



# THE ROLE OF UNIVERSITIES IN THE PROCESS OF DECARBONIZATION OF URBAN AREAS



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# THE DECARBONIZATION IS A GOOD PRACTICES AND EFFECTIVE PROCEDURES FOR GREENHOUSE GAS REDUCTION CAPACITY.

The University of Ferrara has joined the RUS Decarbonisation Network to provide accelerated paths to academics, citizens, industry and the public sector through:

- the exploration of the most promising technological path towards zero net greenhouse gas emissions,
- develop technological solutions and good practices to limit climate change by replacing dependence on fossil fuels,
- innovative degree and doctorate courses to train young researchers and technicians who, starting from their specific background, acquire interdisciplinary and integrated methodologies that allow them to understand, manage and enhance the sustainability of the environment in relation to the well-being of all living organisms., These training courses create synergy between the different macro areas for an inter- and multidisciplinary approach

# THE DECARBONISING HEAT ON AND OFF DEPARTMENTS

Designing the new generation of photovoltaic devices:

- ✓ Increase light energy into electrical conversion capacity and efficiency of silicon wafers,
- ✓ New materials such as semiconductors and sensors
- ✓ The study of natural analogues to overcome dependence and guarantee access to raw materials for the European Green Deal in order to help preserve mineral resources for future generations
- ✓ Ensuring a sustainable supply of rare earths for a zero-carbon global future
- ✓ perovskite solar cells

Saving solutions in the use of natural resources t) inside and outside university facilities (reduction of the water footprint and greenhouse gas footprint).

Possibility of thermal and geothermal energy storage

clean and renewable energy includes solar energy, wind energy, geothermal energy, biomass energy, tidal energy, etc., clean and renewable characteristic s renewable energy includes solar energy, wind energy, geothermal energy, biomass energy, tidal energy, etc., all of which have renewable characteristics

# MAIN DECARBONIZATION PROJECTS OF THE UNIVERSITY OF FERRARA

The UNIFE technopoles (T&A Tech, Teknehub and MechLav) are Membership of the CLUST-ER GREENTECH of the Emilia-Romagna Region whose actions focus on two supply chains representative of the energy and sustainability system of Emilia-Romagna:

- ✓ Low Carbon Economy to encourage the transition of the regional economy towards greater environmental sustainability, reducing dependence on fossil fuels.
- ✓ Environmental Sustainability and Ecosystem Services to improve the management of degraded and/or vulnerable ecosystems and environmental control in all its sectors (air, water, soil) through the development of remediation and mitigation technologies with a circular approach.

PON React UE Projects Research and Innovation of the 2021-2027 PNR

- PhD in Environmental Sustainability and Wellbeing. Title: “**Decarbonisation, sustainability and efficient use of energy conversion, storage and distribution systems**” Tutor Prof. Michele Pinelli, PhD student Dott.ssa Giulia Anna Maria Castorino Objectives: study of accumulation systems (both daytime and seasonal), storage and production of energy from renewable sources
- Project title “**Innovations for the circular economy and decarbonisation in cooperative businesses to support advanced production systems**” P.I. Prof. Massimiliano Mazzanti team Dr. Emy Zecca
- Project title “**Integrated innovations for the circular economy and decarbonisation in cooperative production enterprises for environmental, economic and social sustainability**” P.I. Prof. Massimiliano Mazzanti team Dr. Asia Guerreschi

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# ECOSISTER : ECOSYSTEM FOR SUSTAINABLE TRANSITION IN EMILIA-ROMAGNA



## Ecosystem for Sustainable Transition in Emilia-Romagna

SPOKE	SPOKE 1 Materials for sustainability and ecological transition	SPOKE 2 Clean energy production, storage and saving	SPOKE 3 Green manufacturing for a sustainable economy	SPOKE 4 Smart mobility, housing and energy solutions	SPOKE 5 Circular economy and Blue economy	SPOKE 6 Ecological transition based on HPC & data technology
LEADER	CNR	UNIMORE	UNIBO	UNIPR	UNIFE	UNIPR
AFFILIATES	UNIMORE UNIBO UNIPR UNIFE UCSC POLIMI ENEA CENTRO CERAMICO CERTIMAC DEMOCENTER-TPM MISTER MUSP ROMAGNATECH ALMACUBE	CNR UNIBO UNIPR UNIFE POLIMI ENEA CRPA DEMOCENTER-TPM FONDAZIONE REI LEAP	CNR UNIMORE UNIPR UNIFE UCSC POLIMI ENEA BI-REX CENTRO CERAMICO FONDAZIONE REI MISTER MUSP ROMAGNATECH T3LAB ALMACUBE	CNR UNIBO UNIMORE UNIFE POLIMI ENEA CERTIMAC PROAMBIENTE T3LAB ALMACUBE	CNR UNIBO UNIMORE UNIPR UCSC POLIMI ENEA CRPA LEAP PROAMBIENTE	UNIMORE (co leader) UNIBO INFN CINECA

