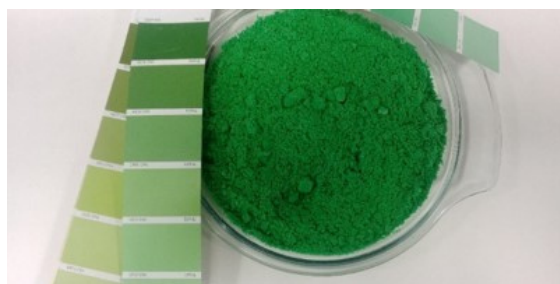


## CHALLENGE

Suitable catalysts for advanced  
methanation reactors

## APPLICATIONS

Conversion of CO<sub>2</sub> into renewable  
natural gas



## DESCRIPTION

The technology consists on the manufacturing of **catalytic material** able to **convert green hydrogen** and **carbon dioxide** to **renewable fuels**. The developed material is suitable for **advanced reactors** and processes. The materials and the process have been implemented in a pilot plant at relevant environment; specifically, in a waste water treatment plant. The catalyst exhibited **higher activity**, **stability** and **tolerance to industrial impurities** compared to the commercial references. The obtained **synthetic natural gas** has similar composition than the fossil natural gas and can be used in the same applications, i.e. household heating, industry and power.

## NOVELTY

- Can be implemented in advanced micro-reactors
- Increase efficiency of catalytic reactor (about 25%)
- More stable, 4x volume reduction vs commercial catalysts

## FURTHER DEVELOPMENT

- Expand the portfolio of the catalytic materials
- Catalyst shaping according to customer requirements

## DESIRED PARTNERS

Reactor engineering companies (for testing the catalysts), end-users (energy industry or companies that aim to convert carbon dioxide into synthetic natural gas) and investors or accelerators.

## CURRENT TRL

5  
(tested in a relevant  
environment)

## TIME-TO-MARKET

2 years

## IP PROTECTION

Patent application filed

# FOWAPP - THE FLOATING OFFSHORE WIND ASSESSMENT APP

## TECHNOLOGY BY:

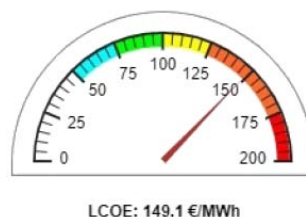


## CHALLENGE

Performing quick and easy  
economical analysis  
of floating wind farms

## APPLICATIONS

Plan, development and evaluation  
of floating offshore wind farms



## DESCRIPTION

FowApp is a **desktop application** that performs quick and easy economical analysis of **floating offshore wind farms**.

The software calculates the **Levelized Cost of Energy (LCOE)** a detailed **life cycle assessment (LCA)**, **Life-Cycle Costs (LCC)** and **Annual Energy Production (AEP)**.

It includes a editable library for the user inputs, such as environment specifications, wind farm components or auxiliary means. It provides information for **decision-makers**, particularly related to the early project development, the technology assessment, the environmental impact evaluation and the performance analysis.

## NOVELTY

- Quick and reliable results
- Overall scenario overview, as well as the intermediate steps
- User friendly and high usability
- Editable library, depending on user preferences

## FURTHER DEVELOPMENT

The App is currently in the process of prototype testing, and will pursue the commercial deployment shortly after final testing.

## DESIRED PARTNERS

Project developers, specialised engineering companies, consultancies and data aggregators.

## CURRENT TRL

5-6

## TIME-TO-MARKET

1 year

## IP PROTECTION

Registered solution



# VERSATILE AND RESILIENT POWER CONVERTER

## TECHNOLOGY BY:

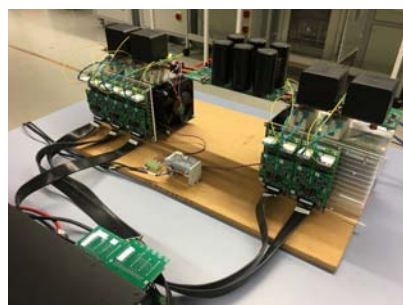
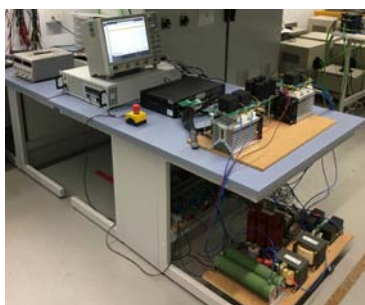


## CHALLENGE

Minimize the impact of failure in the electricity service

## APPLICATIONS

Fault-tolerant converters, specially relevant for remote areas or critical systems



## DESCRIPTION

Power converters are essential for the energy transition towards a system based on renewable electric energy generation, the electric power storage and the electrification and integration of the new vehicles. This **power converter** is adapted to **handle renewable energy** efficiently: from generation, storage to the electrification and integration of new vehicles. It is **fault-tolerant**, avoiding internal failure of the switches, **saving money** and network **problems**. Additionally, it is internally **reconfigurable**, remaining in operation after the fault (automated), while minimizing redundant components.

## NOVELTY

- 40% of capital cost reduction
- Provides reliability of the electrical network
- More than 50% extended lifespan
- Facilitates the implementation of renewables

## FURTHER DEVELOPMENT

After the development and lab-testing of the technology (ongoing), it is required a scale-up for the proof-of-concept, and testing in real conditions.

## DESIRED PARTNERS

Industrial partners in the field of power electronics and investors interested in the scale-up and potentially a spin-off creation.

## CURRENT TRL

4

## TIME-TO-MARKET

4 years

## IP PROTECTION

Patent application filed  
(EP3975401A1)

## TECHNOLOGY BY:

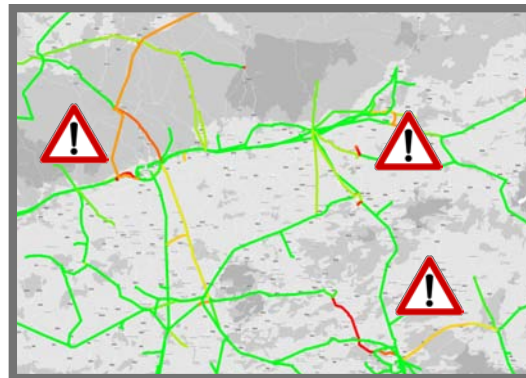


## CHALLENGE

Forecasting risks for the electrical grid in extreme weather events

## APPLICATIONS

Electrical distribution planning, risk prevention and resilience of the electrical grid



## DESCRIPTION

GridWatch is a practical tool that **identifies risk areas** in the **electrical network** in case of **extreme weather events**, such as sudden floods, strong winds or unexpected fire.

It can early **detect vulnerabilities of the system** and translate them to **risk of network failure** in a period from the current time to a forecast of 7 days ahead. The tool improves **network resilience** when applying **corrective and mitigating measures** in the risk areas.

