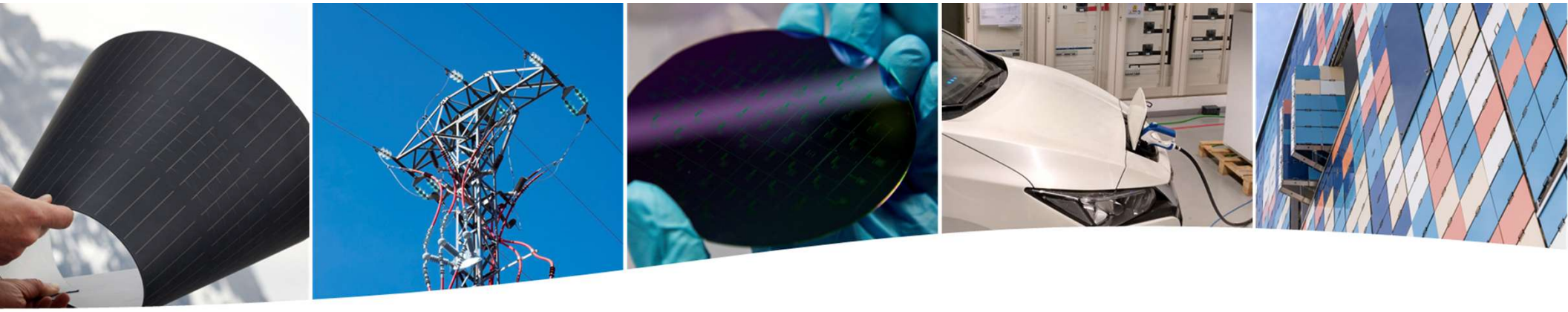

Shaping Energy for a Sustainable Future

Institut de Recerca en Energia de Catalunya (IREC)

INTRODUCTION

Mission

Contribute to the **sustainable development** of society and enhance corporate **competitiveness** via:

- Innovation and the development of new technological products
- Mid- and long-term research
- Dissemination of scientific knowledge to citizens

Vision

Become a **centre of excellence** and an **international benchmark** organization in the energy field through **research**, **development** and **innovation**, working in coordination with the **administration**, the **industry** and the **academia**.

LOCATION

The **IREC** has three headquarters: Sant Adrià de Besòs, Barcelona and Tarragona.

Sant Adrià headquarters

- Advanced materials for energy (M2E)
- Energy SmartLab (ECOS)

Barcelona headquarters

- Energy efficiency: Systems, buildings and communities (ECOS)

Tarragona headquarters

- Thermal energy and integration

AREAS OF EXPERTISE

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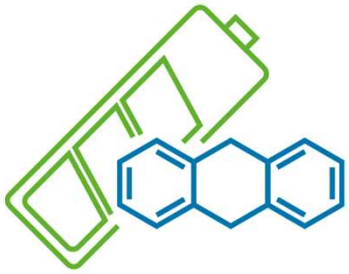
Energy & Environment

- Renewable energy sources and integration to the grid
- Sustainable mobility
- Fusion energy
- Environmental impact



Energy Storage

- Batteries
- Chemical storage
- Energy conversion
- Harvesting and other autonomous systems

Smart Energy Management

- Smart cities & districts
- Smart grids
- Distributed energy management and aggregators
- Energy efficiency in buildings

RESEARCH AND TECHNOLOGICAL UNITS

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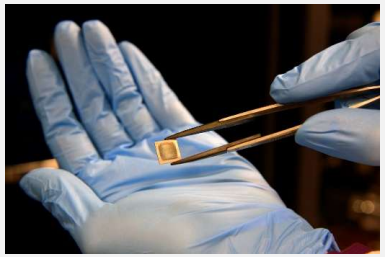

ADVANCED MATERIALS FOR ENERGY (M2E)

- Functional nanomaterials
- Catalysis
- Materials for solar systems
- Nanoionics and fuel cells
- Hydrogen technologies
- CO_2 conversion
- Energy storage and harvesting
- Thermochemical conversion

ENERGY EFFICIENCY: SYSTEMS, BUILDINGS & COMMUNITIES (ECOS)

- NZEB (Net Zero Energy Buildings and Communities)
- Integration of renewables
- Smart Grids and microgrids
- Electric mobility
- Economic analysis and regulation
- Energy systems analytics
- Wind energy (control/integration)

