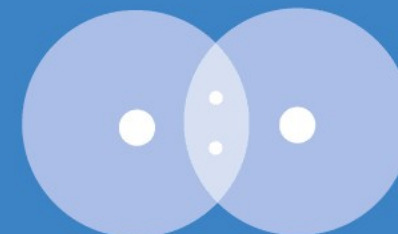


HYDROGEN | H_2 @UniTo



RESEARCH STAFF

Chemistry

Claudia Barolo, Giovanni Ghigo, Lorenzo Maschio, Lorenzo Mino, Marcello Baricco, Gabriele Ricchiardi, Marco Minella, Marta Corno, Michele Chierotti, Salvatore Baldino, Silvia Bordiga, Valter Maurino

Computer Science

Andras Horvath

Cultures, Politics and Society

Alessandro Sciullo

Economics and Statistics

Massimo Nicolazzi, Valeria Di Cosmo

Earth Sciences

Chiara Montomoli, Domenico De Luca, Franceco Dela Pierre, Gessica Umili, Giovanna Antonella Dino, Linda Pastero, Manuela Lasagna, Marcello Natalicchio, Nadia Curetti, Salvatore Iaccarino, Sergio Vinciguerra, Simona Ferrando

11 faculties 35 researchers

Interuniversity Department of Regional and Urban Studies and Planning

Giuseppe Mandrone

Law

Anna Porporato

Life Sciences and Systems Biology

Francesca Valetti

Management

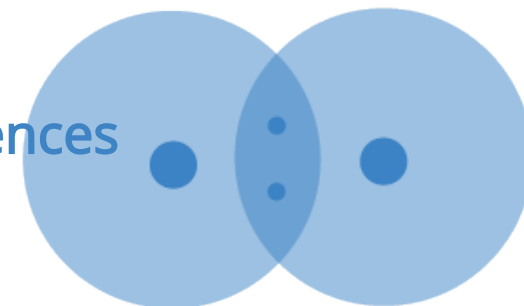
Davide Calandra, Federico Lanzalonga, Paolo Biancone

Physics

Paolo Gambino

Veterinary Sciences

Leila Vincenti



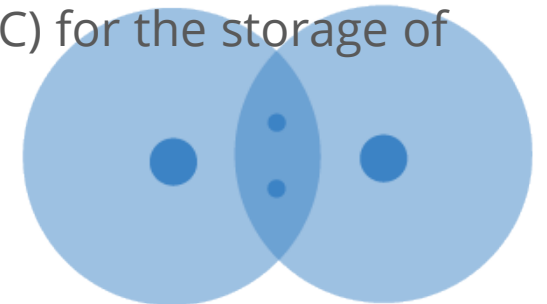
RESEARCH AREAS

Production

- Electrochemical and photoelectrochemical production by water electrolysis
- Photocatalytic production processes (water photosplitting, semiconductor oxides, reforming of organic compounds)
- Mixtures rich in hydrogen for pyrogasification of organic materials (wood) and plastic
- Biomass enzymes (bacteria, algae) by hydrogenase

Logistics (purification, distribution, storage, compression)

- Identification and study of the geological characteristics (tightness, stability of voids, possible fluid / rock interactions) of sites for the storage of hydrogen in depleted reservoirs (quarries, mines) or ad hoc (salt formations, aquifers, hard rocks), including any effects induced in the facing areas
- Synthesis and characterization of materials (hydrides, LOHC) for the storage of hydrogen
- Compression of hydrogen by hydrides
- LCA of hydrogen compression and storage processes



