Thermochemical Power Group – established in 1998

Scientific activities

Publications, Awards, Patents, Spin-off

- >350 Papers, >250 Journals (1998-2024)
- >20 International Awards (1998-2024)
- >20 patents (1998-2024)
- 2 spin off companies (BluEnergyRevolution, SIT Technologies)

Funding

International 65% (45% EU)

National 35%

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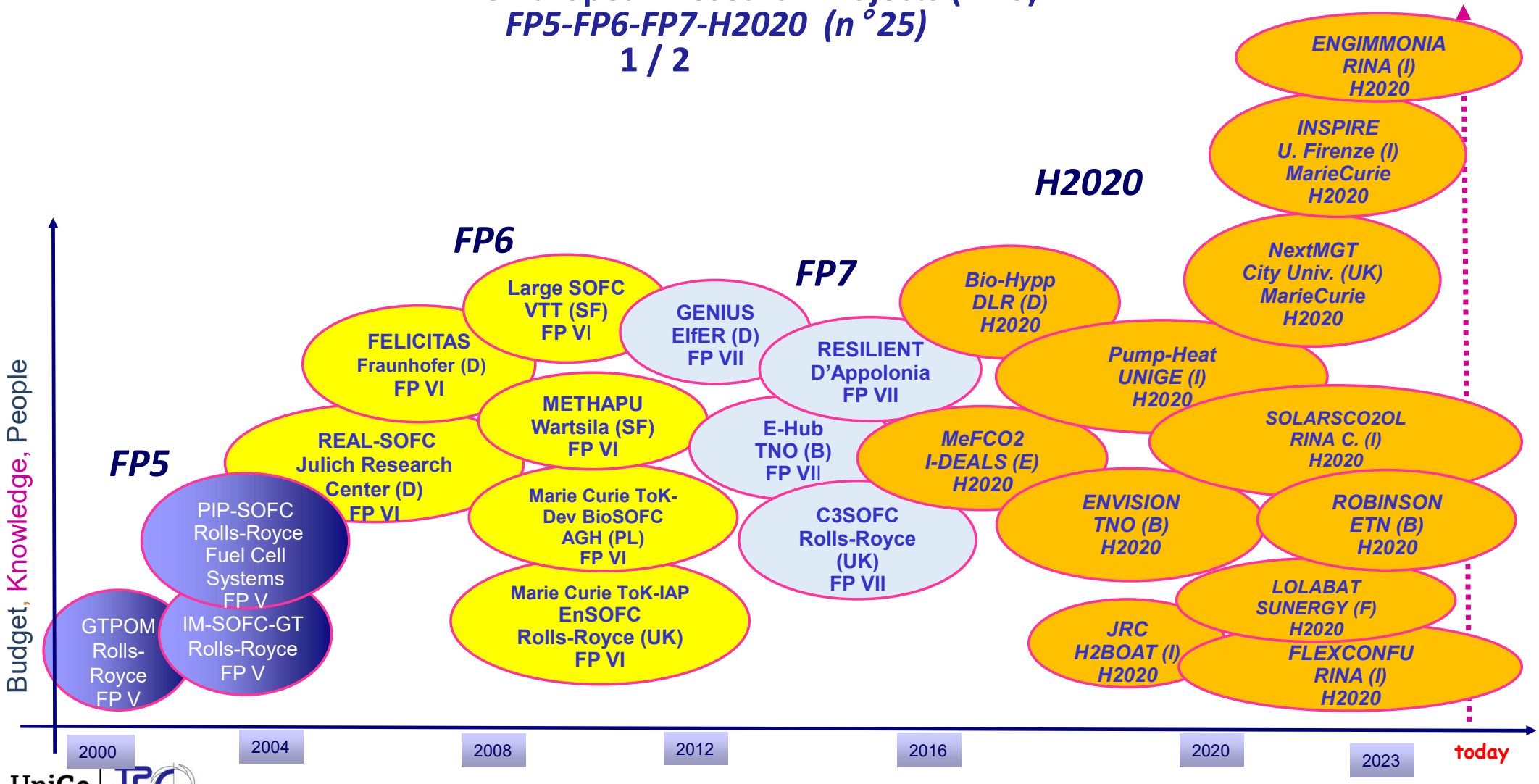
TPG European Research Projects (> 40)
FP5-FP6-FP7-H2020 (n°25)
1 / 2