## NOVELTY

- Low-cost of implementation
- Grid failure locations forecasting interdependent impact
- Risk of failure alerts of the grid based on meteorological data
- Easy to manage and user friendly

## FURTHER DEVELOPMENT

Implementation of a fire alarm system detecting the areas with major wildfire risk and the integration of the self-healing algorithms in order to reconfigure the grid for an optimal power delivery after a failure.

## DESIRED PARTNERS

Electric utility companies.

## CURRENT TRL

7

## TIME-TO-MARKET

1-2 years

## IP PROTECTION

Registered solution

## TECHNOLOGY BY:

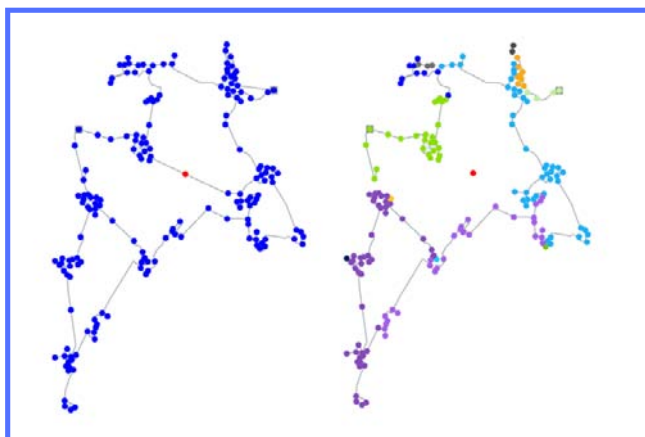


## CHALLENGE

Improve the resilience of the electrical grid

## APPLICATIONS

Electrical grids with faults, cyberattacks, microgrids or other emergencies



## DESCRIPTION

This is a **software solution** designed to **minimize the negative impact** of failures in energy supply and to **maximize system resilience** through grid reconnection and sectorialization in microgrids.

The software computes the **optimal electric scheme** of the grid to isolate the problem and continue the operation.

## NOVELTY

- Specifically designed to isolate the fault
- Allows service continuation, bypassing the faulty element
- Low cost of implementation
- Increases grid resilience

## FURTHER DEVELOPMENT

Improve the time response of the tool and compare it with other algorithms and validate the algorithm with more pilot sites/user cases. This algorithm will be integrated at the GridWatch tool.

## DESIRED PARTNERS

Transport System Operators, Distribution System Operators, SCADA developers and system managers.

## CURRENT TRL

6

## TIME-TO-MARKET

2 years

## IP PROTECTION

Registered solution

## TECHNOLOGY BY:



## CHALLENGE

Making demand aggregation a reality

## APPLICATIONS

Distributed energy resources  
Energy markets  
Global cloud computing



## DESCRIPTION

CASE is a software platform of choice for **demand aggregators**. Demand aggregators are the **new market actors** that enable **demand side response** and **flexibility** to participate in energy markets and grid services. It provides advanced technological solutions to **monetise demand management** and **flexibility** of energy assets to allow the **integration of renewable energy sources**.

CASE aims to accelerate the **energy transition**, **democratize** the access to cleaner and cheaper energy, placing the **consumer in the center** of the energy system.

## NOVELTY

- Reduces energy cost
- Improves innovation and sustainable corporate image
- Increases energy efficiency
- Scalable- it is based on the cloud

## FURTHER DEVELOPMENT

Technology and market deployment, growth and market expansion. Pre-commercial proof-of-concept program in 2021.

## DESIRED PARTNERS

Industrial and commercial partnerships to demonstrate CASE technical and economic feasibility: energy retailers, aggregators, ESCO's, EV fleet managers.

## CURRENT TRL

6

## TIME-TO-MARKET

<1 year

## IP PROTECTION

Registered solution.  
Licensed to Bamboo Energy

## TECHNOLOGY BY:



## CHALLENGE

Smart management of energy using different types of consumption, generation and storage

## APPLICATIONS

Smart energy management for microgrids, buildings, e-parkings or local energy communities



## DESCRIPTION

SEMS is a product for the **optimal management** and rational use of **energy**. It is a **hardware** and **software solution** for the smart and dynamic energy management of **self-consumption solutions** that is able to include multiple types of **consumption** and **generation units**, **energy storage** systems, as well as **electric vehicle** charging infrastructure or **vehicle-to-grid** systems.

SEMS offers the **intelligence** necessary to find the **optimal operation of the system**, to minimize energy costs, energy consumption peaks and emissions, all autonomously and automatically.

## NOVELTY

- Monetize the flexibility of energy assets
- 10-15% reduction of energy bills and peak shaving
- 20% increase in energy storage usage
- 10% increase in self-consumption of renewables

## FURTHER DEVELOPMENT

Commercialization of the product

## DESIRED PARTNERS

Any company or entity requiring smart energy management

## CURRENT TRL

7-8

## TIME-TO-MARKET

2 years

## LICENSING

Registered solution.  
Licensed to Bamboo Energy

## TECHNOLOGY BY:

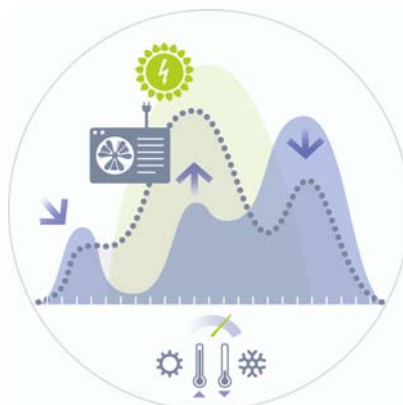


## CHALLENGE

Improving thermal  
energy efficiency in buildings

## APPLICATIONS

Heat pumps, flexible heating and  
cooling loads, control and operation  
of HVAC systems



## DESCRIPTION

Two complementary **control algorithms** improve **operation** and **performance** of **heating and cooling** systems:

A **fault detection and diagnosis** (FDD) algorithm assesses heat pump performance, identifies anomalies to reduce energy and operational costs

A **predictive control scheme** (MPC) enables to plan and operate heat pumps or other HVAC systems in an optimal way based on external inputs. The solution takes into account the specificities of the system, short-term forecasts of weather, occupancy and prices.

## NOVELTY

- 20-30% energy savings
- Better heat pump maintenance
- Improved thermal comfort
- Reduction of energy bills (up to 30%)

## FURTHER DEVELOPMENT

Testing the solution in real buildings- pilot testing.

## DESIRED PARTNERS

Heat pump manufacturers, facility managers, aggregators of flexibility, owners or constructors of buildings, developers of energy management systems.