RESEARCH DEPARTMENTS

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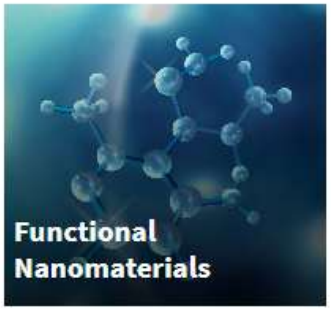
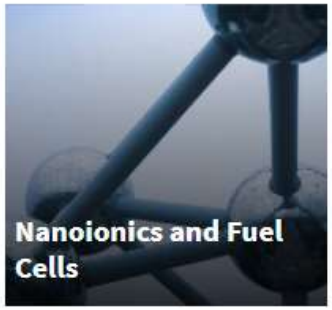
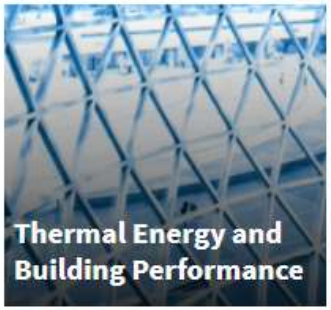
Advanced Materials and Systems for Energy Area





Energy Efficiency in Systems, Buildings and Communities Area



POWER SYSTEMS

POWER SYSTEMS

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The Department aims to provide technical solutions (software and hardware) for the challenges of future electric grid, bringing innovation in aspects for a secure, resilient and RES-based electric system.

CYBER-PHYSICAL SYSTEMS

- LORA-technologies
- CyberSecurity
- PMU Systems
- Energy Cloud-based platforms
- Hardware development

OFFSHORE RENEWABLE ENERGY

- LCOE and LCA estimation
- Modelling of floating Systems
- Digital twin for O&M
- Advanced control (local and coordinated)

POWER ELECTRONICS

- Modelling and optimal design
- Multilevel converters
- Prototyping and test
- Multiport configurations and fault-tolerant

ELECTRICAL NETWORK

- State estimation & fault-location
- Resilience (risk assessment and mitigation)
- Grid operation & microgrids
- Advanced control (local and islanded)

ENERGY STORAGE

- Modelling and characterization
- Advanced BMS
- Advanced models
- Novel Integration schemes
- New battery configurations

4 TRL 8

GROUP'S CONTRIBUTIONS- COORDINATE

HORIZON-CL5-2027-07-D3-25: Advanced TSO control rooms to enhance grid observability, stability and resilience

Contribution to any of the topics mentioned in the scope (observability, stability and resilience, hosting capacity)
Observability: Data-driven state estimation
Stability: Small-signal and transient stability analysis based on PMU data
Resilience: HILP modelling, infrastructure interdependence evaluation, fault diagnosis

HORIZON-CL5-2027-07-D3-26: Advanced Distribution Management Systems (ADSM) for more efficient and flexible distribution grids

Contribution to any of the topics mentioned in the scope (efficiency, flexibility, AI, congestion management)
Efficiency: Decision making tool for suggesting optimal grid reconfiguration.
Flexibility: Computation and integration of flexibility polytopes from flexibility providers into distribution grid planning and management.
Congestion management: Hosting capacity evaluation for planning purposes and in real-time

GROUP'S CONTRIBUTIONS- PARTNER

HORIZON-CL5-2026-03-D3-18: Grid-forming capabilities for more resilient and RES-based electricity grids

Grid forming converters' modelling;
Studies on synthetic inertia placement in transmission grids;
Possibility to invite local DSOs for pilots;
Data-driven converter models extraction and system identification for inertia estimation.

HORIZON-CL5-2026-03-D3-21: Novel solutions for off-grid storage of renewable energy for critical infrastructures

Off-grid energy hubs modelling considering multiple energy carriers.
Resilience studies of the infrastructure against different HILP events: cyber threats, droughts, typhoons etc

HORIZON-CL5-2026-05-D5-02: Energy-efficient software-defined EVs (2ZERO Partnership)

Development of vehicle-to-grid manager.
Optimal planning of V2G charging infrastructure.
Deep reinforcement learning (AI) for charging scheduling.

GROUP'S CONTRIBUTIONS- PARTNER

HORIZON-CL5-2026-03-D3-22: AI-driven forecasting algorithms for Grid and Consumer friendly Energy Sharing – Societal Readiness pilot

AI-driven generation and load forecasting, including EV availability.
Sharing coefficient calculations in energy communities based on generation and demand forecasting.