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## Spoke 1 - Materials for sustainability and ecological transition

**WP1** Advanced materials and processes for a sustainable industrial system  
**WP2** Materials and devices for a sustainable agrifood industry and ecological packaging  
**WP3** Materials for green energy production, saving, storage and zero impact buildings  
**WP4** Advanced materials and devices for health industry, diagnostics and therapeutics with a one-Health approach  
**WP5** High performance and/or lightweight materials for green mobility and aerospace

## Spoke 2 - Clean energy production, storage and saving

**WP1** Technologies, systems & components for the conversion and use of energy from renewable sources  
**WP2** Technologies and systems for energy transport, distribution and storage. Smart sector integration: flexible, integrated, resilient and digitalised energy networks (HPC)  
**WP3** Technologies, systems and components for the production, distribution, accumulation and direct use of green hydrogen and for the production of e-fuel  
**WP4** Capture, sequestration, purification and use of CO2 also through the use of green hydrogen or renewable sources

## Spoke 3 - Green manufacturing for a sustainable economy

**WP1** Development of zero-pollution products, processes and production systems that minimize the energy demand and the use of hazardous and of non-renewable materials  
**WP2** Development of production chains and supply systems with low energy and environmental impact  
**WP3** Life Cycle and Sustainability Assessment of materials, products and processes  
**WP4** ICT Solutions and technologies for the design, construction, monitoring, and control of green, sustainable, safe and reconfigurable machines and industrial processes  
**WP5** Impact of EU taxonomy for sustainable activities on the regional industrial ecosystems

## Spoke 4 - Smart mobility, housing and energy solutions for a carbon-neutral society

**WP1** Pedestrian and cyclist safety, high-quality cycling network, modelling mobility flows, multimodal systems and shared mobility, cybernetic mobility, video system  
**WP2** Design for all, healthy and active city, social-housing design, behavioral change, technological and social innovations, climate-policy assessment  
**WP3** Urban pavement management systems, street lighting solutions, accessibility to historic city center, monitoring and preservation of the cultural heritage  
**WP4** Indoor/outdoor air quality and comfort, PM10 dispersion and control, urban heat island, urban decarbonisation, energy communities, NBS

## Spoke 5 - Circular economy and blue economy

**WP1** Shaping the interplay between innovative circular business models and related policies for sustainable development  
**WP2** Waste and wastewater arising from production and domestic consumption chains: valorization and transformation of waste into new materials/products. Prevention, reuse, recycling, re-design of materials and decommissioning  
**WP3** Biotic and abiotic marine resources  
**WP4** Technologies for regeneration and development of thermal, maritime and coastal tourism systems  
**WP5:** Climate resilient agriculture, soil preservation, agroecology

## Spoke 6 - Ecological transition based on HPC and Data Technology

**WP1** HPC materials design for clean energy applications  
**WP2** HPC design and simulation of advanced devices and components for sustainable systems  
**WP3** HPC simulation for sustainable land, waters and their resources management

