



TECHNOLOGY CENTER

UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

[ENERGY AND ENVIRONMENT]

RESEARCH, DEVELOPMENT AND INNOVATION AT THE UNIVERSITAT POLITÀCNICA DE CATALUNYA (UPC)

The Universitat Politècnica de Catalunya (UPC) specializes in the areas of architecture, science and engineering, including energy and environmental technologies. In this field, the main areas are:

- Energy Technologies
 - Energy Production
 - Renewable energies
 - Nuclear energy & safety
 - Energy Distribution & Consumption
 - Consumers in the energy system – Smart Grids
 - Energy-efficient systems
 - Sustainable transport
- Environmental Technologies
 - Recycling, upcycling, treatment
 - Solid waste recycling and upcycling
 - Gas emissions and air pollution control
 - Water and wastewater treatment
 - Ecosystem Preservation
 - Marine and coastal ecosystems
 - Terrestrial ecosystems
 - Urban ecosystem
 - Environmental impact and technological risk
 - Climate change mitigation

As a result of the UPC's recognized research track record in its areas of specialization, we can offer a wide range of services:

- R&D technology transfer projects
- Consortiums for national and Horizon Europe projects
- Patents
- Technology assessment
- Specialized facilities

The UPC is the leading university in Spain in volume of research and technology transfer to companies. It has become one of the major hubs of knowledge in Southern Europe.

PRODUCTION

PHOTOVOLTAIC ENERGY

- Photovoltaic reconfigurable systems for energy extraction optimization
- Modular power conversion architectures
- Grid-connected photovoltaic systems
- Modelling and control of PV inverters and converters
- Refrigeration and thermal management of PV panels
- Hybridization of PV power facilities with other energy sources

SOLAR THERMAL ENERGY

- Integration of solar ponds: energy storage and energy production
- Solar collectors using transparent insulation materials (TIM)
- Receivers in concentrating solar power plants
- Thermal storage in concentrating solar power plants
- Grid integration of solar power

WIND ENERGY

- Transmission systems for offshore wind power plants
- Analysis and design of advanced controllers for wind turbines
- Analysis of harmonics flow in wind power plants and design of mitigation measures
- Analysis of the performance of wind power plants
- Design of mini-wind generators
- Virtual wind turbine of wind turbine blades

OCEAN ENERGY

- Wave energy resource assessment
- Wave energy balance in wave models
- Testing of wave energy capture devices
- Optimization of buoy geometry design
- Fluid-structure interaction for buoys and waves
- Overtopping devices

HYDROPOWER

- Vibration analysis and diagnostics in machinery
- Predictive maintenance
- Advanced monitoring and damage detection
- Structural dynamics, effects of fluid on structural response
- Experimental and numerical investigation of cavitating flows
- Numerical simulation in turbulent flows
- Hydropower plant performance
- Production analysis of mini hydropower plants

GEO THERMAL ENERGY

- Very low enthalpy geothermal energy (up to 30°C)
- Low enthalpy geothermal energy (from 30°C to 90°C)
- Medium enthalpy geothermal energy (from 90°C to 150°C)

BIOENERGY & BIOFUELS

- Microbial fuel cells in constructed wetlands
- Biofuel production from algal biomass
- Low-cost anaerobic digester
- Hydrogen production from biomass

NUCLEAR ENERGY & SAFETY

- Nuclear safety. Probabilistic risk assessment
- Nuclear instrumentation
- Nuclear power plants
- Nuclear fusion reactors
- Nuclear waste characterization

DISTRIBUTION & CONSUMPTION



ENERGY EFFICIENCY IN BUILDINGS

- Bioclimatic architecture
- Energy-efficient illumination systems
- Building envelope, building insulation technologies
- Building energy management solutions

ENERGY EFFICIENCY IN INDUSTRY

- Saving energy through design
- Integration and intensification of processes
- Integration and circular economy in chemical processes
- Energy storage systems (heat storage tanks and accumulators, thermochemical storage)
- Heat recovery and alternative heating
- Heat exchangers

REFRIGERATION AND HVAC SYSTEMS

- Compressors
- Valves and capillary tubes
- Refrigeration cycle analysis
- Virtual household refrigerator
- Domestic and industrial air-conditioning
- Vapor compression heat pump as alternative heating
- Sprays/evaporative cooling design
- Fan performance analysis (virtual and tunnel)

ELECTRIC VEHICLES (EV)

- Intelligent management of EV
- Modelling EV battery aging for second life business models
- Cooling of batteries
- Electric traction and mechatronics for EV
- Energy efficiency, industrial electronics and high voltage systems for EV
- Design of charging stations



CONSUMERS IN THE ENERGY SYSTEM – SMART GRIDS

- Smart grid architecture and big data
- Power systems design
- Power electronics and mechatronics
- Electrical power conversion and AC/DC grids
- Integration of new power sources: renewable power
- Study of demand response management schemes
- Advanced control of electrical systems

