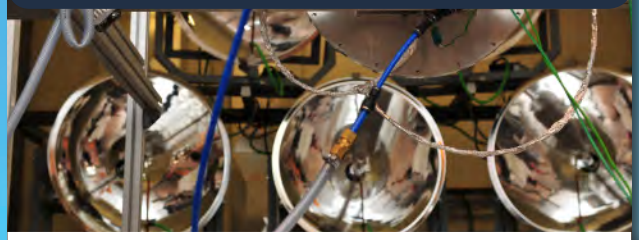
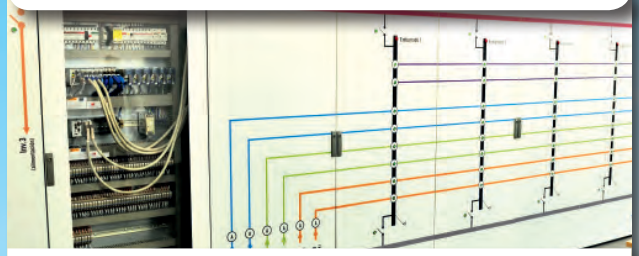
technological resources

Pilot plants



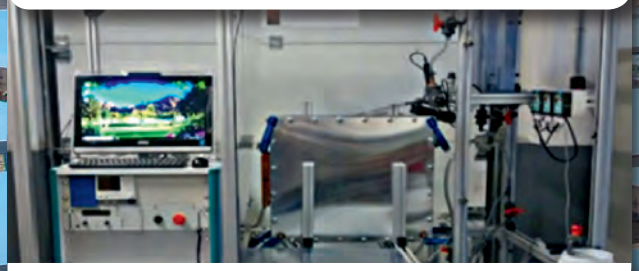
7 and 42 kW High-flux solar simulators

Simulation of concentrating solar energy environments. Surface treatment and synthesis of materials. Solar receivers and reactors. Solar thermochemistry. Thermal fluids.



Smart Energy Integration Lab SEIL

Real-time emulation of AC and DC power networks and microgrids. Development of energy resources management systems. Stability analysis, power quality and control strategies for microgrids and power electronics converters. Integration of renewable sources and storage systems.



Electrochemical Devices Test Lab EDTL

Test Protocols in DC and AC. Simulation of demand cycles in powers from 30 W to 30 kW under controlled temperature and humidity.

Pilot plants for production and conversion of biomass

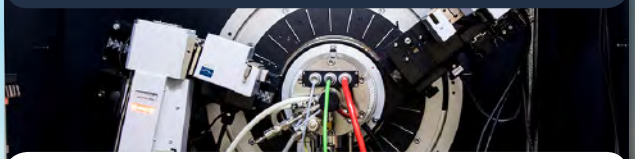
Open and closed photobioreactors of versatile and flexible configuration.

Thermal or catalytic pyrolysis on fluidised bed reactors and hydrodeoxygenation fixed bed reactor, coupled to systems of product analysis.

Concentrating solar field

- Very high concentration solar tower VCHST/ACES.
- Design thermal power, 250 kW.
- Peak flux up to 4000 kW/m^2.
- 169 heliostats, 3 m^2 each.
- 2 test platforms.

Instrumental techniques



- **Chemical characterisation**: mass spectrometry, gas/mass chromatography, NOx analysis by chemiluminescence, GC-MS coupled pyrolysis (Py-GC-MS), elemental analysis ICP-OES and CHONS, oxidative decomposition analysis (AOD) and ion chromatography.
- **Thermogravimetric analysis** (TG-DTA) in an oxidising (air), inert (Ar) or reductive (10% H2/Ar) atmosphere.
- **Properties of solids**: textural and chemisorption.
- **X-ray diffraction** with structural PDF analysis and controlled atmosphere chamber up to 900 °C and 10 bar. Single crystal diffraction.
- **Spectroscopy**: IR (DRIFT, ATR and VEEMAX), UV-vis-NIR, Raman and Fluorescence.
- **Thermal Diffusivity.**
- **Microscopy**: Atomic force, SEM scanning electron and optical.
- **Biotechnological characterisation**: GC and HPLC equipped with different columns and detectors (IR, MS, UVVIS, HPAEC-PAD). Electrophoresis instrumentation for recombinant DNA technology, protein purification and analysis.
- **High pressure X-ray photoelectron spectroscopy** (NAP-XPS).
- **Kinetic photophysical studies**, Transient absorption spectroscopy and photoluminescence.

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EUROPEAN UNION
STRUCTURAL FUNDS

institute IMdea energy

energy.imdea.org

IMDEA Energy Institute was created in 2006 by the Regional Government of "Comunidad de Madrid" as non-profit Foundation to promote and carry out R&D&i activities to contribute to the development of a sustainable and decarbonised energy system.