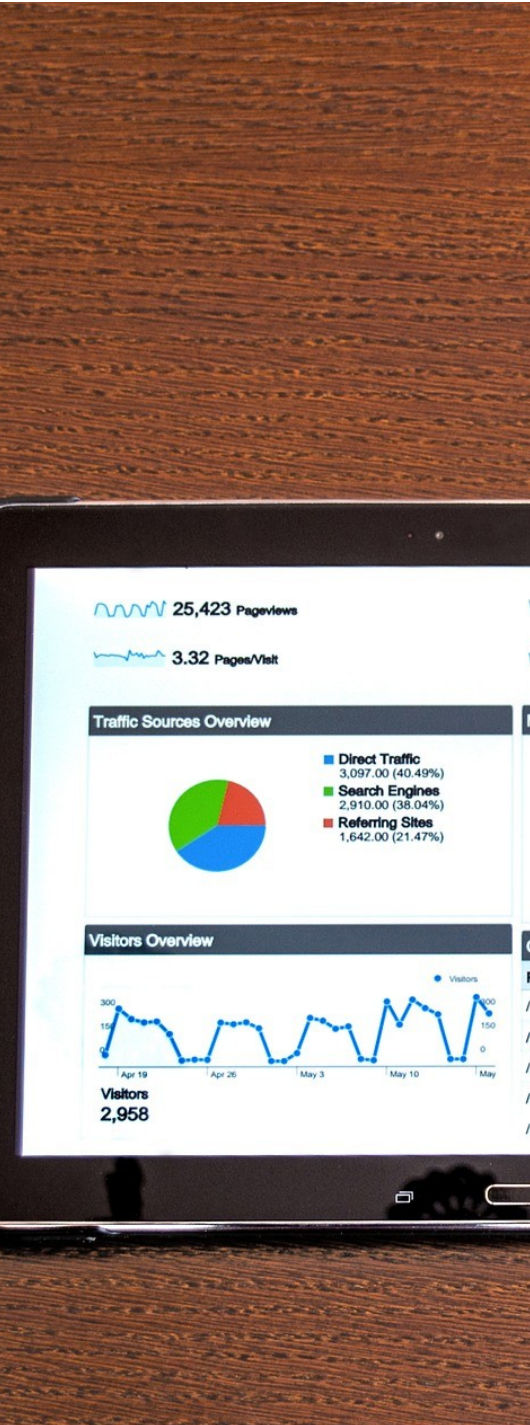
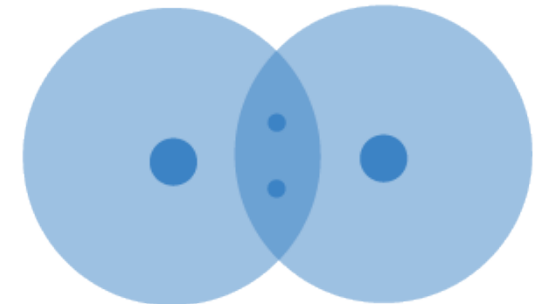
RESEARCH AREAS

Fuel cells

- Polymer membranes for PEM cells
- Oxidic materials for SOFC

Digitalization

- Data processing and use of data: visualization, statistical analysis and forecasts with probabilistic models or machine learning
- Development of formal models based on data (of production processes, energy consumption, production from renewable sources)
- Analysis, optimization of performance (scheduling based on green energy availability, optimal process parameters).





RESEARCH AREAS

Industrial use

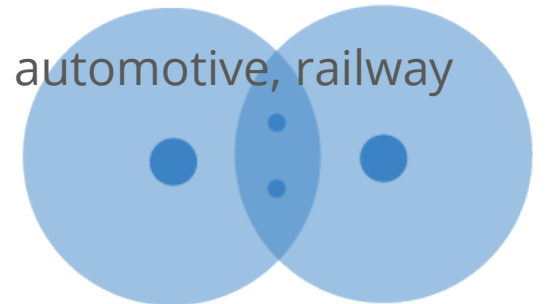
- Use of hydrogen for the synthesis of light hydrocarbons by hydrogenation of CO₂
- Selective hydrogenations for fine chemistry (experiments and modeling)
- Development of highly selective advanced catalysts for saving energy resources and precious materials

Energy use

- Integration of hydrogen storage systems based on hydrides with electrolyzers and fuel cells for storage of renewable energy
- Chemical energy storage through the synthesis of light hydrocarbons to be used as fuel or basic chemical molecules and through selective hydrogenation of CO₂

Mobility use

- Feasibility studies for the use of hydrogen mobility in the automotive, railway and nautical fields
- Hydrogen storage systems for mobility applications
- Hydrogen-powered fuel cell drones