FUEL CELLS & HYDROGEN

- Modelling and control of systems based on proton exchange membrane fuel cell-based systems
- Fuel cell control laboratory, modelling and experimental characterization
- Fuel cell efficiency and durability analysis
- Ethanol reformers for hydrogen production
- Fuel cell systems controller design
- Fuel cell integration into vehicles
- Catalytic and photocatalytic production of hydrogen as a fuel for fuel cells

RECYCLING, UPCYCLING, TREATMENT

GAS EMISSIONS AND AIR POLLUTION CONTROL

- Gas sensors and contaminant detection
- Modelling odor episodes and atmospheric quality
- Industrial emission assessment tools, systems and models
- Modelling, diagnosis and control of sources of air pollution
- Characterization and treatment of gaseous emissions
- Removal, filtration and/or valuation of air pollutants and gases (NH₃, H₂S, CO₂, CO, VOCs and cinder, among others)

ORGANIC

- Characterization and composting of organic waste for agricultural recovery
- Valorization of incineration waste
- Recovery of bio-active components from food and agrowaste
- Sustainable management of cork waste generated in the cork industry
- Development of bio or synthetic organic waste to obtain new materials, for use in the construction industry, transport and packaging
- (Bio) processes of transformation of waste and organic by-products

PLASTICS

- Recycling and recovery of plastic materials
- Plastic recycling by means of hyperspectral techniques
- Conversion of plastic waste (monomers) into new plastics
- Development in bioplastics and biocomposites



CLIMATE CHANGE MITIGATION

- Ecotechnologies and nature-based solutions
- Models and proposals for climate change mitigation
- Multilateral governance
- Global carbon budget and climate justice
- Advice on the Paris Agreement
- Life cycle assessment
- Green and circular economy

ELECTRONICS

- Circular economy of digital devices
- eReuse: reuse of electronics to ensure final recycling
- Bioleaching of low-rank ores and e-waste for valuable metals recovery
- Research on the traceability of digital devices across their lifespan

OTHERS

- Co-gasification and pyrolysis of residual material (including municipal solid waste and forest waste)
- Construction and demolition waste management and recovery
- Mining, urban and industrial waste recovery
- Management, compaction and recovery of the waste process



ECOSYSTEM PRESERVATION



DRINKING WATER

- Real-time monitoring and operational control of drinking water systems
- Improvement in the efficiency of water use, energy consumption, water loss minimization and water quality
- Modelling and simulation of drinking water networks
- Optimization of water transport and distribution networks

WASTEWATER TREATMENT

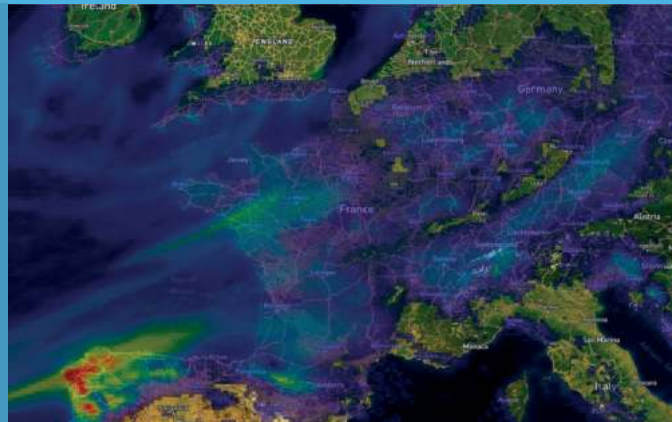
- Real-time control of sewage systems and wastewater treatment plants
- Natural low-cost bioprocesses for wastewater and sludge treatment
- Design of constructed wetlands for wastewater treatment
- Numerical simulation of bioprocesses to remove contaminants from wastewater
- Life cycle assessment and economic evaluation of products and technologies for wastewater treatment, sludge management and biogas production
- Use of cork to clean wastewater and produce electricity
- Urban and industrial wastewater treatments and related technologies

MARINE AND COASTAL ECOSYSTEMS

- Engineering and physical oceanography
- Port and coastal structures. Coastal zone management
- Morphodynamics and coastal processes
- Maritime research and experimentation wave flume
- Data acquisition system design and automation of marine system measurements
- Development of multifunctional sensors for in-situ monitoring of the marine environment
- Development of mobile and fixed ocean observing platforms

TERRESTRIAL ECOSYSTEMS

- Application technique of phytosanitary products to reduce the risk of environmental pollution
- Application technique for organic fertilizers to reduce environmental impact
- Efficiency in composting systems and optimization of agricultural productivity. Sustainable agriculture
- Studies to evaluate risk to human health and ecosystems
- Landslide risk management
- Ecosystem services and sustainable resource management



ENVIRONMENTAL IMPACT AND TECHNOLOGICAL RISK

- Risk analysis in the process industry
- Wildland fires monitoring and prediction
- Compartment fires modelling
- Floods and flash-floods, forecasting and derived impact
- Ecotoxicology

URBAN ECOSYSTEM

- Urban contaminants and the environment
- Green building architecture and materials
- Noise pollution



CIT UPC
Ed. Omega (planta 0)
C/Jordi Girona 1-3
08034 Barcelona - Spain
Tel. +34 93 405 44 03
info.cit@upc.edu