IMDEA Energy is strongly committed to the transfer of R&D outcomes to the productive sector and to seek joint efforts with other technology research centers and universities, promoting excellence in research on energy issues and complementarity among different entities.

IMDEA Energy gathers cutting edge skills and significant experience in R&D, testing and assessment of energy technologies. IMDEA Energy offers these services to private companies, universities and research and technological centers at both national and international levels.

Capabilities

Simulation and process feasibility studies. Thermodynamic analysis, energy and exergy balance. Socio- and techno-economic and sustainability studies.

Management and life cycle analysis. Studies of LCA, LCA+DEA, LCC, "emergy" and support of environmental declarations applied to products, processes and carbon footprinting.

Synthesis and characterisation of advanced materials. Catalysts, materials for high temperature and energy storage, nanoparticles prepared by sol-gel, coating of electrodes and electrochemical cells.

Proactive management of power networks and electric power conversion. Design and control of power electronics interfaces. Static and dynamic modelling of power networks and microgrids. Real-time control systems.

Opto-mechanical and thermal engineering. Concentrating solar systems and technologies. Numerical and experimental characterization under high densities of solar radiation and / or high temperatures.

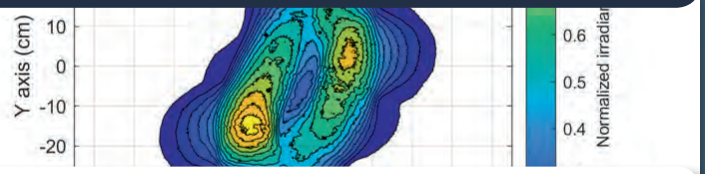
Technology watch and foresight on renewable energy and energy technologies.

Software tools:

- Chemical process analysis and optimization: Aspen Plus.
- Biochemical process simulation: SuperPro Designer.
- Simulation of thermodynamic cycles and thermal plants: EBSILON Professional.
- Dynamic simulation of solar thermal power plants: STEC/TRNSYS.
- Life cycle assessment, LCA, and carbon footprinting: Simapro 7.2 Professional.
- Sustainability analysis: GaBi Professional and DEA-Solver Pro.
- Energy planning and thermal fluid dynamics: LEAP.
- Process simulation and data analysis: Matlab-Simulink.
- Simulation of power electronics circuits: PLECS.
- Data acquisition, process control and calorimetric loops: LabVIEW.
- 3D computer-aided design: SolidWorks and KUDO 3D.
- CFD analysis: COMSOL Multiphysics.
- Ray tracing: TracePro.
- Power systems: IPSA and PowerWorld.
- Computational chemistry: Chemcraft, Gaussian and Vasp.

research topics

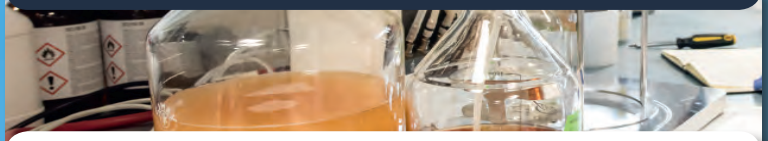
Solar energy



Modular, efficient, dispatchable and cost-effective solar concentration technologies for the production of fuels and chemicals, industrial processes heat and power generation.

- Modular solar thermal technologies with high efficiency, dispatchability and urban integration.
- Solar receivers and reactors based on advanced thermal fluids and particles.
- Solar fuels and chemicals production by solar thermal routes.
- Integration assessment of solar energy for electricity generation and industrial processes, heat recovery & environmental impact: advanced thermodynamic cycles, water/brine management & treatment, glint & glare.
- Photovoltaics: development of advanced materials for novel semiconductors.

Sustainable fuels



Production of advanced fuels from biomass and wastes and other alternative renewable fuels.

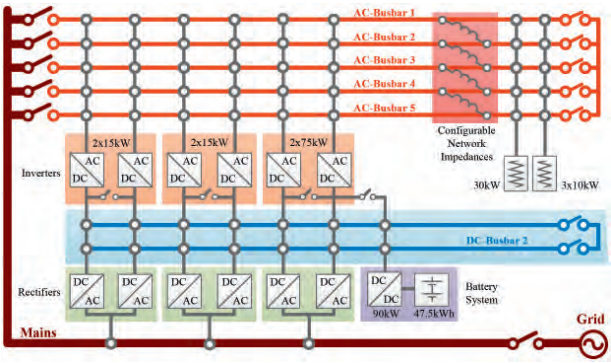
- Production of advanced fuels and products of commercial interest from biomass residues.
- Valorization of waste plastics and used tires.
- Development of thermochemical processes and catalysts with improved efficiency.
- Application of pyrolysis biochars as bio-filters for air decontamination.
- Microalgae / bacteria consortia for anaerobic digestate treatment and biomass fermentation.
- Microbial oil production from volatile fatty acids.
- Lignocellulose based biofuels and bioproducts.
- Anaerobic fermentation of waste streams for carboxylate and biogas production.
- Production of solar fuels through thermochemical cycles.
- Photo (electro) catalytic processes for the production of fuels by means of solar energy.