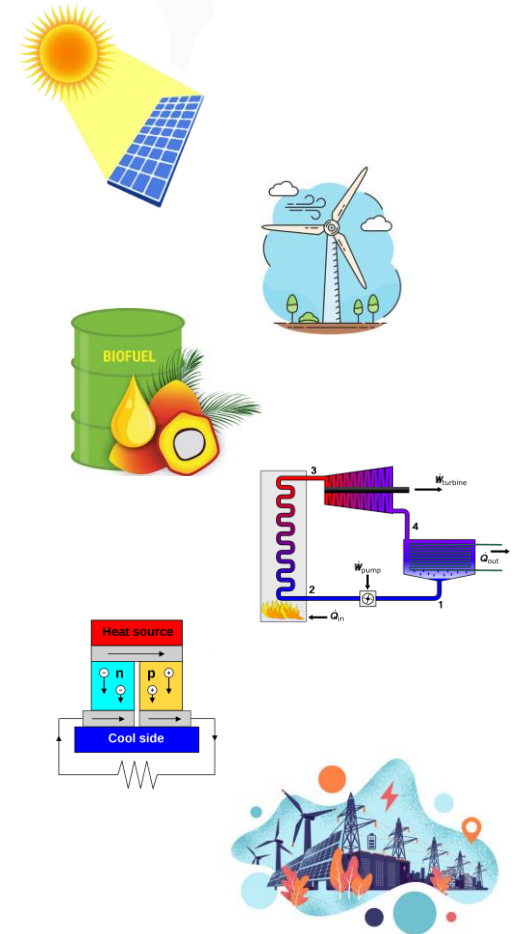




# ECOSISTER : ECOSYSTEM FOR SUSTAINABLE TRANSITION IN EMILIA-ROMAGNA

SPOKE 2 led by the University of Modena and Reggio Emilia is focused on **Clean Energy production, storage and saving.**

1. Conversion technologies from **solar Energy**: PV cells, power converters, solar concentrators, PV systems architecture and identification of their key components.
2. Conversion technologies from **wind Energy**: wind turbines technologies with particular reference to modular small wind turbines integrated with PV power plant and H2 production.
3. Conversion technologies from **biomass and biofuels**, including gasification and pyrolysis plants (for coupling with CHP plants).
- 4. Waste Heat Recovery** technologies from local resources, including heat pumps and **ORC plants**.
5. Electrical energy conversion systems for energy production from **low grade enthalpy fluxes** (including thermo-electric generators).
6. Methodologies and solutions for the **integration of RES technologies and plants** in actual energy networks, including legislative framework.



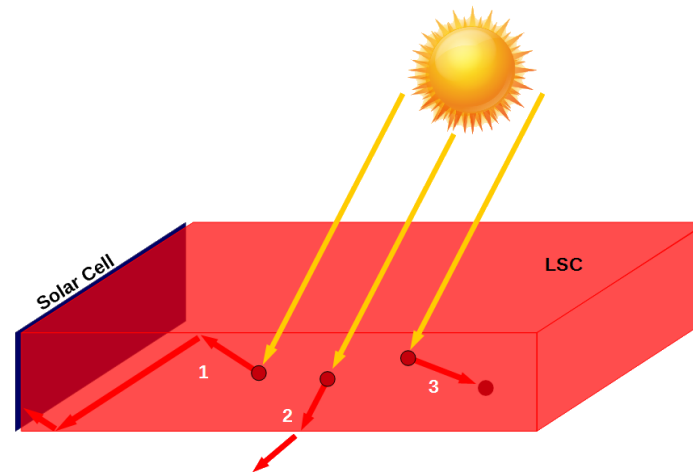


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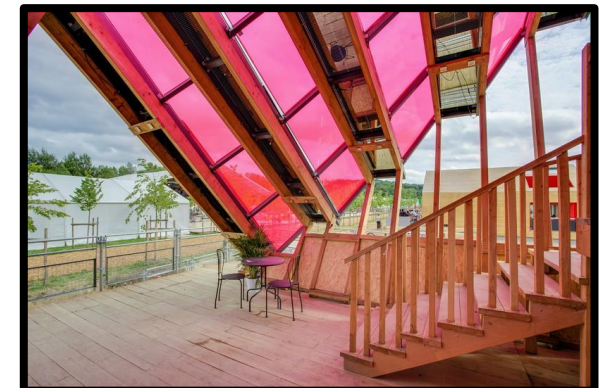
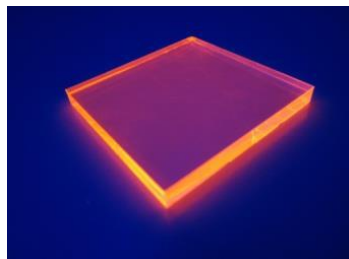
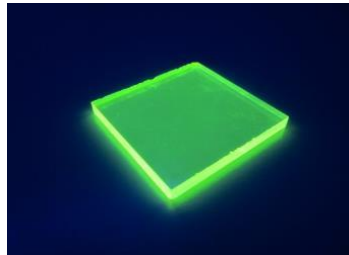
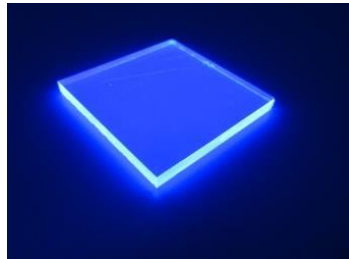
The University of Ferrara is leader of SPOKE 2 - WP1: **Conversion technologies from solar Energy**