## CURRENT TRL

5-6

## TIME-TO-MARKET

1-3 years

## IP PROTECTION

n/a



## TECHNOLOGY BY:

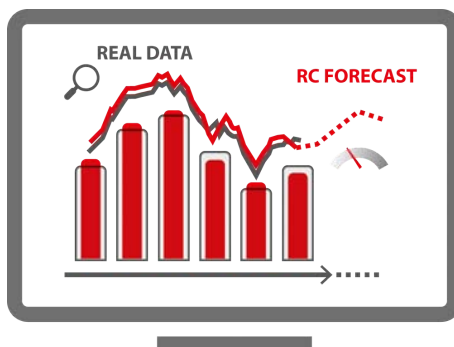


## CHALLENGE

Improving energy efficiency in new or existing buildings

## APPLICATIONS

Energy audits, recommendations to users, predictive control, flexibility at district level



## DESCRIPTION

Building reduced models (RM) are **simplified building behavior algorithms** that predict the energy profile using few resources. The models define the **key parameters** able to **explain and forecast** the energy demands and consumption behaviour of the building. They can be adapted to various cases, ready to be implemented in existing technologies or devices. They can predict the user behaviour and user interaction with the building and serves for the assessment and predictive maintenance of technologies.

## NOVELTY

- 20-30 % energy savings
- 30-50 % energy cost reduction
- Improved thermal comfort
- Optimized maintainance

## FURTHER DEVELOPMENT

Train the existing reduced models with real data coming from existing buildings to harmonize the solutions and define the required optimal steps for case-to-case adaptation.

## DESIRED PARTNERS

Monitoring devices producer, BIM developers, BEMS developers, district tools producers, DSO and utilities.

## CURRENT TRL

6

## TIME-TO-MARKET

1-3 years

## IP PROTECTION

n/a

## TECHNOLOGY BY:

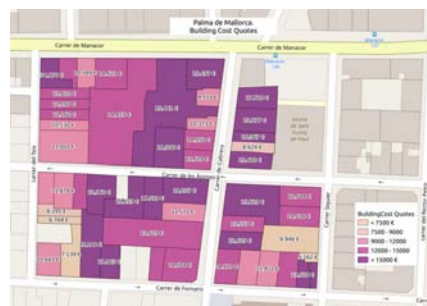


## CHALLENGE

Detailed economic and financial information for large-scale retrofitting actions

## APPLICATIONS

Large scale retrofitting under a private public partnership



## DESCRIPTION

The business model supports a **reliable predictive economic and financial estimation** of potential businesses from **large-scale retrofitting actions**, under a **PPP** (Private Public Partnership) framework. It performs a **quantitative evaluation** and **analyses the critical elements** of the operation for the different types of stakeholders. The most critical parameters can be analysed in a **sensitivity analysis** around a defined case base. Once provided a short number of systematised inputs listed in a wizard, the business model will automatically display **valuable financial assessment results** (outputs) for different stakeholders in the process.

## NOVELTY

- Results are relevant for PPP stakeholders and users.
- Economic impact based on % of participation, loan's duration and cost of renovation.
- Only known tool to address the financial appraisal of Large Scale Retrofitting under a PPP ranging from 150-300 dwellings in several building (10-50)

## FURTHER DEVELOPMENT

Promotion of the tool for its next exploitation. Interoperability and/or implementation in GIS software and other web platform is planned. Testing of tool on demo sites.

## DESIRED PARTNERS

Private and SME stakeholders (e.g. investors from real estate, urban design) and public sector (e.g. municipalities)

## CURRENT TRL

6

## TIME-TO-MARKET

2 years

## IP PROTECTION

Registered solution

# STOCHASTIC MODEL OF OCCUPANCY BEHAVIOUR, ELECTRIC CONSUMPTION AND DOMESTIC HOT WATER DEMAND

## TECHNOLOGY BY:

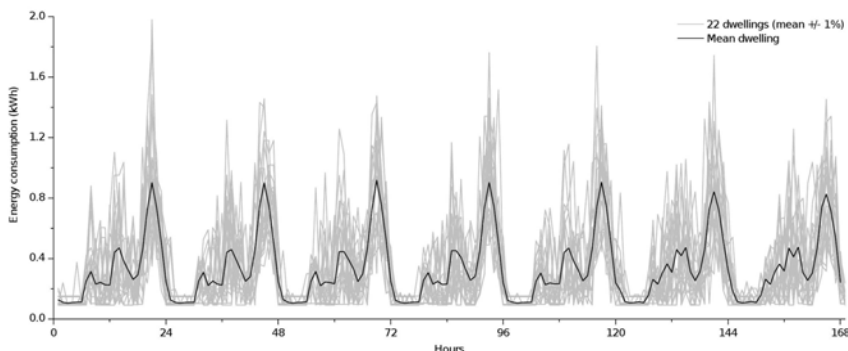


## CHALLENGE

Reproduce variability between dwellings due to the stochastic behavior

## APPLICATIONS

PED and neighbourhoods. Electrical grid optimization and renewable energy systems integration



## DESCRIPTION

The stochastic model generates **occupancy patterns**, **electric consumption** related to electric devices and **domestic hot water profiles for residential buildings**. Those profiles are provided with a **high time resolution**, 3-minutes. The profiles are generated randomly, based on different statistical datasets, and are able to **reproduce realistic households** with different occupancy levels and electric devices. The profiles are different from one household to another, and at the same time, from one day to another. The model is implemented in **TRNSYS**, as a Type/Subroutine coded in Fortran.

## NOVELTY

- High resolution: 3 minutes
- Adapted to Spanish behaviour
- Flexible methodology that can be adapted to: occupancy levels and scenarios, stock of appliance and energy performance.

## FURTHER DEVELOPMENT

Implementing the model for different occupancy scenarios. Validation of the model with different monitoring datasets and scenarios.

## DESIRED PARTNERS

Municipalities and building managers

## CURRENT TRL

7

## TIME-TO-MARKET

2 years

## IP PROTECTION

Registered solution

## TECHNOLOGY BY:



## CHALLENGE

Development of suitable components for fusion energy

## APPLICATIONS

Design of accelerator and fusion-related mechanical components



## DESCRIPTION

The FusionCAT-ACDPT tool can perform calculations related to the **design of accelerator and fusion-related mechanical components**. It determines and **validates designs** of such components using different industry standards and methods. Uses **widely known codes and standards**, brought together for the first time for accelerator components design. The tool is already being used to design components of IFMIF-DONES's High Energy Beam Transport (HEBT) and Beam Dump (BD) line.

## NOVELTY

- Assists on the validation of designs
- Specially designed for accelerator and fusion components
- Time saving
- Reduces cost of implementation

## FURTHER DEVELOPMENT

Adding new functionalities, such as hexapod positioning tool, structural simulation with seismic criteria, radiation shield thickness determination, among others.