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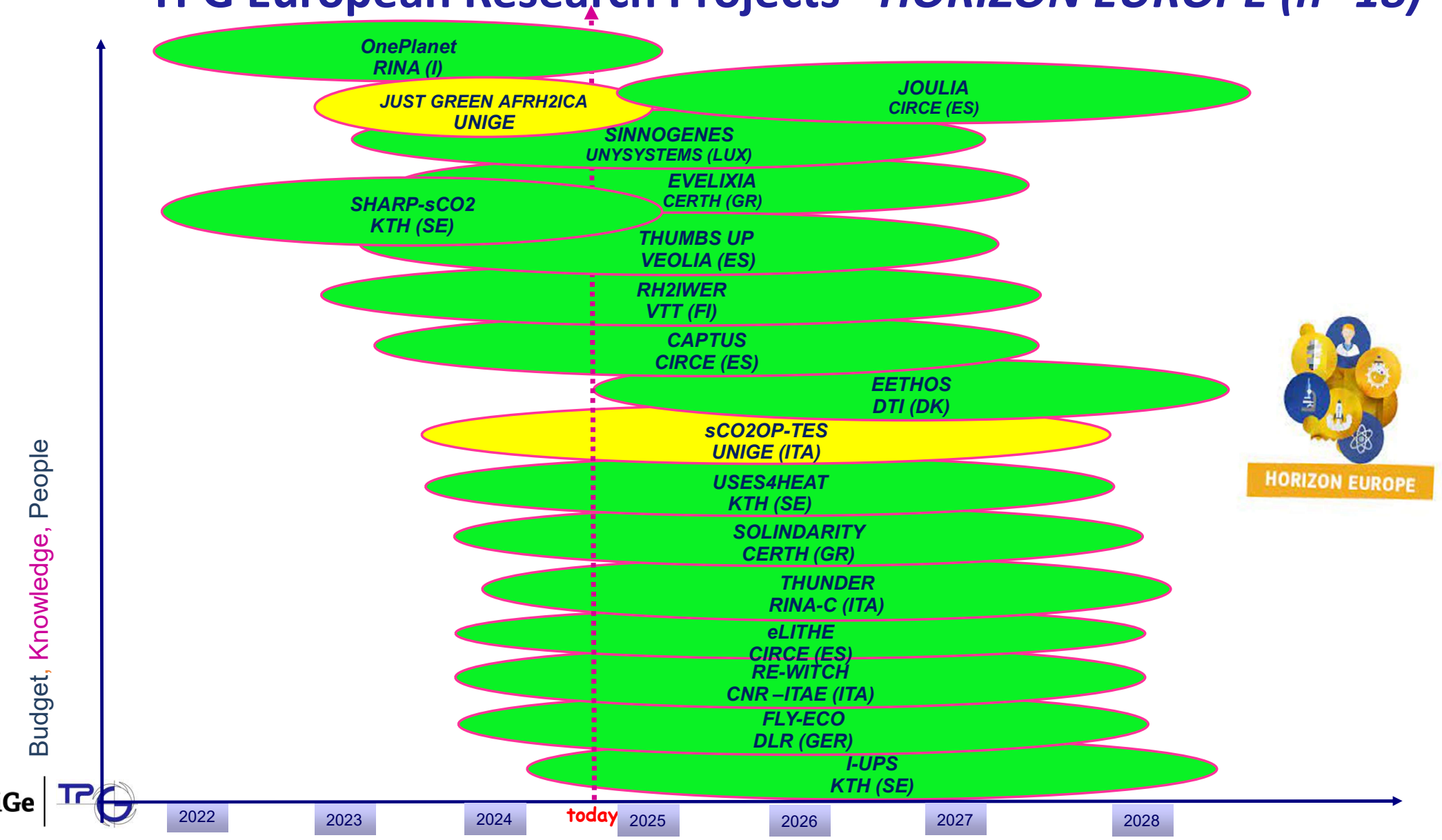
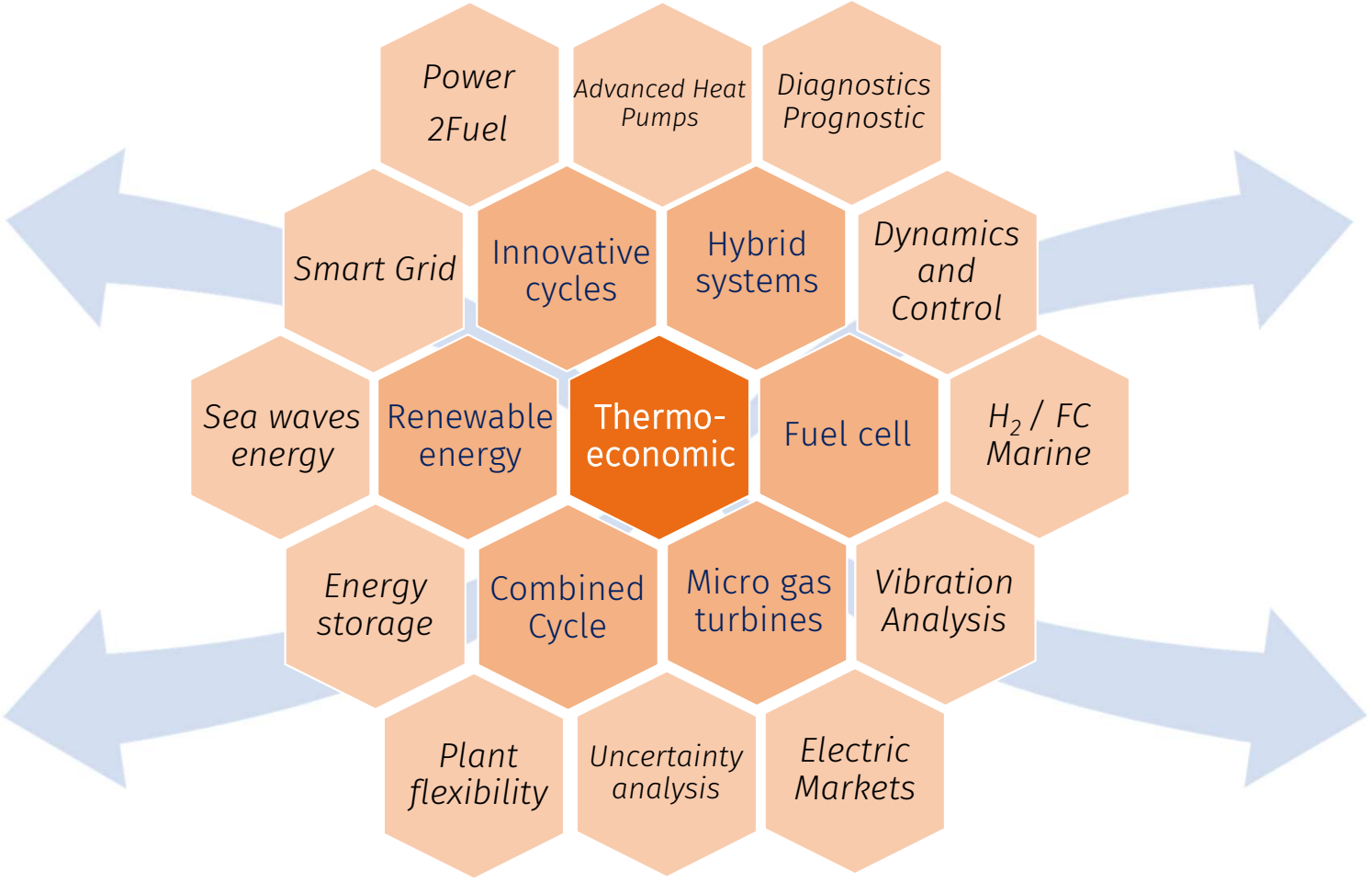
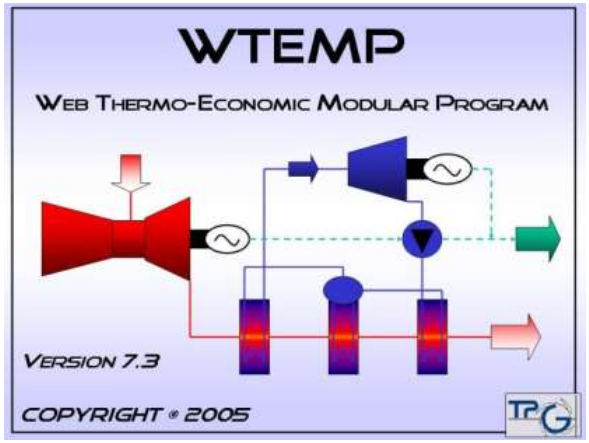
TPG European Research Projects - *HORIZON EUROPE (n°18)*



