



RESEARCH GROUP IN SUSTAINABLE AND RENEWABLE ELECTRICAL TECHNOLOGIES (PAIDI-TEP023)

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Research group:

<https://bit.ly/3IQkDfc>



- 7 PhD members, 3 PhD collaborators, 2 research fellows and 11 PhD students.
- 12 periods of 6 years on research work (research activity recognition)
- 20 research projects + 9 research contracts with companies: 1,7 M€ (led 0,4M€)
- 90 articles published in journals indexed in JCR-SCI + 75 papers published in national and international conferences + 5 book chapters published in internationally renowned publishers
- 11 supervised PhD theses (2 with Extraordinary Doctorate Award, 3 with International Doctorate Mention and 2 with International Joint Supervision)
- Participation in the Editorial Board of 10 international journals + Guest editors of 12 Special Issues in journals indexed in JCR-SCI
- Technical scientific evaluators of research projects for Spanish and Italian Governments.
- Participation in the Master in Renewable Energies and Energy Efficiency and in the PhD Programme in Sustainable and Energy Engineering (UCA)
- Collaborations with 4 Spanish research groups (Jaén, Málaga, Catalonia and Huelva) and 8 International research groups (from UK, Italy, Denmark, Brazil, Turkey, and Algeria).



Research lines:

- **Extensive research experience**, supported by publications, doctoral theses and research projects /contracts, and **advanced equipment for the development of electrical, electronics and control technologies in the following research lines:**

SMART GRIDS/MICROGRIDS



RENEWABLE ENERGY (Wind Energy, Photovoltaic Energy, Marine Energy)



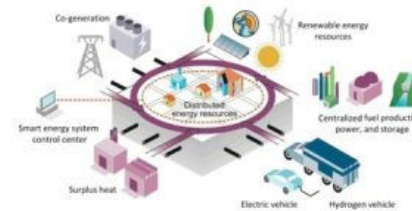
GREEN HYDROGEN



TRANSPORTATION ELECTRIFICATION



MULTI-ENERGY/INTEGRATED ENERGY SYSTEMS



SMART ENERGY



Research lines:

- **SMART GRIDS/MICROGRIDS:**

Design, control and operation of smart grids/microgrids with renewable energy and energy storage for isolated and grid-connected applications in distributions networks, smart cities or smart ports



- **WIND ENERGY:**

Control and operation of wind turbines and wind farms, integrating energy storage and hydrogen production systems, and FACTS devices for improving power quality and the integration of wind turbines and wind farms into the network



Research lines:

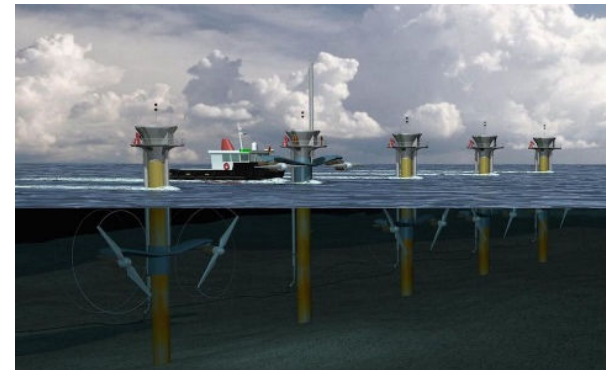
- **PHOTOVOLTAIC SOLAR ENERGY:**

Design, control and operation of isolated and grid-connected photovoltaic systems



- **MARINE RENEWABLE ENERGY:**

Electricity generation from offshore wind energy, marine current energy and tidal energy, and their connection to the grid



Research lines:

- **GREEN HYDROGEN:**

Design, control and operation of green hydrogen systems (fuel cell and/or electrolyser) for production of electricity or hydrogen, and for electric transport



- **TRANSPORTATION ELECTRIFICATION:**

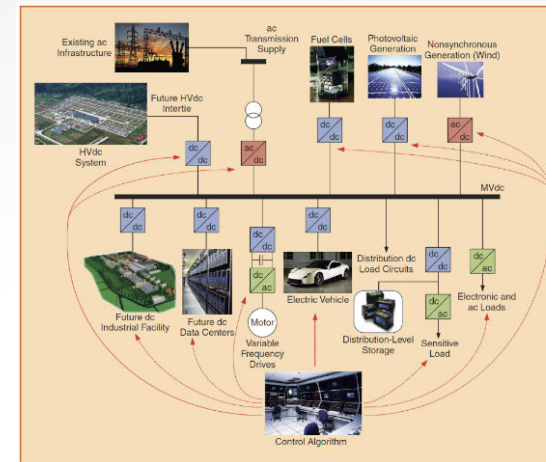
Design, control and operation of hybrid electric traction systems for transport (vehicles, buses, trams, port cranes, etc.), and electric charging stations.