## DESIRED PARTNERS

Experienced institutions in particle accelerator and fusion-related technologies

## CURRENT TRL

5-6

## TIME-TO-MARKET

2 years

## IP PROTECTION

Registered solution

## TECHNOLOGY BY:



## CHALLENGE

Circular economy  
Thermal and acoustic insulation  
material

## APPLICATIONS

Sound insulation panels,  
multilayer wall partitions,  
underflooring, flexible membranes



## DESCRIPTION

REWASTEE **recycles** electric arc furnace dust (EAFD) – transforming the byproduct with a patented process into a usable building product for construction applications. What is unique about REWASTEE is the integration of phase change materials into the recycled material resulting in a product with high thermal inertia.

## NOVELTY

Alternative for recycling and stabilization of EAFD, by encapsulating the waste in an ethylene propylene diene monomer (EPDM) matrix and the addition of organic compounds that act as phase change materials (PCM), achieving a flexible dense sheet with acoustic and thermal properties.

## FURTHER DEVELOPMENT

This product is demonstrated in a relevant environment. It needs to be proven in operational environment.

## DESIRED PARTNERS

Companies interested in scaling the product.

## CURRENT TRL

6-7

## TIME-TO-MARKET

This technological  
process is currently  
available

## IP PROTECTION

Spanish patent granted  
(ES2450765A2)



## TECHNOLOGY BY:



## CHALLENGE

Optimal management of energy hubs

## APPLICATIONS

Decision support Toolkit:  
Forecasting, statistical  
monitoring and scheduling services



## DESCRIPTION

The solution is conceived as a **commercial off-the-shelf (COTS) solution, ready to be integrated** within DMS (Distribution Management Systems), BMS/BEMS (Building Energy Management Systems), IoT middlewares and other facility operation software. A suite of web services that provides **enhanced energy monitoring and scheduling capabilities**. Monitoring methods are built on data mining methods and follow fault detection and isolation principles. Scheduling consists on optimal solutions provided by artificial intelligence methods. Data models allow to automatically build reference models for enhanced monitoring, forecasting and assets optimisation in a low voltage grid context or energy multi-vector scenarios.

## NOVELTY

- Easy integration
- Multivariate modelling
- Time-granularity
- Direct connectivity with weather forecasting agencies

## FURTHER DEVELOPMENT

- Prototype final integration and validation
- Valorisation and product requirements (market approach)
- Business and marketing plans

## DESIRED PARTNERS

DSOs, ESCOs, monitoring system providers, aggregators, energy communities and cooperatives, facility managers, building owners, middleware providers

## CURRENT TRL

6

## TIME-TO-MARKET

2 years

## IP PROTECTION

n/a



## TECHNOLOGY BY:



## CHALLENGE

Boosting reverse osmosis membrane technology towards the circular economy

## APPLICATIONS

Water treatment sector  
Reverse osmosis membranes users



Reverse osmosis membranes



Reverse osmosis membranes  
Hosted in the membrane housing device



## DESCRIPTION

The technology gives sustainable and environmentally friendly solutions to the **reverse osmosis (RO) membrane** waste generated in the **water treatment** sector (e.g. seawater desalination) by **regenerating the membranes** for a second life and selling them back to the market. End-of-life RO membranes have to be preserved properly before the regeneration process. Preservation and the gravity-driven regeneration process are completed by the **membrane housing device** (patented). The invention will be also useful for applying recycling processes to convert the RO performance into nanofiltration and ultrafiltration performance and for manufacturing compact gravity-driven **filtration systems** using recycled ultrafiltration membranes

## NOVELTY

- Saves up to 60% membrane replacement costs and prolongs its lifespan by at least 50%
- Uses less energy reaching the water quality standards
- Avoids 85.5 Kg CO<sub>2</sub> and 12 kg plastic disposed of in landfills

## FURTHER DEVELOPMENT

Increasing proofs of concept in industry up to 20 cases in different customs segments, creation of the spin-off and attraction of public and private funds

## DESIRED PARTNERS

Desalination plants for drinking water, irrigation and industry processes, membrane manufacturers and wastewater treatment plants (landfill, leachate, swine, mining, etc).

## CURRENT TRL

7

## TIME-TO-MARKET

1 year

## IP PROTECTION

Patent application filed  
(EP20382065)

## TECHNOLOGY BY:

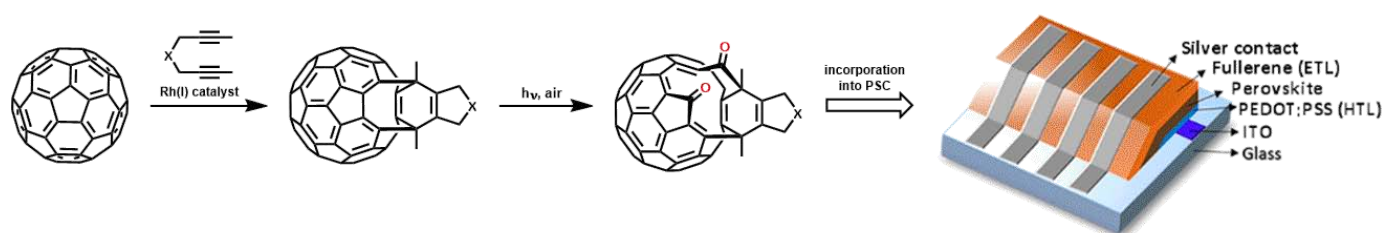


## CHALLENGE

Efficient solar cell materials based on perovskites

## APPLICATIONS

Solar cells



## DESCRIPTION

A **simple route** is developed to synthesize oxidized open-cage **fullerene derivatives** that are then incorporated as electron-transporting materials in **perovskite solar cells**. The obtained devices provide competitive power conversion efficiencies, open-circuit voltage values and good stability.

These good figures arise from the high perovskite passivation ability of the open-cage fullerenes, and a good overlap between the highest occupied molecular orbital/lowest unoccupied molecular orbital levels of our derivatives and the conduction band of the perovskite.

## NOVELTY

- High stability
- Combination of mechanisms for perovskite passivation
- Combined role as passivation layer and electron-transporting material

## FURTHER DEVELOPMENT

Product development by establishing economically optimized scale procedures and identifying the ideal configuration and preparation methods.

## DESIRED PARTNERS

Solar panel manufacturers or providers of components for their fabrication.