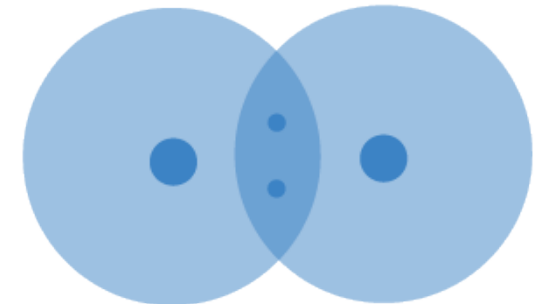




RESEARCH AREAS

Economic-financial, legal and regulatory, social perspective

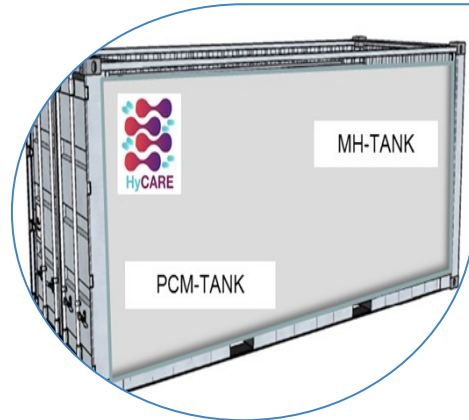
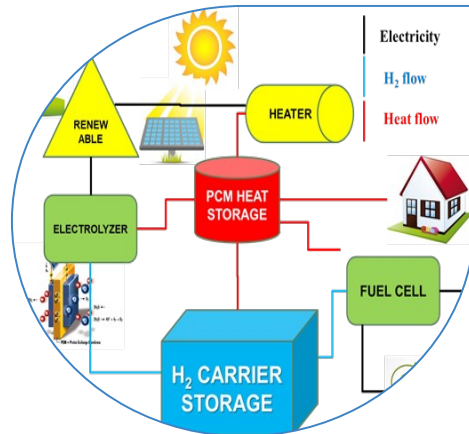
- Economic impact of the use of hydrogen on the electrical system and for mobility
- Economic analysis of Hydrogen Valleys and EU taxonomy on the reduction of the cost of debt linked to green hydrogen
- Analysis of competition scenarios based on patent portfolios, strategic positioning and new business models
- Business Case on the development of hydrogen technologies
- Analysis and evaluation of laws, incentives, regulations
- Social acceptance of hydrogen-based technologies
- Hydrogen for energy communities



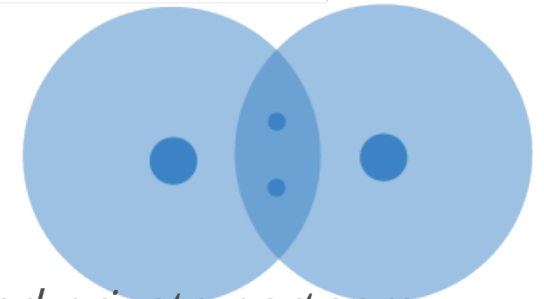
PROJECTS

HyCARE: Hydrogen Carrier for Renewable Energy Storage

Storage of renewable energy through the conservation of hydrogen carriers and heat accumulation



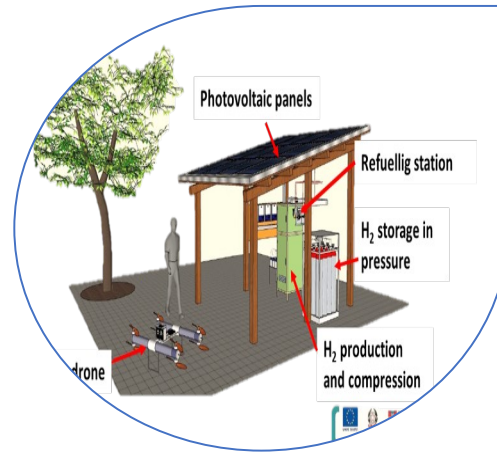
- Project financed 2019 - 2022
- Demo plant near Paris (ENGIE)
- Coupled system H₂ storage – heat storage (PCM)
- ~ 50 kg of H₂ stored (\approx 4 tons of alloy)
- H₂-carrier: TiFe-alloy
- Innovative tank design



European FCH JU funded project with several public and private partners

PROJECTS

Clean-DronHy: H₂ powered drone with H₂ refuelling station
Produce, compress and use H₂ onsite



H₂-REFUELLING STATION

- PV panels: 10 panels of 300 W
- Electrolyser: 250 NI/h of H₂ at 30 bar and T_{amb}
- MH-Compressor: output pressure of 200 bar
- Booster: from 200 to 400 bar