Research lines:

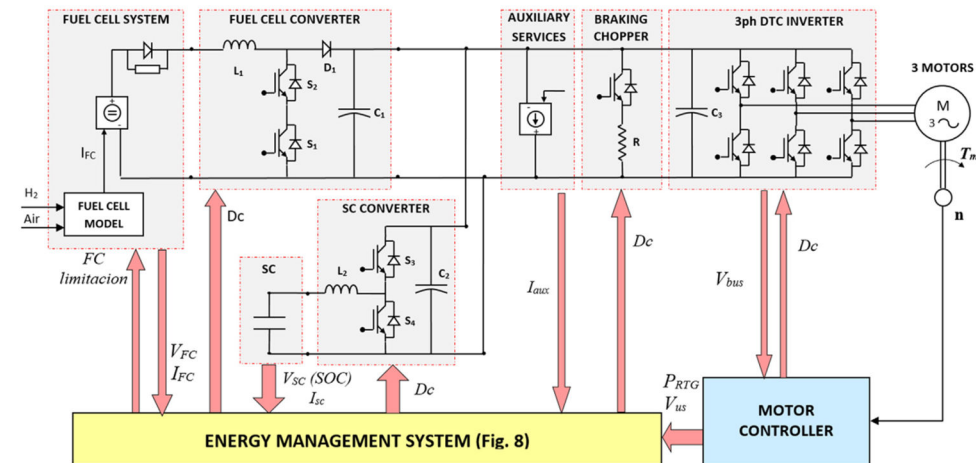
- DC ELECTRICAL GRIDS:**

Design, control and operation of DC electrical grids (LVDC, MVDC, HVDC) with renewable energies and energy storage systems.



- ELECTRONIC POWER CONVERTERS:**

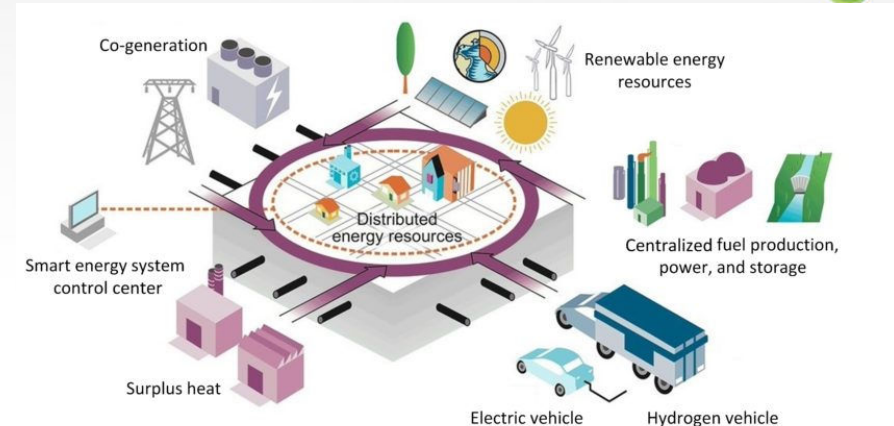
Design and control of electronic power converters applied to renewable energies, energy storage systems, etc.



Research lines:

- **MULTI-ENERGY/INTEGRATED ENERGY SYSTEMS:**

Design, control and operation of multi-energy/integrated energy systems for integrated production of electricity, hydrogen, energy for transport, heating/cooling, etc.



- **SMART ENERGY:**

Design of intelligent control and management systems for energy systems.