## CURRENT TRL

2

## TIME-TO-MARKET

7 years

## IP PROTECTION

n/a

## TECHNOLOGY BY:

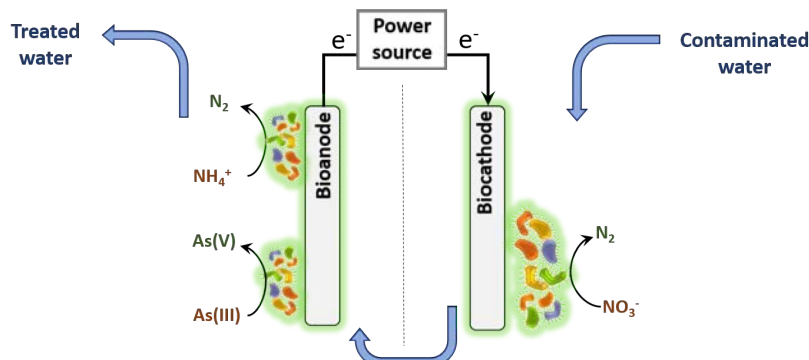


## CHALLENGE

Waters contaminated with ammonium, nitrate or arsenic

## APPLICATIONS

Treatment of groundwater and wastewater



## DESCRIPTION

Microbial electrochemical technologies are used for the **bioremediation of contaminated waters**. Electroactive bacteria capable to use an electrode as electron donor or electron acceptor allow the **removal of ammonium, arsenic and nitrate**. Bioelectrochemical reactors are engineered and operated for the selective bioremediation of the target pollutant at **low energy costs** and **without** the need of **chemicals** addition (common method for dealing with these contaminants).

## NOVELTY

- Usage of renewable and low-cost catalysts (microorganisms)
- Lower energy consumption

## FURTHER DEVELOPMENT

- Improve current removal rates and reactor's scalability
- Implement methods for hardness removal
- System prototype demonstration in operational environment - Increase to TRL 7

## DESIRED PARTNERS

Investors and industrial partners

## CURRENT TRL

6  
(technology demonstrated in relevant environments)

## TIME-TO-MARKET

<10 years

## IP PROTECTION

Patent on nitrate bioremediation:  
(EP 1238471.6  
PCT/EP2013/074711).

## TECHNOLOGY BY:

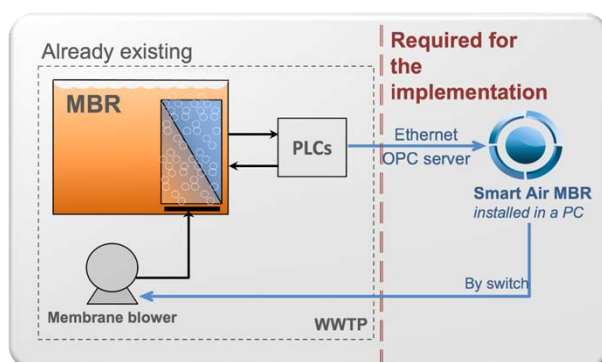


## CHALLENGE

Energy savings, membrane life  
time extension

## APPLICATIONS

Membrane bioreactors  
Wastewater treatment plants  
Hollow / flat sheet fibre



## DESCRIPTION

SmartAirMBR® is an automatic control system for membrane bioreactors (MBRs), a consolidated technology for the biological treatment of industrial and urban wastewater. SmartAirMBR® regulates the air-scour flow in the membrane tank based on the permeability evolution. It is the only product on the market that effectively reduces the energy costs associated with membrane bioreactor aeration according to the online monitoring of permeability, and places it in an excellent competitive position. SmartAirMBR® can contribute to promote the use of MBRs, benefiting their users and accelerating the technology's implementation.

## NOVELTY

Real time monitoring for fouling control.  
Easy to implement

## FURTHER DEVELOPMENT

Integrate a fouling prediction model in the control system

## DESIRED PARTNERS

Industrial partners to validate the technology in other facilities

## CURRENT TRL

6

## TIME-TO-MARKET

2 years

## IP PROTECTION

Patent granted

## TECHNOLOGY BY:

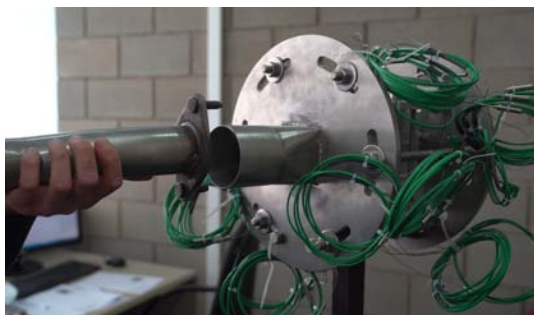


## CHALLENGE

Low cost per energy produced

## APPLICATIONS

Heat and power generation for zero energy buildings or isolated households



## DESCRIPTION

WOODTRICITY is a **biomass-powered mCHP** that produces part of the daily **electricity** and **hot water** needed for a household. It uses thermoelectric technology and the innovation relies on a mechanism, based on pulsating heat, that makes conventional and cheap **thermoelectric generators** improve their effective efficiency by a factor of 4 (from 1.25% to 5%). This system opens the door to a **new business opportunity**. WOODTRICITY is the first mCHP system that fulfils required indicators to generate sufficient market penetration: production of cheap and green energy, low initial investment and low payback time.

## NOVELTY

The innovation relies on a mechanism, based on pulsating heat, that improves the efficiency of the thermoelectric generator and reduces the cost per energy produced compared to other systems like ORC or Stirling.

## FURTHER DEVELOPMENT

Scale-up the laboratory prototype to a minimum viable product. Carry out an experimental proof of concept.

## DESIRED PARTNERS

Industrial partners in the biomass heating segment with similar products on the market. Interested customers for concept testing. Other entities interested on transforming heat or waste heat into electricity.

## CURRENT TRL

5

## TIME-TO-MARKET

1-2 years

## IP PROTECTION

n/a

## TECHNOLOGY BY:

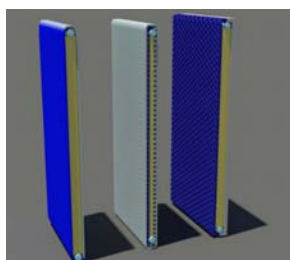


## CHALLENGE

Minimize buildings energy consumption

## APPLICATIONS

Building industry  
Application in walls, floors, roofs, fenestrations and doors



## DESCRIPTION

The technology consists in a novel **dynamic thermal system** to be used in buildings to **minimize** their **energy consumption** for space **heating and cooling**. It is composed of several layers of materials, being one of them mobile and containing a material with capacity to absorb and release high amount of heat - such as **phase-change materials** (PCM). In winter during the day, the PCM layer is exposed outdoors to capture and store solar radiation whilst by night it is placed indoors to release the absorbed energy to provide comfort to occupants. In summer, the PCM is moved to face outdoors to be solidified, and during the day is moved back indoors to discharge the cooling to the indoor environment. This system **works cyclically** and allows the building to **optimize** its **bioclimatic behavior**.

## NOVELTY

- Significant energy savings
- Envelope as space heating and cooling supplier
- Unique aesthetic and commercial options

## FURTHER DEVELOPMENT

To design and create a prototype to experimentally test and demonstrate its high performance under a relevant environment. Investment needs 150.000 – 500.000€.