TPG cloud competences



TPG Tools for Energy Systems Modeling

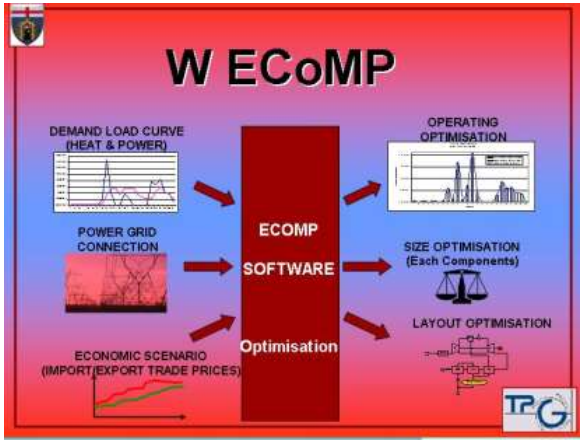


WTEMP

Optimization of the design of energy systems and power plants

NEW **WTEMP-EVO**

Optimization of the design of open and closed cycles



WECOMP

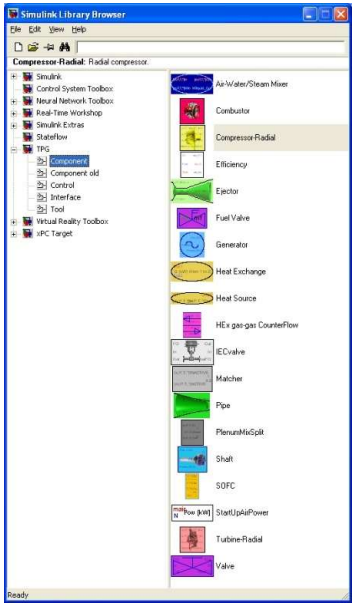
Time dependent optimization of the design and management of polygenerative energy districts

HELM

Optimization of energy systems design on board of vessels and utilization of alternative fuels

TRANSEO

Dynamic simulation of energy systems



TPG Expertise in Hydrogen and Fuel Cell Sector

MODELING - http://www.tpg.unige.it/TPG/software/

- Dynamic simulation of SOFC and PEMFC based energy systems: off-design performance simulation, control development (coupled with different type of energy storage), e-fuels modelling also from a reactor process point of view, FC + battery + energy systems system modeling
- Thermoeconomic modelling and optimization: sizing and management of solutions for Power-to-Gas and for Fuel Cell based systems
- Design Modeling and optimization: optimization of thermal management, waste heat recovery etc.
- Hydrogen Storage sizing and management modelign: specialized in metal hydrides solutions

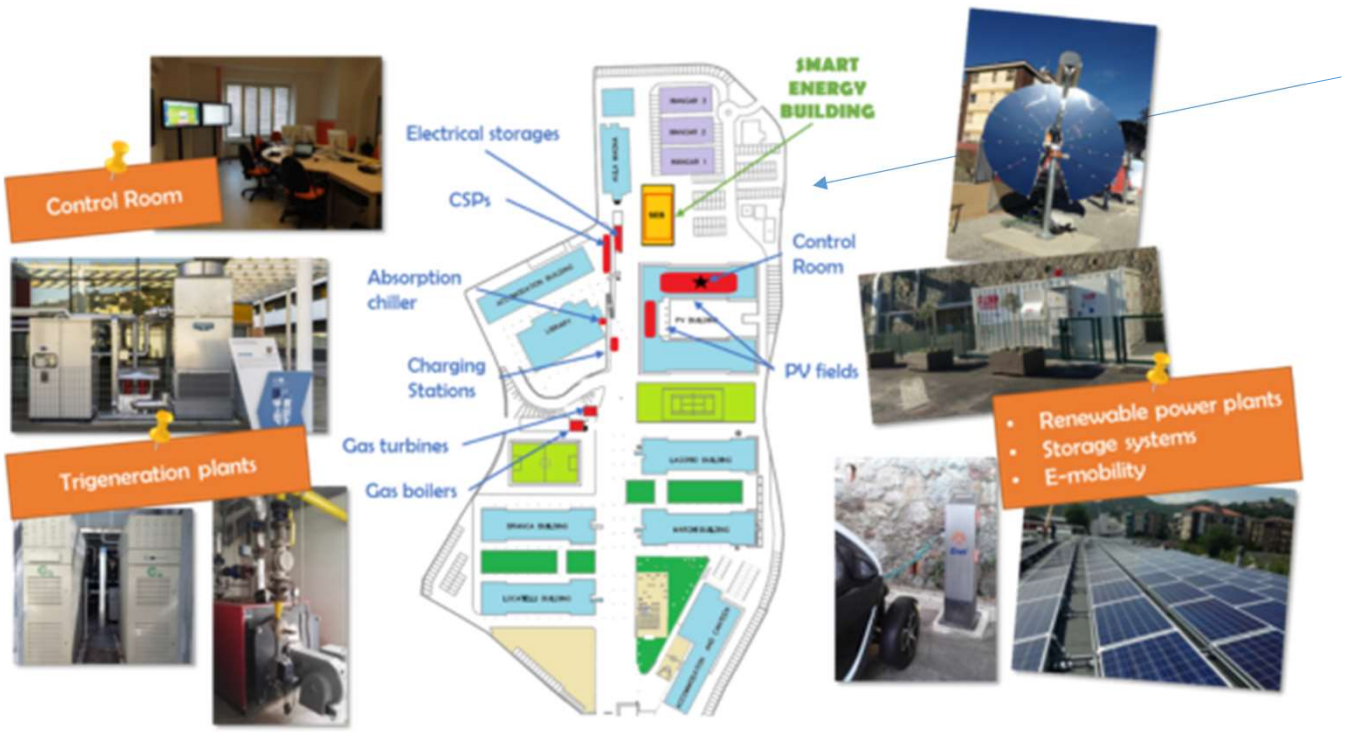
TESTING FACILITIES - http://www.tpg.unige.it/TPG/ies-laboratory/