HORIZON-CL5-2026-11-D3-23: Data sharing to support the training and development of AI foundation models in the energy sector

Contribution to any of the use cases mentioned in the call: planning and operation of electricity grids (including static power flow modelling and dynamic EMT modelling), forecasting, congestion management, anomaly detection, fault diagnosis, predictive maintenance, flexibility management, demand-side energy efficiency, smart and bidirectional charging of EVs.
Power Hardware in the loop testing for data generation in our lab facilities.

HORIZON EUROPE PROJECTS

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https://theflowproject.eu/

2022-2026

Flexible energy systems Leveraging the Optimal integration of EVs deployment Wave - IREC- COORDINATOR

ID: 101056730
Main IREC Group: Energy System Analytics, Coordinator
PI: Josh Eischam
All IREC Groups: Power Systems, Energy System Analytics

FLOW tests, validates and enhances **user-centric V2X smart charging solutions** and their orchestrated **integration into energy grids** that deliver flexibility assets to favour additional penetration of renewables and alleviate energy grid challenges.

SCAPE

2022-2026

https://www.scapepower.eu/

Switching-Cell-Array-based Power Electronics conversion for future electric vehicles - IREC- COORDINATOR

Main IREC Group: Power Systems, Àlber Filbà, Coordinator
All IREC Groups: Power Systems, Energy System Analytics

SCAPE's 4-year journey, powered by the European Union, aims to move towards the **standardization, cost reduction**, and increased **performance of power electronics** for next generation electric vehicles.

HORIZON EUROPE PROJECTS

RESPONDENT

https://respondent-project.eu/

2022-2025

Renewable Energy Sources Power FOrecasting and SyNchronisation for Smart GriD NEtworks MaNagemenT

ID: 101082355
Main IREC Group: Power Systems, Partner
PI: José Luis Domínguez

At the heart of RESPONDENT's innovation lies the powerful integration of AI-driven forecasting algorithms with European space technologies like Galileo and Copernicus. By harnessing these systems, RESPONDENT delivers **accurate, real-time forecasts for solar and wind energy generation,** helping grid operators balance supply and demand more effectively. These tools not only enhance the reliability of renewable energy but also reduce dependence on fossil fuels, empowering Europe to meet its climate goals while safeguarding its energy independence.

COLD SPARK

https://coldspark.eu/

2022-2025

ColdSpark driven energy and cost-efficient methane cracking for hydrogen production

ID: 101069931
Main IREC Group: Energy System Analytics, Partner
PI: Victor Ferreira

The project will **develop and test a novel plasma reactor for production of hydrogen**, alongside high-value carbon, at low energy cost (< 15 kWh/kg H2 produced) without the need for catalysts and water.

HORIZON EUROPE PROJECTS

NEVERFLAT

2025-2028

iNnovative EV-charging EnviRonment for Future Low-cost mAss deploymenT

ID: 101192973
Main IREC Group: Power systems (Partner)

NEVERFLAT aims to develop and demonstrate in real-life settings an **innovative, efficient, and user-friendly pervasive low-cost smart bi-directional charging infrastructure for electric vehicles (EVs)**, directly contributing to a specific strategic objective of the 2Zero Partnership - developing affordable, inclusive, user-friendly charging infrastructure concepts and technologies that include vehicle and grid interaction

REBORN

2025-2028

https://cordis.europa.eu/project/id/101138031

Reusable battery module and management system development for reliable 2nd life

ID: 101138031
Main IREC Group: Power systems (Partner)

REBORN aims to minimize the post-characterization process on the battery packs received from 1st life, and achieve **faster screening and sorting based on smart strategies that combine the cell data identifiers from the cloud and ML sorting algorithms.** The project will target to mobility and stationary applications, and it will provide an agnostic and technology neutral, regardless of cell chemistry or form factor, modular design methodology. An end-user demonstrator will be built and evaluated in the relevant environment accounting for reconfigurable battery packs.

HORIZON EUROPE PROJECTS

https://cleanhypro.eu/

2023-2027

Open Innovation Test Bed for Electrolysis Materials for Clean Hydrogen Production

ID: 101091777

Main IREC Group: Nanoionics and Fuel Cells (Partner)
PI: Albert Tarancón

CLEANHYPRO gathers some of the **most recognised experts in Europe on the electrolysis field for clean hydrogen production and acknowledged facilitators of technology transfer, corporate finance, funding and coachin**g, making available (i) the most promising and breakthrough manufacturing pilots and (ii) advanced characterization techniques and modelling together with (iii) non-technical services through this Test Bed: while relevant improvement metrics can be defined, the potential network of reachable stakeholders counts thousands of businesses on an international scale.