## DESIRED PARTNERS

- Industrial partners to develop a viable product
- Future clients for technology transfer under a license agreement

## CURRENT TRL

3

## TIME-TO-MARKET

3-5 years

## IP PROTECTION

Spanish Patent granted  
European Patent filed



## TECHNOLOGY BY:



## CHALLENGE

Thermal energy storage  
materials from agro-foods

## APPLICATIONS

Energy thermal storage  
in buildings and industry



## DESCRIPTION

**Bio-based phase change materials (PCMs)** are prepared from oils and fats of low commercial value, such as those found in the **by-products of animal origin** not intended for human consumption.

Bio-based PCMs show a substantial **improvement of energy density performance** compared to products with similar characteristics currently on the market. The application of this product focuses on the energy aspect, as a material to be used in **thermal energy storage technologies**.

## NOVELTY

- Materials based on by-products from industrial processes (fatty acids, vegetable oils or esters)
- Not based on paraffins or salt hydrates (state-of-the-art)
- Lower carbon footprint than commercial petroleum-derived PCMs and other existing bio-PCMs

## FURTHER DEVELOPMENT

- To optimize the production and scale up at pilot plant level
- To design, build and commission a prototype of a heat exchanger (prototype start-up)

## DESIRED PARTNERS

- Companies that produce and market storage materials
- Investors for a future spin-off

## CURRENT TRL

3

## TIME-TO-MARKET

4 years

## IP PROTECTION

Spanish Patent granted  
(ES2611780B1)

## TECHNOLOGY BY:

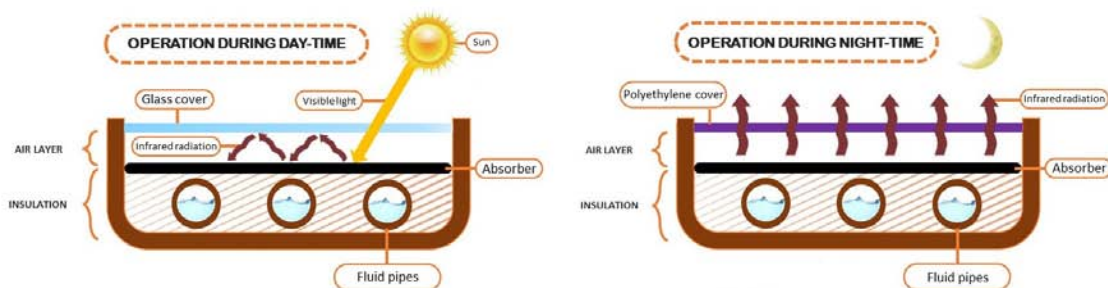


## CHALLENGE

Improved solar thermal collectors for buildings

## APPLICATIONS

Residential buildings  
Industrial sector



## DESCRIPTION

This solution combines the two functionalities: a solar thermal collector and a radiative cooler, requiring an **adaptive cover**. This cover is transparent to solar radiation and opaque to long-wave radiation at daytime, allowing solar collection and reducing heat losses, and transparent to long-wave radiation at night-time, facilitating radiative cooling.

The solution has a similar geometry and composition as a **solar thermal collector** with an improved adaptive cover. It preserves the simplicity and efficiency of solar thermal collectors, and a similar production cost, adding and extra cooling production, making it more cost-effective.

## NOVELTY

- Provides renewable heat and cold
- Reduces energy consumption
- Reduces the complexity of the system
- More cost-effective than commercial solutions

## FURTHER DEVELOPMENT

Testing under real conditions and validation in a real environment.

## DESIRED PARTNERS

Solar collector companies and companies producing cooling systems (heat pumps) and other thermal equipment. Advanced/smart optical material partners (for manufacturing or development of smart optical materials).

## CURRENT TRL

4

## TIME-TO-MARKET

5-6 years

## IP PROTECTION

Patent pending

## TECHNOLOGY BY:

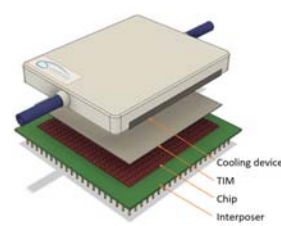
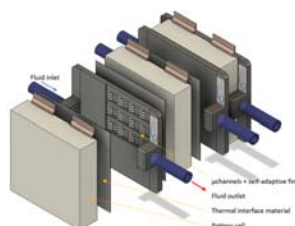
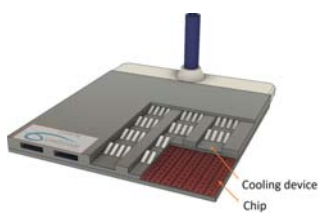


## CHALLENGE

Advanced energy efficient thermal management

## APPLICATIONS

Data centres, power electronics, electrical vehicle, solar technologies and advanced semiconductors



## DESCRIPTION

The accelerated growth of **data processing** during the last decades has increased the need to attend to **thermal loads** in a **more efficient and sustainable** way. The proposed technology is an innovative **liquid-cooled self-adaptive heat sink** capable of efficiently adapting the distribution of its heat extraction capacity to time-dependent and non-uniform heat load scenarios. The proposed thermal management solution can be implemented at different levels, to become an on-chip or in-chip liquid cooling solution. **Scalable** and with a **simple design** which can be easily implemented. Technology developed at the *University of Lleida* in collaboration with the *University of Sherbrooke*.

## NOVELTY

- Improved thermal performance to remove up to 300 W/cm<sup>2</sup>
- Energy efficiency (pumping power reduced 30-70%)
- Smart optimization for any kind of heat loads scenario
- Compact, reduce heat sink size (x10)
- Self-adaptative solution (no customized design)
- No need for sensors, external actuators or external power

## FURTHER DEVELOPMENT

Testing under relevant environment (proof-of-concept), perform reliability tests of the concept, finalizing with the design and fabrication of a final prototype for product validation.

## DESIRED PARTNERS

Data centres, and electric vehicle, solar technologies and advanced semiconductors manufacturers to perform pilot projects.

## CURRENT TRL

5

## TIME-TO-MARKET

2 years

## IP PROTECTION

Transferred to the spin-off Uniscool.

# DUAL ACTIVE BRIDGE ISOLATED BIDIRECTIONAL DC-DC CONVERTER

## TECHNOLOGY BY:

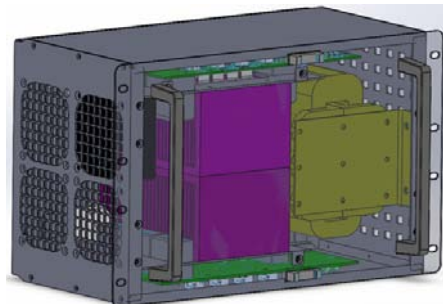


## CHALLENGE

Isolated Bidirectional DC-DC converter

## APPLICATIONS

Battery integration  
V2G chargers  
Compact transformer



## DESCRIPTION

The **Dual Active Bridge (DAB) converter** provides galvanic isolation between different battery technologies or DC links with compact dimensions.

It transmits up to 20 kW of **bidirectional power** for applications such as **electric-vehicle chargers** (i.e. V2G or V2H), **battery integration**, or provide isolation to back to back **converters**.