- PEMFC Test facilities (Ballard, Nuvera, Proton Motor systems already in-house – characterization of PEMFC performances with different load profiles – possibility to study marinization of PEMFC - HI-SEA Lab)
- Power-to-ammonia facility (small scale ammonia reactor, to use ammonia in a mGT – FLEXnCONFU Project)
- Metal hydrides storage test bench: characterization of hydrogen storage materials and their coupling with PEMFC
- SOFC-mGT Hybrid systems emulator: characterization of dynamic behaviour of the system

TPG laboratories

Grid

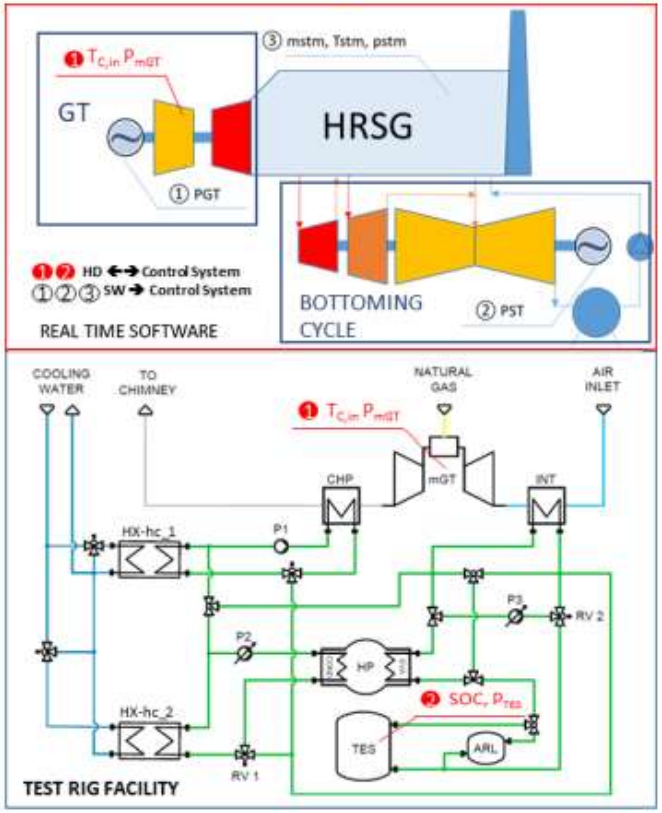
...the first Mediterranean Smart



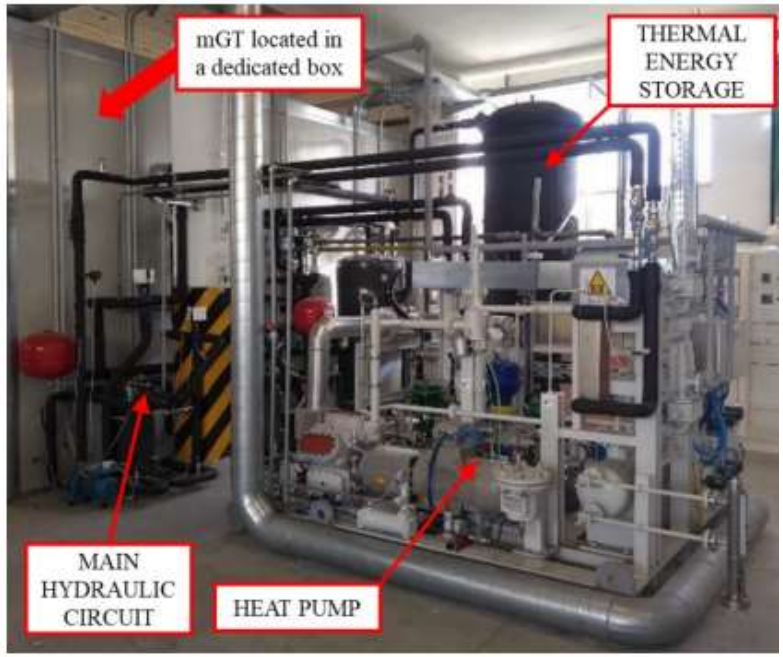