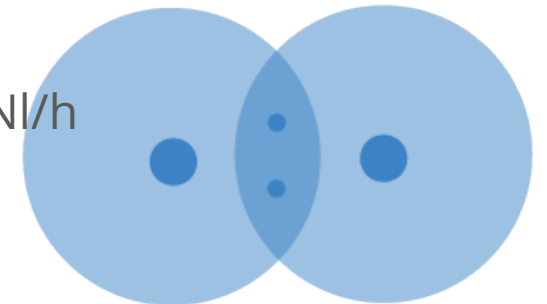
DRONE

- Two bottles of 1 l or one of 3 l of H₂ - Type IV bottle
- H₂ pressure = 300 bar
- 2 Fuel Cell : 650 W each
- Battery - Consumption : 8 NI/h
- Time of flight : 1:00-1:30 h

Diameter = 1.3 m Weight = 5.6 kg

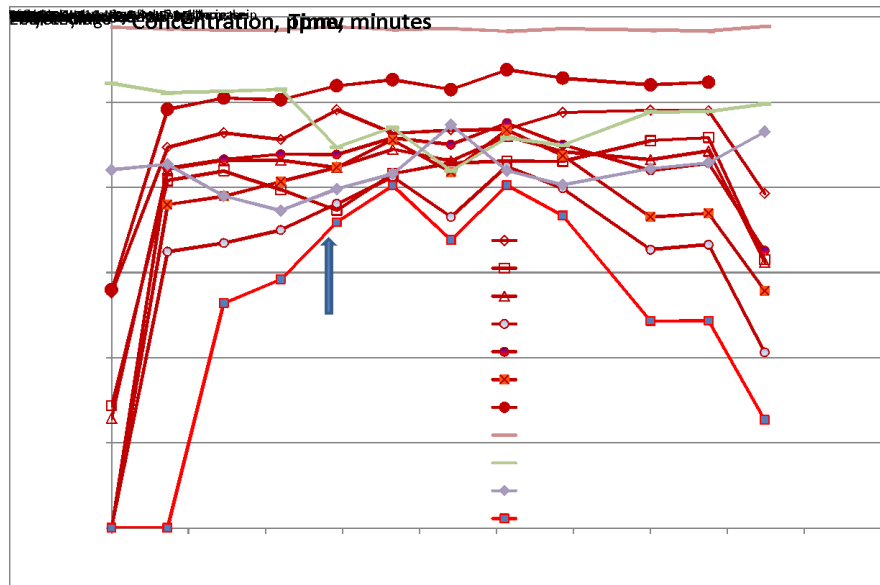


Regional funded project with SME private partners



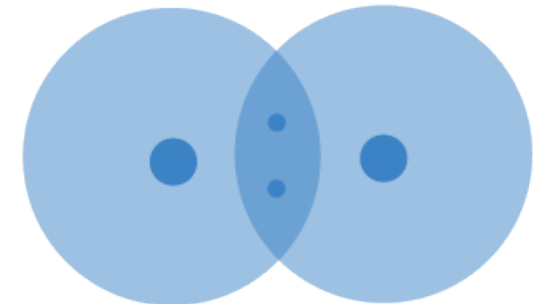
PROJECTS

SmallGreenCHP4.0: Autonomous and connected cogeneration system for small users based on renewable biomass of local forest origin certified for the production of syngas with a high hydrogen content



SYNGAS STATION

- Creation of an off-Line GC Station for syngas analysis
- Creation of an on-line measurement station of the composition of syngas (CH_4 , H_2 , CO , CO_2), pollutants (HCL , Tar, Particulate, H_2S)



Regional funded project with SME private partners

PROJECTS

VI-R: SynGas conditioning system generated from hospital / marine waste for the abatement of sulfur, chlorinated and tar gases



PECO STATION

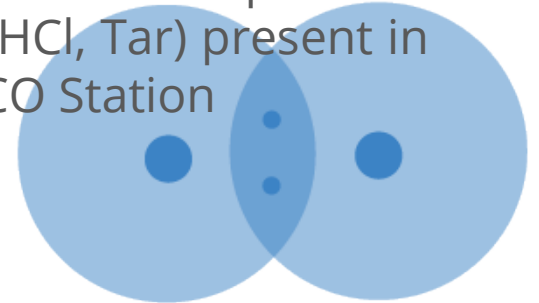
PECO is a complete gas cleaning unit placed on a mobile skid. The system is aimed at particulate abatement, dechlorination, desulfurization and tar reforming. The device couples reagents, catalysts and an innovative Plasma-Enhanced Catalytic Oxidation treatment for tar reforming.