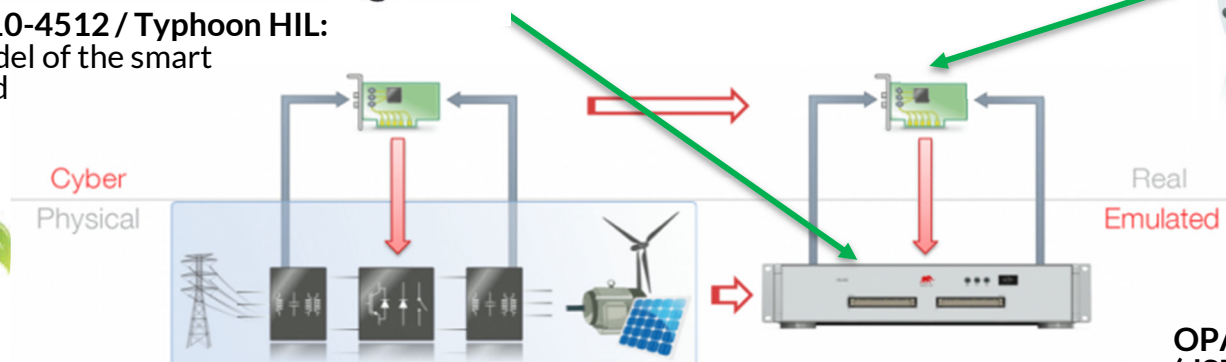


Laboratory/research equipment:

HARDWARE-IN-THE-LOOP (HIL) SYSTEM FOR DEVELOPMENT AND EVALUATION OF SMART GRIDS, MICROGRIDS, INDUSTRIAL EQUIPMENT AND MOTOR DRIVES



OPAL-RT 4510-4512 / Typhoon HIL:
Real-time model of the smart grid/microgrid



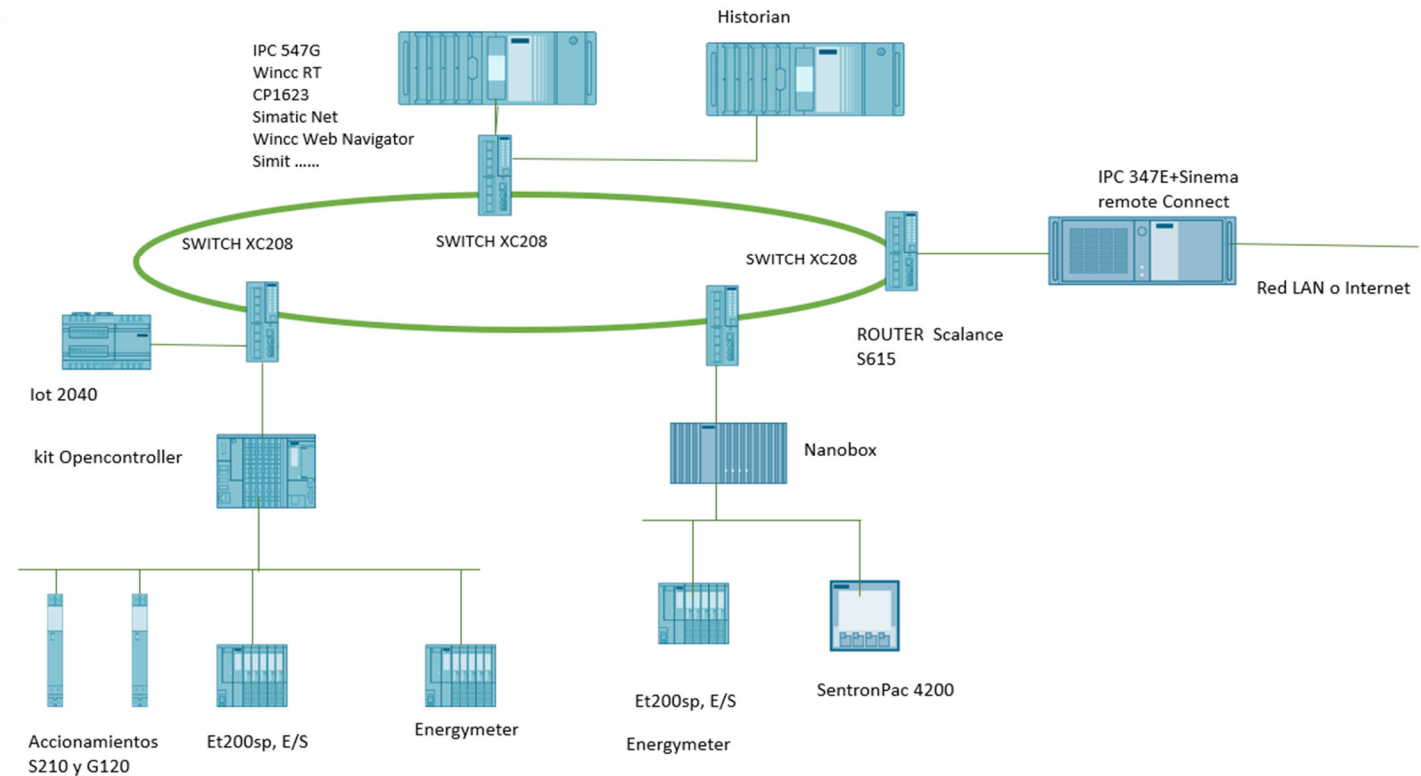
OPAL-RT OP4510-4512 / MicroLabBox (dSPACE) / Raspberry Pi:
Real time control system



