Shaping Energy for a Sustainable Future

Institut de Recerca en Energia de Catalunya (IREC)

CM2025-01 Multi-vector interactions between the integrated energy system and industrial frameworks

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ORIENTATION

The Institute's orientation takes a **dual approach**

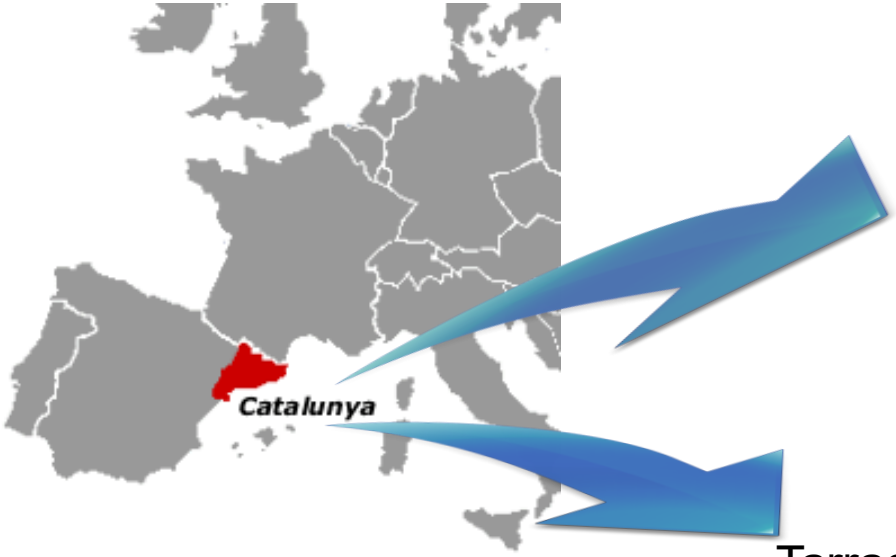
Market orientation

Market Orientation focusing on **technology development**, **new products** and new **technical solutions** for energy sector companies active in the same fields as IREC's established lines of action.

Long-term research

Long-term research into different aspects of the established lines of action. It will not be initially aimed at the market, but at **generating knowledge** amongst groups in the Institute itself, with a **long-term commercial projection** in mind.

LOCATIONS



Barcelona headquarters

Diagonal-Besos

ETSEIB

Tarragona: Campus Sescelades

RESEARCH DEPARTMENTS

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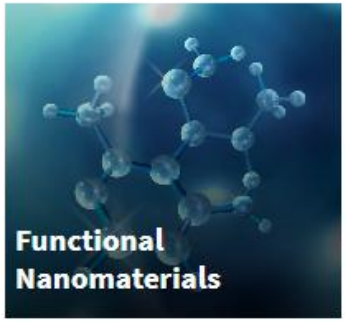
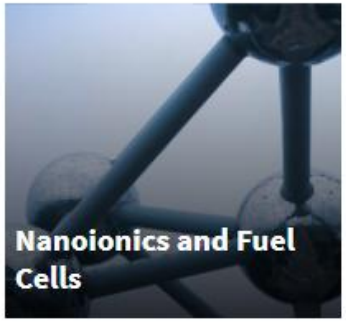
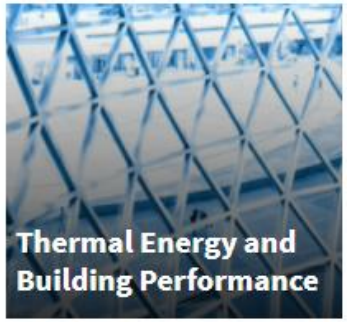
Advanced Materials and Systems for Energy Area