The power converter is quickly placed because it perfectly adjusts to rack dimensions, and it is easily parallelizable since its power terminals fit in the busbar.

High power hybrid Si-SiC DAB controlled with soft-switching modulation strategy.

## NOVELTY

High power hybrid Si-SiC DAB controlled with soft-switching modulation strategy. The mix of semiconductor technologies results in an effective cost reduction compared with a full SiC IBDC without penalizing converter losses.

## FURTHER DEVELOPMENT

Adapt to a different mix of wide-bandgap semiconductor technologies. Design and implementation of the magnetics. Design the whole converter for easy assembly.

## DESIRED PARTNERS

Electric vehicle chargers manufacturers. Automakers. DSO or UPS manufacturers.

## CURRENT TRL

7

## TIME-TO-MARKET

1-2 years

## IP PROTECTION

Industrial secret

## TECHNOLOGY BY:



## CHALLENGE

Planning, monitoring, operation and maintenance of power grids

## APPLICATIONS

Energy forecasting, fraud detection, optimal operation and maintenance of distribution grids

Circuit breaker Tap changer

LIST MAP

Download file

Asset ID	Time to failure (days)	Probability of failure (%)	Criticality of failure	Asset health index
13L92	22	84	3	103
45M10	32	77	2	87
12C16	17	80	1	76
87L42	42	64	2	52
91A109	65	53	3	38
57L32	83	36	1	22
113C05	112	18	1	13

## DESCRIPTION

Nowadays, huge amounts of **energy-related data** are available, mostly from **smart meters** latest deployments. The appropriate processing of this data can boost innovative tools and services. Through the use of AI techniques such as **optimization, supervised learning, deep learning, reinforcement learning, data mining** or **pattern recognition**, innovative business solutions for the energy market can be used to improve the planning, operation, maintenance and monitoring of electrical distribution grids.

## NOVELTY

Include new AI techniques in the power system management to enable data-driven decision making in the operation, planning and maintenance processes.

## FURTHER DEVELOPMENT

These tools have been tested at pilot sites. It will be a commercial product by improving the robustness and performance of the developed solutions.

## DESIRED PARTNERS

System operators, energy suppliers and aggregators, microgrid operators, and e-mobility service providers.

## CURRENT TRL

6-7

## TIME-TO-MARKET

2-3 years

## IP PROTECTION

Industrial secret

TECHNOLOGY BY:

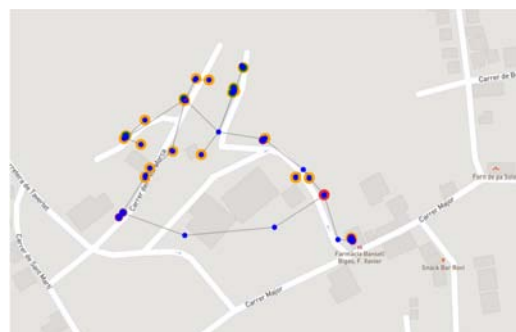
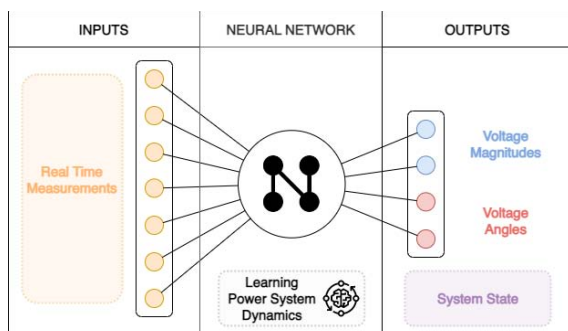


## CHALLENGE

## Modernization of the electric grid

## APPLICATIONS

## Smart Grids, electrical industry and distribution grids



## DESCRIPTION

The Artificial Neural Network based State Estimation (ANN-SE) provides **local grid observability** to the Distribution Systems Operator (DSO) in low voltage (LV) power grid areas, that are normally unobservable.

The product performs the State Estimation at distribution level with a low number of available measurements. This enables the DSO to control normally un-observable LV grids. The tool leverages AI and simulation based techniques to carry out the grid monitoring task through the estimation of the network state.

## NOVELTY

- Solves the problem of unobservability in LV grid
- Low-cost monitoring with scarce measurements
- Leverage on AI tools
- Leverage on digital twin simulations of the power grid

## FURTHER DEVELOPMENT

Field testing and integration (proof of concept) will be soon tested in real pilot site conditions. The software product will be offered within a DSO toolbox.

## DESIRED PARTNERS

Mainly distributor system operators (DSOs), while independent grid owners and local energy communities can benefit from this solution.

## CURRENT TRL

2-3

## TIME-TO-MARKET

1 year

## IP PROTECTION

n/a



## TECHNOLOGY BY:



## CHALLENGE

Predictive and optimizer model control

## APPLICATIONS

Electric scooters, vehicles and machines



## DESCRIPTION

**Electronic controller** based on Field Oriented Control for both an **electric motorbike** and electric **mild-hybrid vehicle** for Synchronous Permanent Magnet Machines. Specs:

Rated power of 6.6 kW, and peak power at 20 kW. Low-voltage range of 36 to 60 V. Control board and power electronics integrated into unique equipment for compact and robust solutions. CAN interface communications to straightforward integration in the electrical vehicle network. Thermal design by finite element analysis. Off-line parametrisation through an easy user interface from the characteristics parameters of the electrical machine and the battery. Off-line firmware update, facilitating the upgrade of its functionalities.

**Real time monitoring** of the powertrain status, alarms and control variables.

## NOVELTY

- Complete torque-speed capabilities
- Easy tuning of the machine and controller assembly
- Predictive thermal de-rating to maximise power

## FURTHER DEVELOPMENT

Product development to reduce production costs and Industrialisation of the mechanical and electrical design to comply with the regulations.

## DESIRED PARTNERS

Electronic controller developers and electric motorbike or vehicle manufacturers.

## CURRENT TRL

7

## TIME-TO-MARKET

1 year

## IP PROTECTION

Industrial secret

## TECHNOLOGY BY:

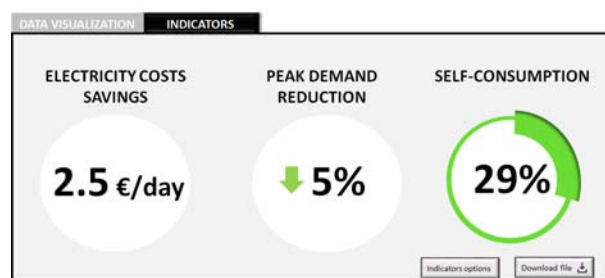
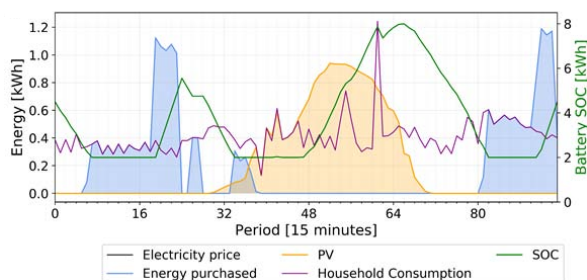


## CHALLENGE

Optimization of building energy management

## APPLICATIONS

Electricity bill minimization  
Self-consumption maximization  
Efficiency increase



## DESCRIPTION

The **Building Energy Management System (BEMS)** is a control and monitoring system for optimally operating flexible devices. The same concept can be used to manage not just one building but a group of buildings within the same local energy community with self-consumption and collective storage.