Laboratory/research equipment:

SMART ENERGY LABORATORY FOR ENERGY MANAGEMENT IN THE INDUSTRY 4.0 (Research scientific-technical equipment supported by the Ministerio de Ciencia, Innovación y Universidades, Spain: Ref. EQC2018-004520-P)

Platform for development of energy management systems in industry based on a industrial network with Siemens industrial PC/PLCs for the design of controllers, control and diagnostic systems, and/or process and energy management algorithms to improve the operability and energy efficiency of a wide variety of applications in industry, smart grids or microgrids



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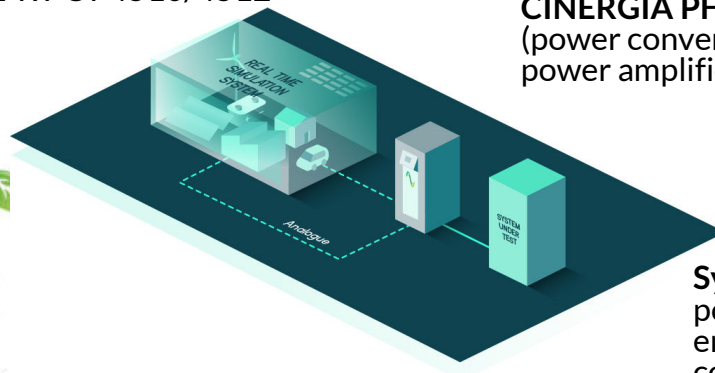
SMART CITIES LAB

(Research scientific-technical equipment supported by the Ministerio de Ciencia, Innovación y Universidades, Spain:
Ref. EQC2019-006399-P)

Platform based on Power Hardware in the Loop (PHIL) system for the design and experimental evaluation of smart cities, smart grids or microgrids with renewable energies, energy storage systems, hydrogen systems, electric vehicles and loads, and solutions to improve their control and energy management.

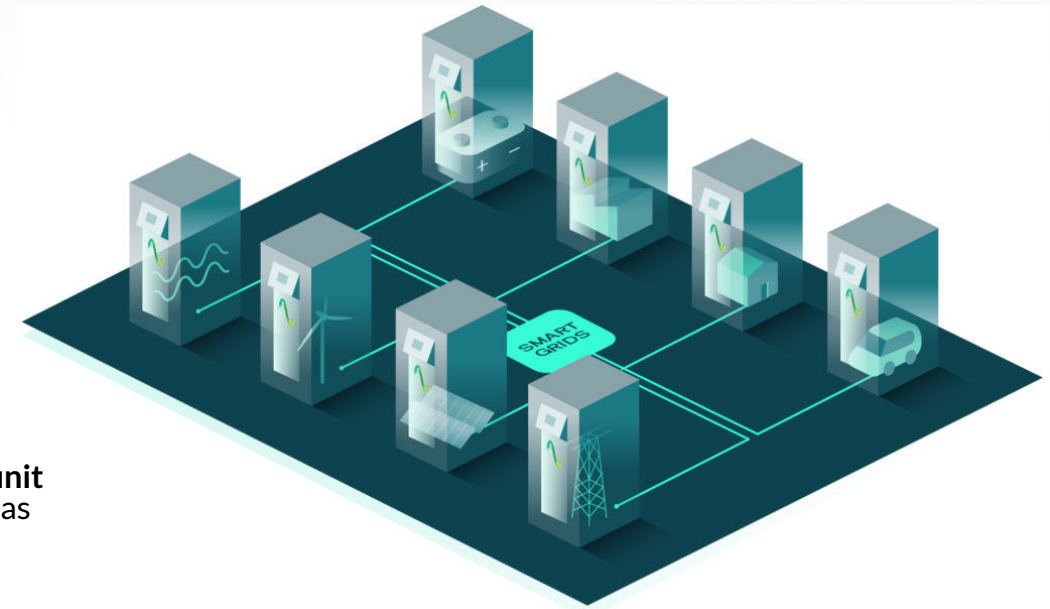
Real-time simulator:

- Typhoon HIL-402/404
- OPAL-RT OP4510/4512



CINERGIA PHIL unit
(power converter as power amplifier)

Systems under study (smart grid/microgrid, PV power plant, wind farm/turbine, electric vehicles, energy storage systems, motors, loads, controllers, etc.)



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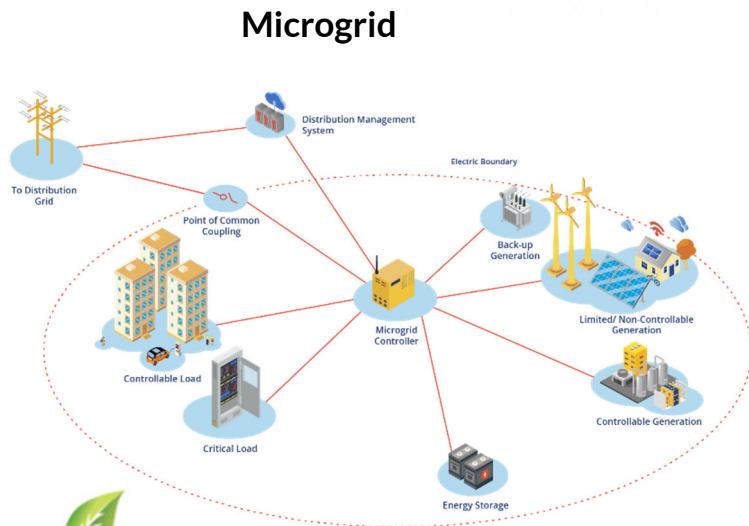
CINERGIA PHIL units



Ongoing Project: Microgrid Clusters

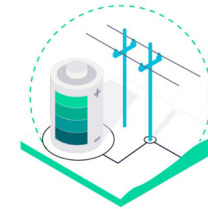


DYNAMIC STUDY AND CONTROL OF MICROGRID CLUSTERS
(Research project supported by Ministerio de Ciencia e Innovación, Agencia Estatal de Investigación, FEDER, UE - Project PID2021-123633OB-C32 supported by MCIN/AEI/10.13039/ 501100011033/ FEDER, UE)



Sustainability

Using primarily renewable energy sources microgrids support your grid independence and help to reduce carbon emissions.



Resiliency

Microgrids provide uninterrupted 24/7 power and balance load demands for your changing power needs.



Efficiency

With sophisticated control, you can optimize power usage based on demand, energy prices, and other factors.



Ongoing Project: Microgrid Clusters



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Ongoing Project: Microgrid Clusters