Energy Efficiency in Systems, Buildings and Communities Area



POWER SYSTEMS GROUP

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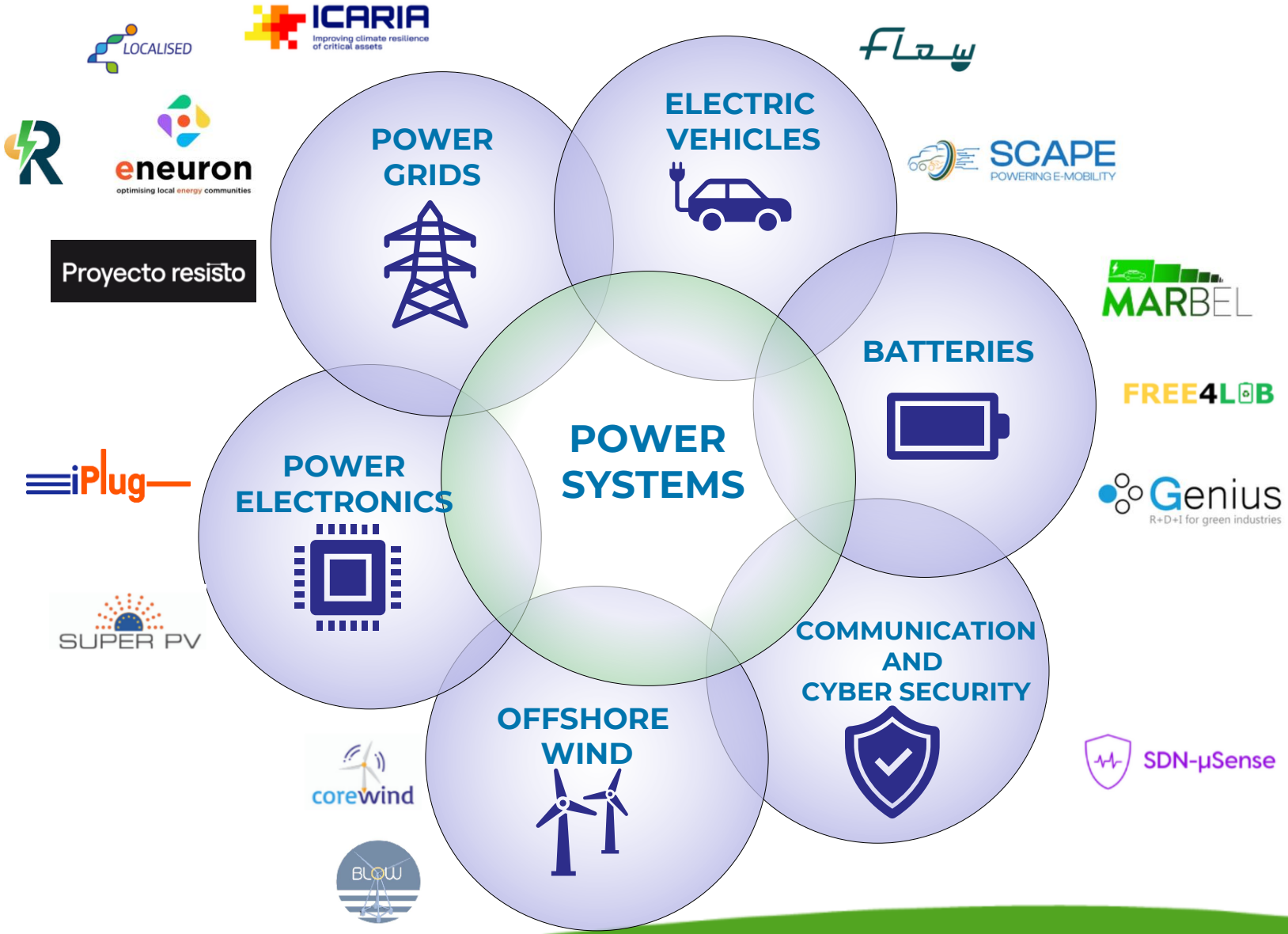