The BEMS allows **controlling electrical assets** at the **household level** (e.g., HVAC, water heater, battery storage, PV generation, heat pump, EV) and also on the **community level** (e.g., battery storage, PV plants, EV stations) in order to best utilize own optimization criteria and/or provide a flexibility service to third parties through incentive-based programs.

## NOVELTY

- Can control many different devices (electric water heaters, HVAC, electric vehicles, batteries, solar panels)
- Can optimize considering emitted greenhouse gas emissions

## FURTHER DEVELOPMENT

- Testing at a pilot site
- Implement business strategies for commercialization of the product

## DESIRED PARTNERS

Batteries and PV companies. Residential households. Commercial/ business buildings. Collaborations with : household and/or buildings for testing.

## CURRENT TRL

4-5

## TIME-TO-MARKET

1 year

## IP PROTECTION

Industrial secret

## TECHNOLOGY BY:



## CHALLENGE

Providing energy and power services

## APPLICATIONS

Integration of renewables, Power quality and security, Grid-and off-grid operation



## DESCRIPTION

The Hybrid Energy Storage Solution (HESS) is a **modular solution** that integrates different **battery technologies** in one product. The optimal and complementary management of each battery ensures the best characteristics of each technology. It is a hybrid storage solution aiming for **minimum battery degradation** and **power losses** when in operation. It can be associated with grid-connected and isolated LV electrical systems, including neighbourhoods or buildings from the tertiary sector, maximising the integration of renewable energies. The investment expenditures can be reduced while providing excellent technical performance.

## NOVELTY

- High power density and modular design
- Capability to work with batteries of different voltages range
- Optimal and simultaneous management of the batteries

## FURTHER DEVELOPMENT

Improvement of the product, including communication interfaces protocols, ancillary services, off-grid operation, among others. Implementation of a highly flexible software design to integrate more solutions for the clients.

## DESIRED PARTNERS

Electronic and assembly manufacturers. DSO operators. Renewable energy investors.

## CURRENT TRL

6

## TIME-TO-MARKET

3 years

## IP PROTECTION

Industrial secret

## TECHNOLOGY BY:

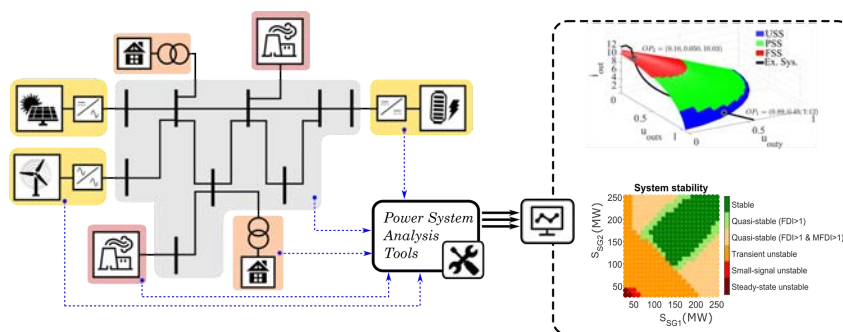


## CHALLENGE

Analysis, operation, protection and control of modern power systems

## APPLICATIONS

Solar PV and wind power plants  
Transmission and distribution grids  
Micro-grids



## DESCRIPTION

Modern power systems are dominated by **power electronics** based converters (renewables, micro-grids, battery charges, electrical vehicle, HVDC and FACTS) which are used in **generation, transmission and distribution** in electrical systems. A variety of **tools** are developed to size, design and analyze power systems dominated by power electronics. The tools can be applied to **large scale PV or wind power plants**, or **transmission and distribution networks**. The operation, protection and control packages are developed to be used in the mentioned systems, considering the special characteristics of power electronics (limited inertia and short-circuit current) and the nature of **renewable energy sources**.

## NOVELTY

- Can analyze systems dominated by power electronics considering converter states
- Allow to derive equivalent representations
- Capture the characterization of grids with power electronics

## FURTHER DEVELOPMENT

Commercialisation of the product and use in practical applications. Testing with large scale systems.

## DESIRED PARTNERS

System operators. Exploring collaborations to create a spin-off company.

## CURRENT TRL

4

## TIME-TO-MARKET

1-2 years

## LICENSING

European patent filed  
Licensed to eRoots Analytcs S.L.

## TECHNOLOGY BY:



## CHALLENGE

Obtaining bio-based and energy efficient insulating materials for buildings

## APPLICATIONS

Construction materials market



## DESCRIPTION

This technology comprises the development of an **innovative thermal insulation rigid panel** based on vegetal pith and natural binders. The pith can be obtained from a wide variety of crop by-products, such as corn or sunflower.

These bio-based insulation panels exhibit a **thermal conductivity around 0.04 W/mK**, similar to other commercially available insulation materials. The panels can also incorporate different repellents, fungicides or flame retardant to improve their performance. These panels also have a **high capacity to store or release moisture** in accordance with the environmental conditions.

## NOVELTY

- Valorisation of local agricultural residues
- Rigid variable dense boards ( $40-150 \text{ kg/m}^3$ )
- Completely compostable panels
- Low thermal conductivity and high moisture buffering

## FURTHER DEVELOPMENT

Construction and testing of prototypes that contain the developed insulation materials. Usage as a living lab to demonstrate the use of the technology to stakeholders. Scale-up the process and subsequent certification of the product.

## DESIRED PARTNERS

Manufacturers of bio-based building materials or materials with similar functions, agricultural cooperatives, architects and constructors.

## CURRENT TRL

5

## TIME-TO-MARKET

2 years

## IP PROTECTION

Spanish patent granted

This project is co-financed by the European Regional Development Fund of the European Union in the framework of the ERDF Operational Programme Catalonia 2014-2020 and supported by the Secretary of Universities and Research of the Ministry for Business and Knowledge of the Government of Catalonia.



**Unió Europea**  
Fons europeu  
de desenvolupament regional



Generalitat de Catalunya  
Departament d'Empresa i Coneixement  
**Secretaria d'Universitats i Recerca**

## MEMBERS OF THE NETWORK



UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH







XARXA d'R+D+I  
ENERGY FOR SOCIETY