A Polygenerative Energy Hub (composed by different prime movers and storage, both electric and thermal) where to test new energy solutions and controllers coupled to local DHN and smart grid

TPG laboratories

CLOSED CYCLES (HPs – CBs) and TES LAB



CYBER-PHYSICAL SETUP



Performance Untapped Modulation for Power and Heat via Energy Accumulation Technologies

Equipment
mGT = 100 kWel
Heat Pump = 10 kWel
TES = 180 kWh (filled with water)

Aim of the project: to increase the flexibility and operative range of Combined Cycles through integration with HP and TES

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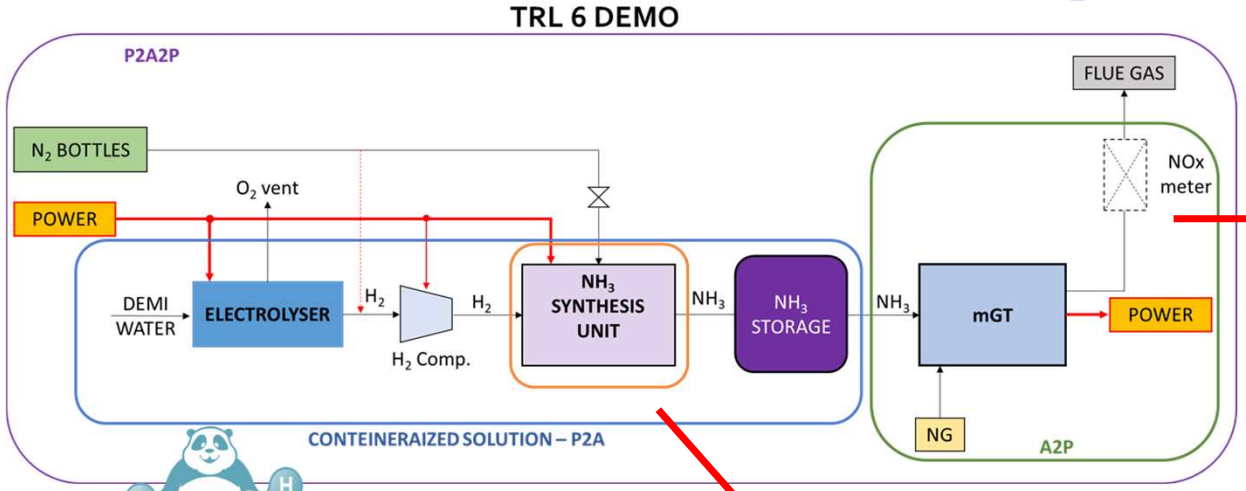
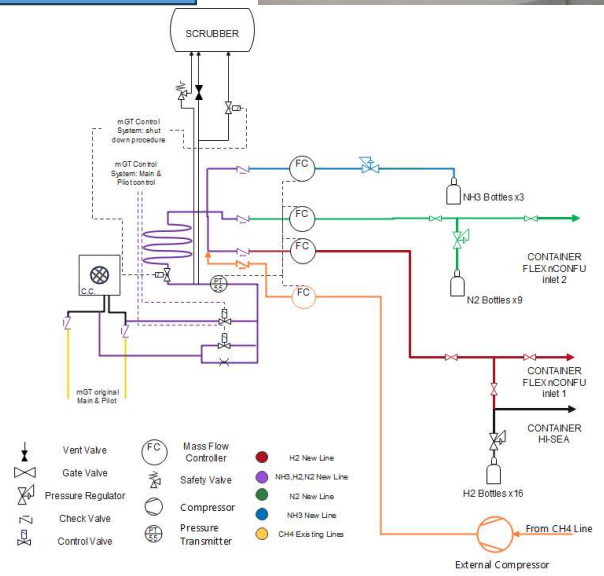
… the first power-to-ammonia-to-power system in Italy!