ENERGY SMARTLAB

CAPABILITIES

- Design, development and deployment of devices to monitor and control energy consumption, generation and storage
- **Model, control and validation** of renewables and power electronics
- Rapid **prototyping** and **validation** of electric equipment (including power electronics)
- Control and communications architectures for smart grids
- **Grid emulator** for testing of faults, dynamics, islanded operation and perform power hardware-in-the-loop.
- **Real-Time Simulators**
- Set of **emulator cabinets** to reproduce the electrical behaviour of generators, storage systems and consumers
- **Cybersecurity laboratory** for smart grids (with EURECAT)
- **Smart Energy Lab** for laboratory testing of Smart Grids
- **Battery testing** equipment (i.e. ciclers, programable sources,..)

RELEVANT EXPERTISE OF THE GROUP

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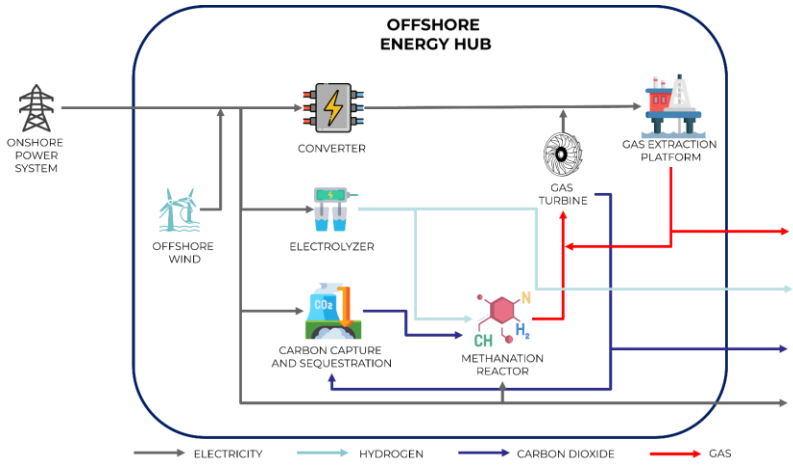
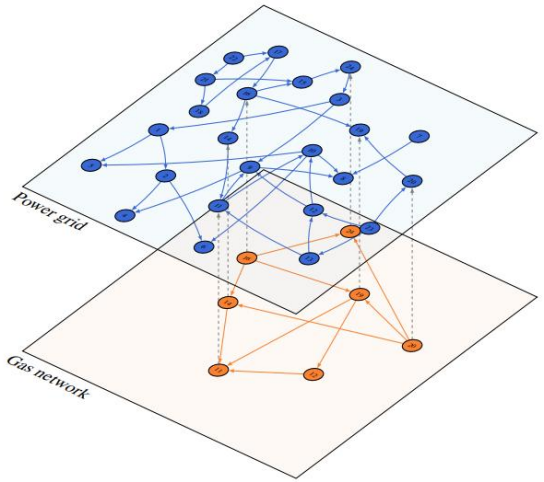
- **Power system analysis** for grid integration of distributed energy resources.
- **Modelling and optimization** of multi-vector energy hubs for flexibility service provision.
- **Power hardware in the loop** testing of optimization and control solutions in distribution grids.
- **Complex network analysis** of interconnected energy infrastructure as multi-layer networks.
- **Data-driven techniques** for forecasting, state estimation or anomaly detection.





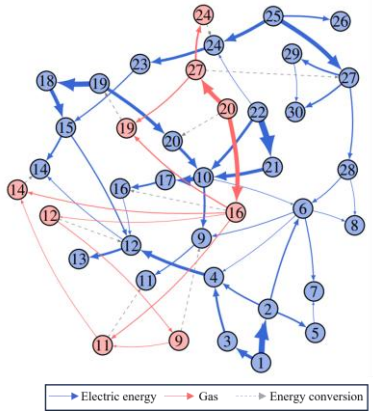
RESEARCH IDEAS

LOW TRL

- Understand and **model multi-energy interdependencies in industrial processes** currently not modelled in scientific literature.
- Employ the understanding and model developed to **find new flexibility sources** in that industrial process and assess its capability to participate in flexibility markets.
- Explore the concept of **tridimensional operating envelopes** for flexibility provision. In addition to the classical P/Q envelope, a third dimension based on another energy carrier could provide additional insights on the actual flexibility margin of an industrial plant.
- Assess how the presence of multiple energy vectors and their flexibility increases the **resilience of the industrial plant** to extreme events like blackouts or infrastructure issues.