## Luminescent Solar Concentrators

- Smart PV windows
- Preserve from UV radiation
- Application in BIPV systems, agrivoltaics, PV sheds



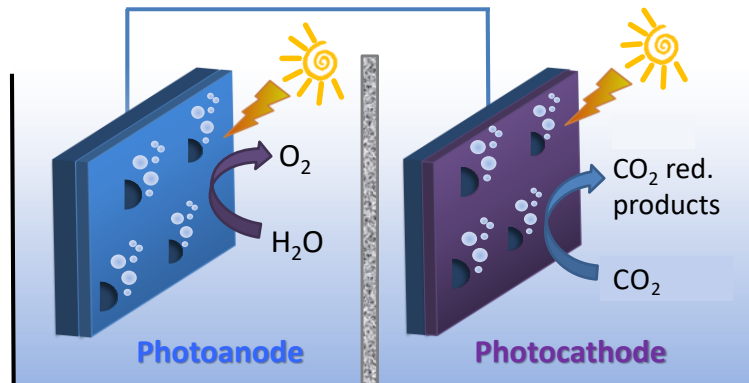
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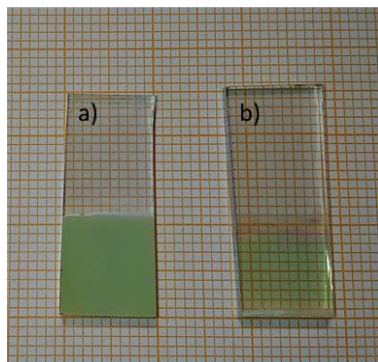
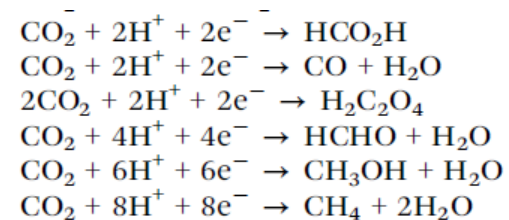
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## Artificial photosynthesis via photoelectrochemical cells



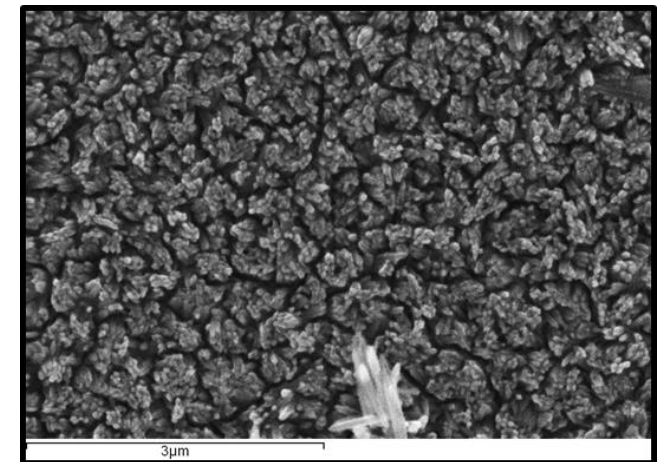
✓ Several possible reduction semi-reactions:



Photocatalytic materials such as  $\text{WO}_3$  or  $\text{Fe}_2\text{O}_3$  can be semi-transparent and used as coating for water splitting reactors.

Either  $\text{H}_2$  or  $\text{CO}_2$  reduction products can be obtained.

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# CIRCULAR ECONOMY RESEARCH (CERCIS)

The University of Ferrara coordinates the CEntre for Research on Circular economy, Innovation and SMEs (CERCIS)  
Leading **Spoke 5** on “**Circular Economy and Blue Economy**”

- Among many activities, CERCIS is focused on investigating firm eco-innovative behaviors to combine competitiveness with sustainability and to face the challenges set by the European Union Action Plan for the Circular Economy in 2015
- The Centre involves four university departments:
  - Economics & Management;
  - Engineering;
  - Chemical, Pharmaceutical and Agricultural Sciences (DOCPAS);
  - & Environmental and Prevention Sciences.



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<http://eco.unife.it/it/ricerca-impres-territorio/centri-di-ricerca/cercis>