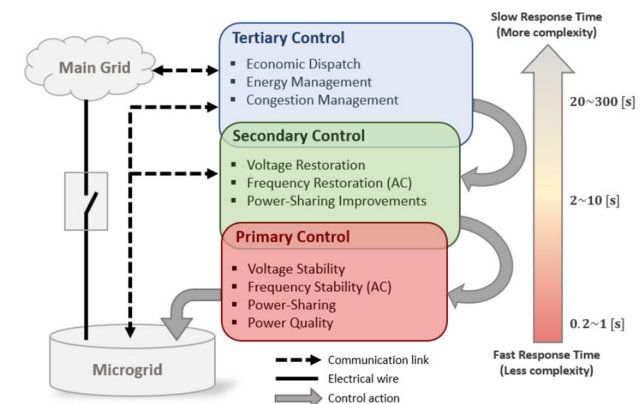
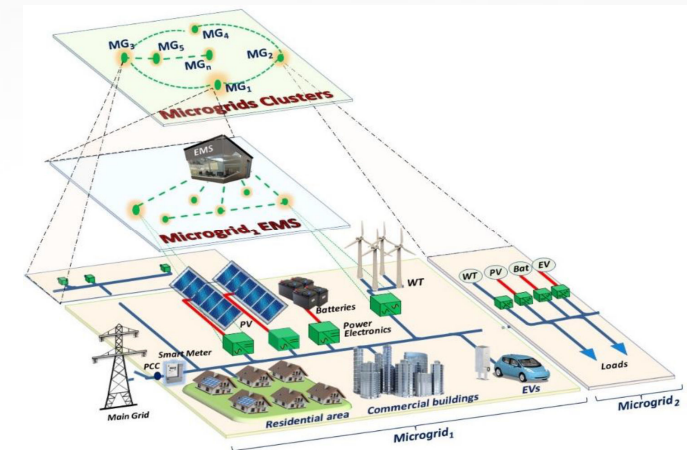


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Specific objectives and main contributions:

- 1) Dynamic study of MGCs with AC MGs, DC MGs and/or hybrid MGs, integrating renewable energy, energy storage systems and electric vehicles, among others.
- 2) Development of new dynamic equivalent models of MGs in MGCs to represent the dynamic behavior and to design the control system.
- 3) Development, evaluation and experimental validation of new control methods and controllers for the primary control, secondary control and tertiary control of MGCs





Ongoing Project: Multi-Energy Microgrids



COORDINATED CONTROL OF MULTI-ENERGY MICROGRIDS WITH ELECTRICITY, HIDROGEN AND GAS VECTORS

(Research project supported by Ministerio de Ciencia e Innovación, Agencia Estatal de Investigación, and Unión Europea “NextGenerationEU”/PRTR” - Project TED2021-129631B-C32 supported by MCIN/AEI/10.13039/501100011033 y NextGenerationEU/PRTR)

Multi-energy microgrid





Ongoing Project: Multi-Energy Microgrids

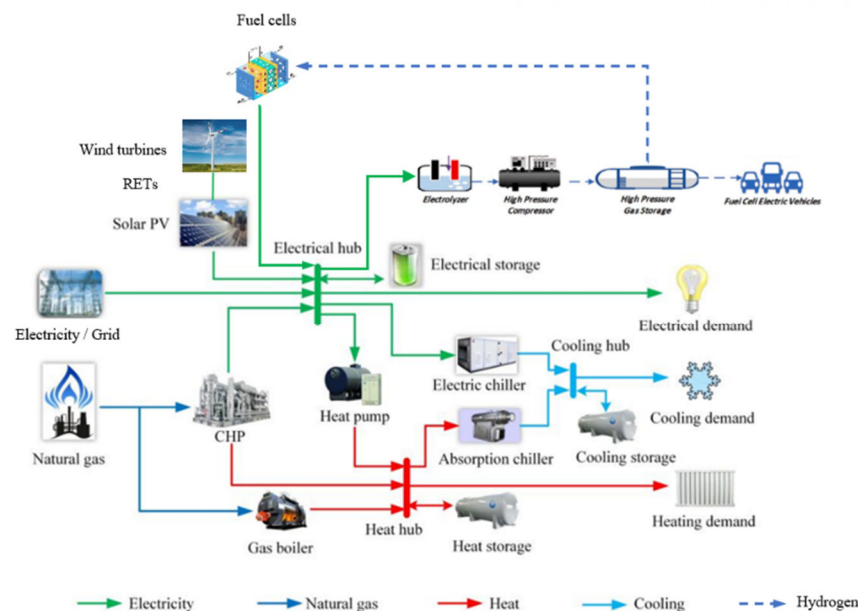


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Specific objectives and main contributions:

- 1) Development and experimental validation of dynamic models of MEMGs with electricity, hydrogen and gas vectors.
- 2) Development, evaluation and experimental validation of control methods of MEMGs integrating control agents for electricity, hydrogen and gas networks, which will work coordinately with other MEMGs.
- 3) Study of multi-energy complementarities (electricity, hydrogen, thermal energy and electricity/thermal energy storage) in a MEMG and among MEMGs to properly satisfy power and thermal demands flexibly.



Many thanks



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