Modified Comb. Chamber
New Fuel injection system

flexnconfu



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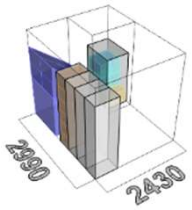
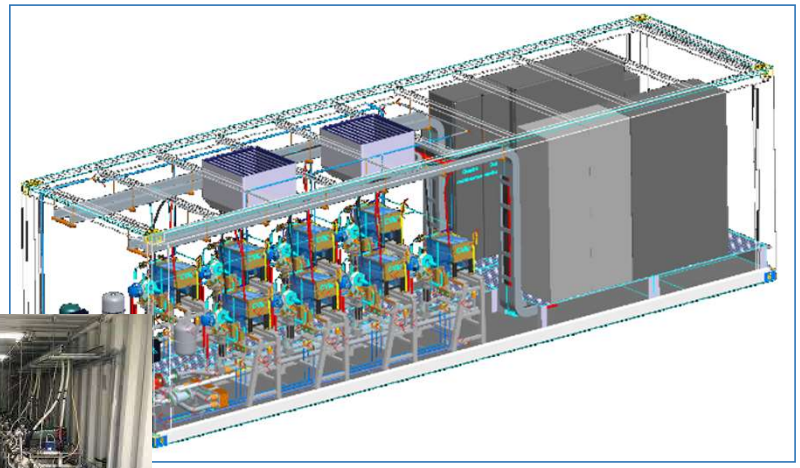
TPG laboratories
The FINCANTIERI Hi-Sea lab @ TPG

...since 2018

The largest PEM fuel cell laboratory systems of the world specifically designed for marine applications assessment





Numbers

Fuel Cell Power 130kW + 130kW
Two DC/DC converter 350-600 V
One AC/DC 60kW

Current operational achievements

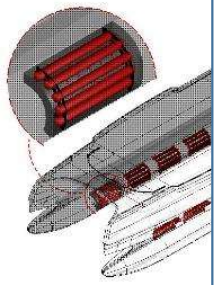
fuel cell H2/Air 30 kW
fuel cell system H2/AIR of 130 kW
fuel cell system H2/AIR of 130+130 kW
operating series-parallel
battery physical simulation
fault simulation

Basic Design

Assessment of Fuel Cell Systems for marine applications: Mega Yacht, Navy, Passenger Ships, Ferries

System Sizing

Dynamic simulations of Fuel Cells and Metal Hydrides Storage systems coupling



***Genova* HI-SEA**

Hydrogen Initiative for Sustainable Energy Applications

Univesity of Genova

FINCANTIERI
The sea ahead

H2 for Shipping but...not only! Ammonia, methanol etc.

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sCO2 CYCLES: studies and experiences

HORIZON EUROPE PROJECTS

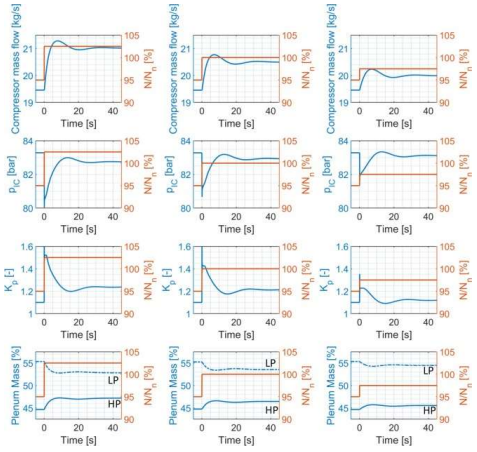
2015

First activities in cooperation with NETL

Lambruschini, F, Liese, E, Zitney, SE, & Traverso, A. "Dynamic Model of a 10 MW Supercritical CO_2 Recompression Brayton Cycle." . https://doi.org/10.1115/GT2016-56459