2024-2027

https://ibattman.eu/

Smart, Connected and Secure Battery Management System Enhanced by NextGeneration Edge and CloudComputing, Sensors and Interoperable Architecture

ID: 101138856

Main IREC Group: Power Systems (Partner)
PI: Lluís Trilla

iBattMan project unites leading European entities to revolutionise BMS technology. By **integrating novel sensors and advanced modelling**, iBattMan monitors SOH during operation and charging, enhancing performance and safety. This initiative aims for an innovative, scalable BMS applicable across various vehicles, from passenger cars to electric trucks.

HORIZON EUROPE PROJECTS

EERA
European Energy Research Alliance

2023-2028

Research Infrastructure Services for Renewable Energy

ID: 101131793

Main IREC Group: Power Systems (Partner)
PI: José Luis Domínguez

FREE4LiB

2022-2026

Feasible recovery of critical raw materials through a new circular ecosystem for a Li-ion battery cross-value chain in Europe

ID: 101069890

Main IREC Group: Energy Storage, Harvesting and Catalysis (Partner)
PI: Jordi Jacas
All IREDC Groups: Energy Storage, Harvesting and Catalysis, Power Systems, Energy System Analytics

Recovery of lithium is a complicated process that the EU-funded FREE4LIB project aims to simplify. It will develop technologies to achieve six new sustainable and efficient processes to recycle end-of-life LIBs. The project will also deliver three processes aimed at reuse of metals and polymers and electrode synthesis for remanufacturing new LIB battery packs based on the design for recycling. The use of Battery Passports will overcome the current lack of access to open data in the LIB value chain.

HORIZON EUROPE PROJECTS

SPINMATE

https://www.spinmate.eu/

ID:101069712
Main IREC Group: Energy Storage, Harvesting and Catalysis, Partner

2022-2026

A scalable and sustainable pilot line based on innovative manufacturing technologies toward the industrialization. SPINMATE aims to demonstrate a scalable, sustainable, safe, and cost-effective digital-driven proof-of-concept pilot line, at a Technology Readiness Level 6, as a first step towards the large-scale manufacturing of generation 4b (Gen 4b) SSB cells and module, to support the electrification of the automotive sector.n of solid-state batteries for the automotive sector

Nautical SUNRISE

Survivability assessment, cost redUction pathways and eNvironmental evaluation of offshoRe Installed floating Solar energy farms

2023-2027

ID: 101135639
Main IREC Group: Power Systems (Partner)
PI: José Luis Domínguez

HORIZON EUROPE PROJECTS

IntelLiGent

2022-2025

https://heuintelligent.eu/

Innovative and Sustainable High Voltage Li-ion Cells for Next Generation (EV) Batteries

ID: 101069765
Main IREC Group: Energy Storage, Harvesting and Catalysis, Partner
All IREC Groups: Functional Nanomaterials, Energy Storage, Harvesting and Catalysis, Power Systems, Energy System Analytics

IntelLiGent will develope safe, sustainable, long-lasting generation 3b Li-ion batteries with high-voltage cathodes and high-capacity silicon-graphite anodes. IntelLiGent will design optimized electrode structures to achieve the energy density and fast charging targets

iPLUG

2022-2025

https://iplug-he.eu/

Distributed multiport converters for integration of renewables, storage systems and loads while enhancing performance and resiliency of modern distributed networks

ID: 101069770
Main IREC Group: Power Systems, Partner
PI: José Luis Domínguez

the iPLUG project, supported by the European Union, aims to create **innovative power electronics utilizing multiport converters**. These converters will enable the seamless integration of multiple renewable energy sources, energy storage systems, and loads into the distribution grid.

HORIZON EUROPE PROJECTS

ICARIA
Improving climate resilience of critical assets

https://www.icaria-project.eu/

2023-2025

Improving ClimAte Resilience of crItical Assets

ID: 101093806
Main IREC Group: Power Systems, Partner
PI: José Luis Domínguez

The ICARIA project will promote the use of a **comprehensive asset-level modelling framework to achieve a better understanding of climate-related impacts** produced by complex, compound and cascading disasters and the possible risk reduction provided by suitable, sustainable and cost-effective adaptation solutions.

SOMMER

2023-2027

Solar-Based Membrane Reactor For Syngas Production

ID: 101118293
Main IREC Group: Nanoionics and Fuel Cells (Partner)
PI: Marc Torrell

WeGenerate

2023-2027

Co-creating people-centric sustainable neighbourhoods through urban regeneration

ID: 101123546

Main IREC Group: hermal Energy and Building Performance (Partner)
Jaume Salom

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https://www.irec.cat/

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