GC ANALYSYS

Characterization of the device according to the operating parameters of the plasma through gas chromatography analysis of the gaseous components and of the tar and pollutants (H_2S , HCl , Tar) present in the Syngas before and after the PECO Station

Regional funded project with SME private partners



MAIN EU PROJECTS ENERGY 2016-20 - 5,6 M€

Call identifier	Acronym	Project title
FCH2 JU CALL FOR PROPOSALS 2018	HyCARE	An innovative approach for renewable energy storage by a combination of hydrogen carriers and heat storage - Prof. Marcello Baricco
H2020-LC-SC3-2018-NZE-CC	COMETS	Collective action Models for Energy Transition and Social Innovation– Prof. Dario Padovan
H2020-MSCA-ITN-2018	PARACAT	Paramagnetic Species in Catalysis Research. A Unified Approach Towards Heterogeneous, Homogeneous and Enzyme Catalysis – Prof. Mario Chiesa
H2020-MSCA-ITN-2020	CHASS	Cu-CHA zeolite-based catalysts for the selective catalytic reduction of NOx in exhaust diesel gas: addressing the issue of Sulfur Stability – Prof. Gloria Berlier
MSCA-IF-2020	PLEC	Private Law and the Energy Commons – Prof. Alessandro Quarta
H2020-LCE-2016-RES-CCS-RIA	GEMex	GEMex: Cooperation in Geothermal energy research Europe-Mexico for development of Enhanced Geothermal Systems and Superhot Geothermal Systems – Prof. Giuseppe Mandrone
H2020-LC-SC3-2018-Joint-Actions-3	Impressive	Ground-breaking tandem of transParent dye Sensitised and perovskite solar cells – Prof. Claudia Barolo
H2020-LC-SC3-2018-NZE-CC	COZMOS	Efficient CO2 conversion over multisite Zeolite-Metal nanocatalysts to fuels and Olefins – Prof. Silvia Bordiga
H2020-LC-BAT-2019	MODALIS2	MODElling of Advanced LI Storage Systems – Prof. Lorenzo Maschio
H2020-LC-SC3-EE-2019	eCREW	establishing Community Renewable Energy Webs - Rolling out a business model and operational tool creating webs of households that jointly manage energy to improve efficiency and renewables uptake – Prof. Dario Padovan
H2020-LC-SC3-2020-Joint-Actions-1	LEAP-RE	Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy – Prof. Alessandro Sciallino
H2020-LC-SC3-2020-NZE-RES-CC	4AirCRAFT	Air Carbon Recycling for Aviation Fuel Technology – Prof. Francesca Bonino
ERC-2019-SyG	CUBE	Unravelling the secrets of Cu-based catalysts for C-H activation – Prof. Silvia Bordiga

EDUCATION

PhD programs for research on hydrogen

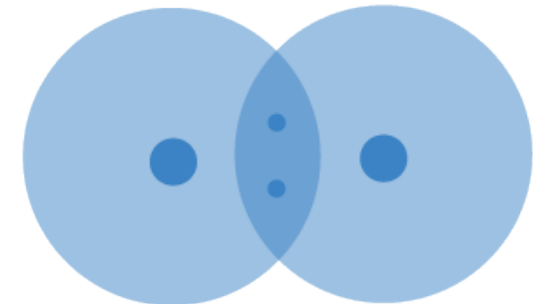
- Chemistry and Material Sciences
- Earth Sciences
- Innovation for the Circular Economy

Master courses

- Material Science



[to learn about all PhDs at Unito](#)

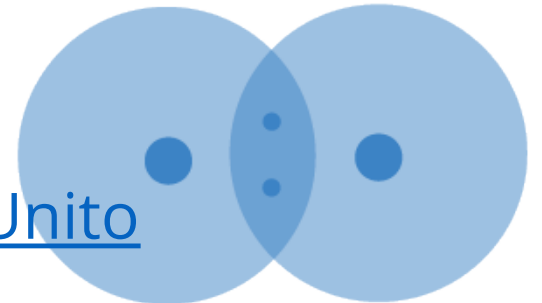


LABORATORIES

- Electronic microscopy and EDS microanalysis
- Transmission electron microscopy (TEM) with chemical microanalyzer in energy dispersion spectrometry (EDS)
- Chemical analysis and material characterization
- Structural characterization - NMR spectrometer
- Gas Chromatograph Spectrometer (high resolution)
- Closer Lab: decision analysis, based on economic incentives