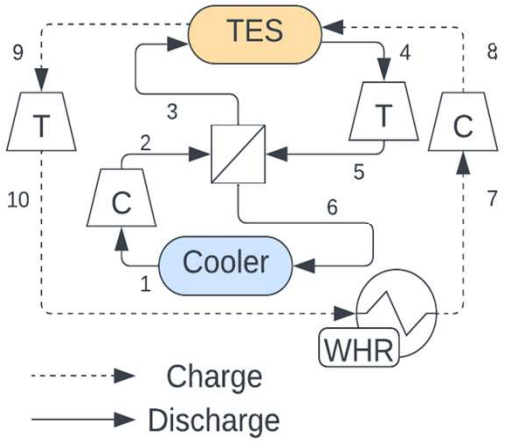
2019

SOLARSCO2OL PROJECT and full dynamics of sCO2 power cycles



2024

SCO2OP-TES project and targeting our own sCO2 loop

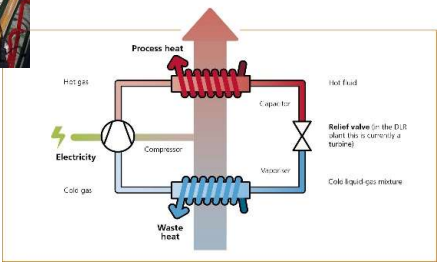


HIGH TEMPERATURE HEAT PUMPS
Studies and experiences

HORIZON EUROPE PROJECTS

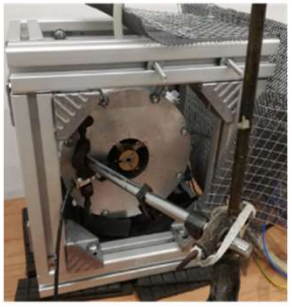
2024

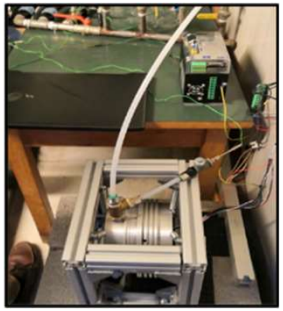
AIR DRIVEN HTHPs AND sCO2 DRIVEN HTHPs STUDY (Mod and Exp)



2018

BLADELESS TURBINES FOR HTHP AND STUDY OF COMPRESSOR DYNAMICS OF HTHPs





2016

PUMP HEAT PROJECT

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THERMAL STORAGES: studies and experiences

ThumbsUp

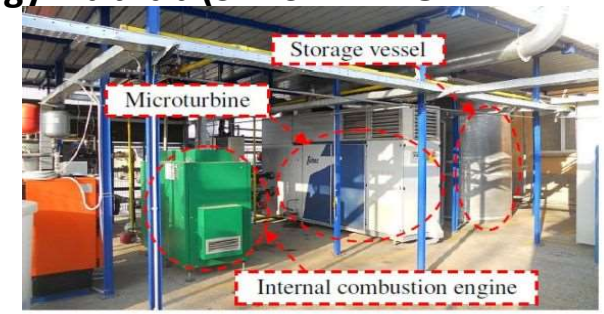
SHARPsCO2

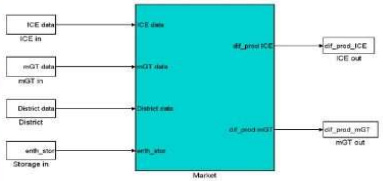
eLITHE

HORIZON EUROPE PROJECTS

2012

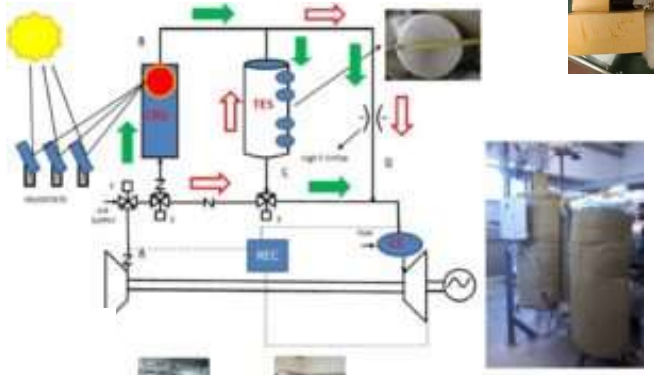
Energy-Hub lab (SENSIBLE HOT WATER TANKS)





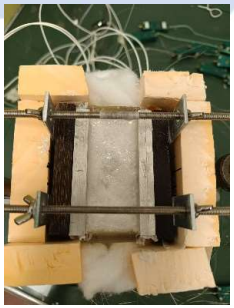
2015

CERAMIC HIGH T TES FOR CSP



2020

PUMP HEAT PCM TES + HP



2023

INNOVATIVE DESIGN AND MATERIALS FOR TES

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