HIGH TRL

- Development of a **multi-energy EMS** based on the developed model and deployment in a pilot site.
- Development of a multi-energy, **data-driven flexibility forecaster** for industrial sites, based on energy data metering available (e.g. electricity, gas, water) and artificial intelligence models.
- Assessment of the **grid impact and environmental benefits** from the multi-energy EMS (reduced renewable energy curtailment, reduced grid losses…).



POTENTIAL PARTNER PROFILES

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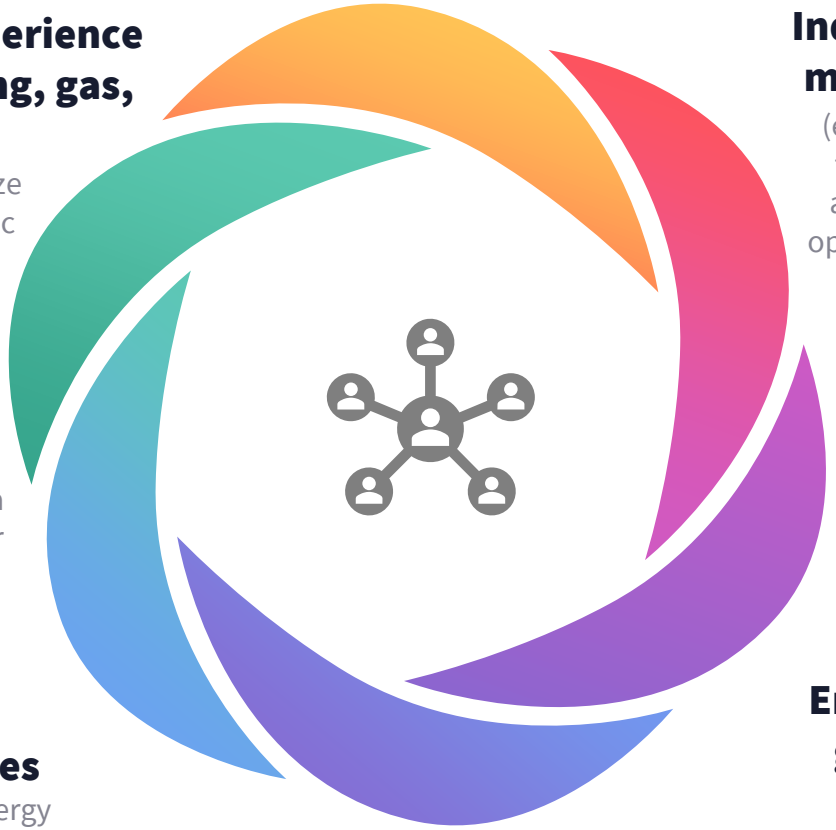
Research partners with experience in hydrogen, district heating, gas, energy storage

willing to engage in a synergize with our experience in electric power grids.

Industries operating with multiple energy carriers

(electricity, gas, hydrogen, fossil fuels, water, etc.) interested in advanced characterization and optimization of their energy flows.



Energy/water infrastructure operators

with network and metering data about the specific energy carrier they manage.

Companies with energy metering data available

providing access to electricity, gas, and water consumption data (e. g. energy service company).

Living labs or demonstration sites

integrating multiple energy carriers, for validation and pilots.

Energy systems research groups with industrial partners

and pilots for modelling new industrial processes as energy hubs or living labs.

Research partners with expertise in AI and data analytics

applications in the energy sector, to analyse metering data and support on forecasting.

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