[To learn about all Research Labs at Unito](#)



PARTNERSHIP & NETWORK

International and European



JP Fuel Cells and Hydrogen

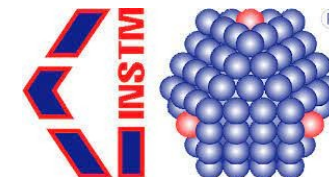


Hydrogen valleys

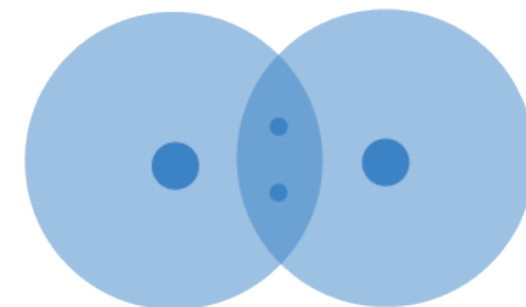
Italian



ASSOCIAZIONE ITALIANA IDROGENO E CELLE A COMBUSTIBILE



Piedmont Region and local



PARTNERSHIP & NETWORK

FINCANTIERI

+ COMPETENCE
INDUSTRY
MANUFACTURING
4.0

TECNO DELTA S.r.l.

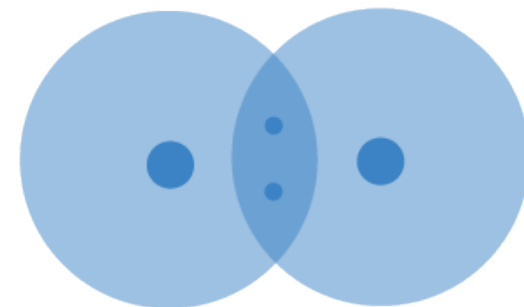
enel



BluEnergy Revolution

IRIS
PLAYGROUND FOR NEW IDEAS

PUNCH | Group



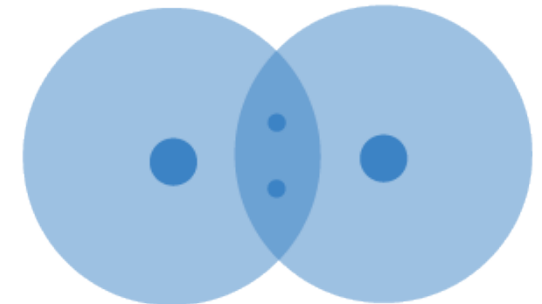
PARTNERSHIP & NETWORK



Bando PNRR “Ecosistemi dell’Innovazione”

NODES: Unito is a node of the Spoke “INDUSTRY 4.0 FOR SUSTAINABLE MOBILITY AND AEROSPACE”, led by **Politecnico di Torino**. The project covers among others the following topics:

- Green Hydrogen Production and Storage
- Synthetic fuels (also through CO₂ reduction with Hydrogen)