Energy storage

Energy storage to increase the dispatchability of renewable sources and to foster the electrification of transport.

- Thermal heat storage: sensible, latent and thermochemical.
- Development of supercapacitors with high power density.
- Design, modeling and prototyping of flow batteries with or without membrane at macro- and micro-scales.
- Application of selection criteria based on computational chemistry methods and characterization of novel redox pairs.
- Materials, components and designs to improve the performance, cyclability and recyclability of Li-ion batteries, redox flow batteries and other post-lithium technologies.
- New accelerated testing methodologies, post-mortem analysis and aging models of electrochemical devices.

Power systems and demand management

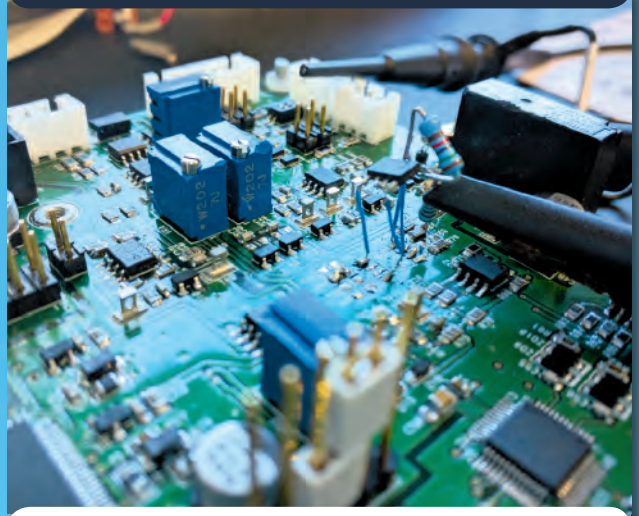


Control, reliability and stability of electricity networks with renewables and storages.

Optimisation based algorithms for demand management and renewable integration.

- Control of power converters for applications in electricity networks.
- Renewable and energy storage integration.
- Stability of power networks with high penetration of renewables.
- Reliability of power systems with high share of distributed generation and storage.

Energy systems with enhanced efficiency



Energy saving and efficiency.

Energy-efficient devices for energy and environmental applications.

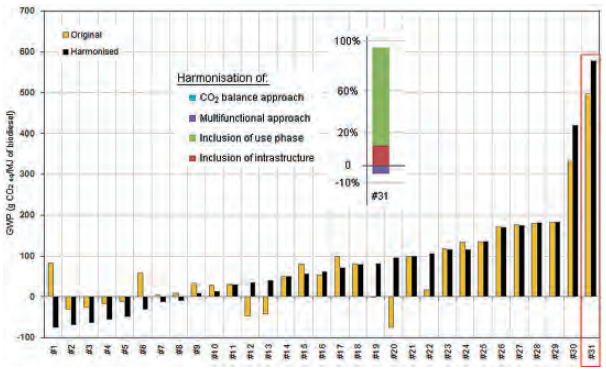
- Active demand management and energy efficiency in buildings, residential, hotels,…
- Optimisation of energy supply mix.
- Management of energy resources in industries, operations and processes.
- Energy efficiency in systems for vibration testing.
- Design and scale up of brackish water treatment processes by electrochemical deionization.

Valorisation of CO_2 emissions

Processes and technologies of CO_2 valorisation.

- CO_2 photoreduction, water splitting and photoreforming of biomass-derived products.
- Chemical looping reforming of CH_4 with CO_2.
- Development of inorganic and hybrid multifuctional materials.
- Process evaluation and scale-up.
- Techniques for CO_2 capture and storage: life cycle, environmental and techno-economic studies.

Analysis and assessment of energy systems



Sustainability assessment of energy systems.

Process design, simulation and optimization.

Energy systems modelling for energy planning.

- Life cycle management: LCA environmental, social, costs, multicriteria analysis (LCA+DEA), sustainability analysis and ecodesign.
- Simulation and techno-economic analysis: bioenergy, biorefineries, renewables, hydrogen and CO2 capture.
- Circular economy strategies.
- Prospective analysis: Development of energy models, sustainability indicators, scenarios for transportation and electricity.