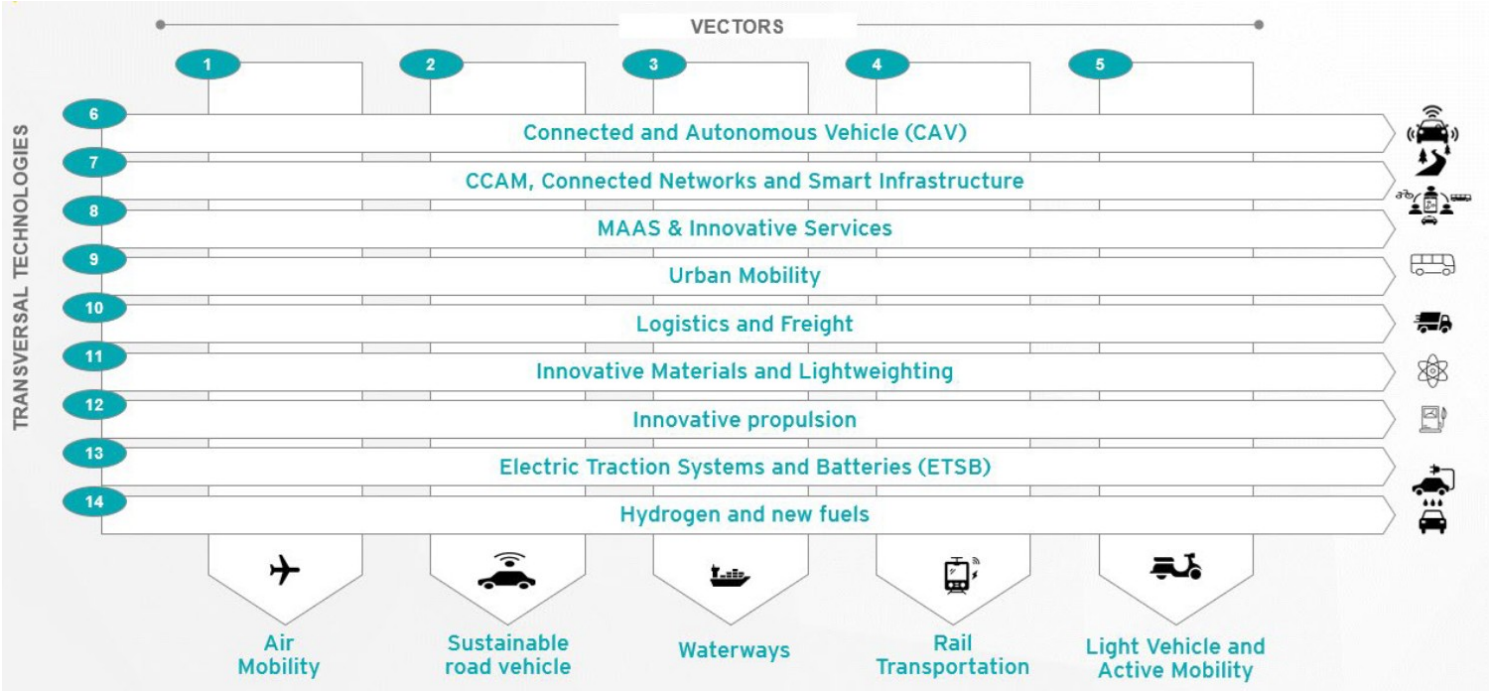




PARTNERSHIP & NETWORK



Centro Nazionale di Ricerca per la Mobilità Sostenibile



Hydrogen and new fuels



COMPANY ON CAMPUS

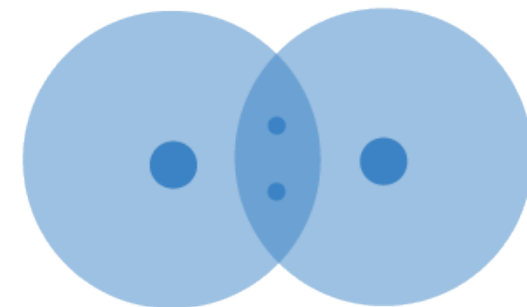
Major hydrogen activities will be located inside the Campus of the University of Turin **Città delle Scienze e dell'Ambiente**, which is undergoing an important expansion work, ending in 2024.

It will be **one of the most important academic construction sites in our country in recent years.**

The Campus will welcome 1,000 researchers and 10,000 students, to enhance knowledge in **agri-food, biotech, green chemistry, mobility, energy, environment, human and animal health, material science.**

Design with us the Scientific and Technology Area - Butterfly Area - of 50,000 sqm, that within the Campus, **will host companies and organizations to make R&D** together with our researchers and students, through joint labs, testing plants, access to research instruments and innovation services.

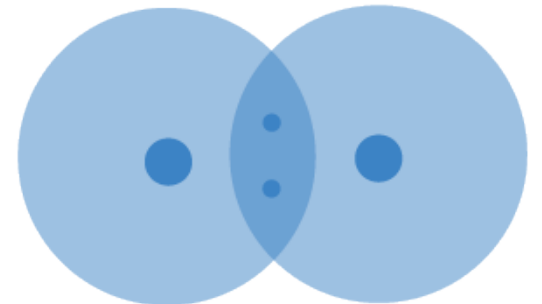
Apply to the Call for interest, contact butterflyarea@unito.it





POSSIBLE COLLABORATIONS

- interdisciplinarity
- joint participation in funded projects
- direct access to Labs and use of research tools
- commissioned research (e.g. feasibility studies, new materials)
- joint publications
- sponsorship of doctoral scholarships
- internships and theses
- joint labs and pilot plants



CONTACTS

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