Unige OpenLab: Invito a conoscere le infrastrutture di ricerca del territorio

UNIVERSITÀ DEGLI STUDI DI GENOVA

Progetto Multi-Dominio per Smart Communities: Production, Energy Harvesting, Mobility & Security

Partners:

UniGe | Distretto Tecnologico Ligure sui Sistemi Intelligenti Integrati SIIT

Supportato da:

REGIONE LIGURIA

UNIONE EUROPEA
Fondo Europeo di Sviluppo Regionale

REPUBBLICA ITALIANA

REGIONE LIGURIA

FESR

Università di Genova

Installazione di un cogeneratore a gas da 100 kWe e integrazione nella *Smart Polygeneration Grid* del Campus Universitario di Savona

Completato: Dicembre 2021

PROGETTO COFINANZIATO DALL'UNIONE EUROPEA

FONDO EUROPEO DI SVILUPPO REGIONALE

POR LIGURIA FESR 2014-2020
ASSE 1 - Ricerca ed Innovazione


AE T100
ANSALDO
ENERGIA

A **Smart Polygeneration Microgrid** (SPM) feeds the Campus and provides electric and thermal energy with a district heating network (DHN).

IES LAB: Innovative Energy Systems, FC & Hydrogen

UNIVERSITÀ DEGLI STUDI DI GENOVA

The power installed at the whole TPG lab is about 0.5MW, and also including high pressure hydrogen storages.

Fuel Cell Systems
University Technology Centre

Università degli Studi di Genova
Thermochemical Power Group

Rolls-Royce

Installazione di un cogeneratore a gas da 100 kWe e integrazione nella *Smart Polygeneration Grid* del Campus Universitario di Savona

Completato Dicembre 2021

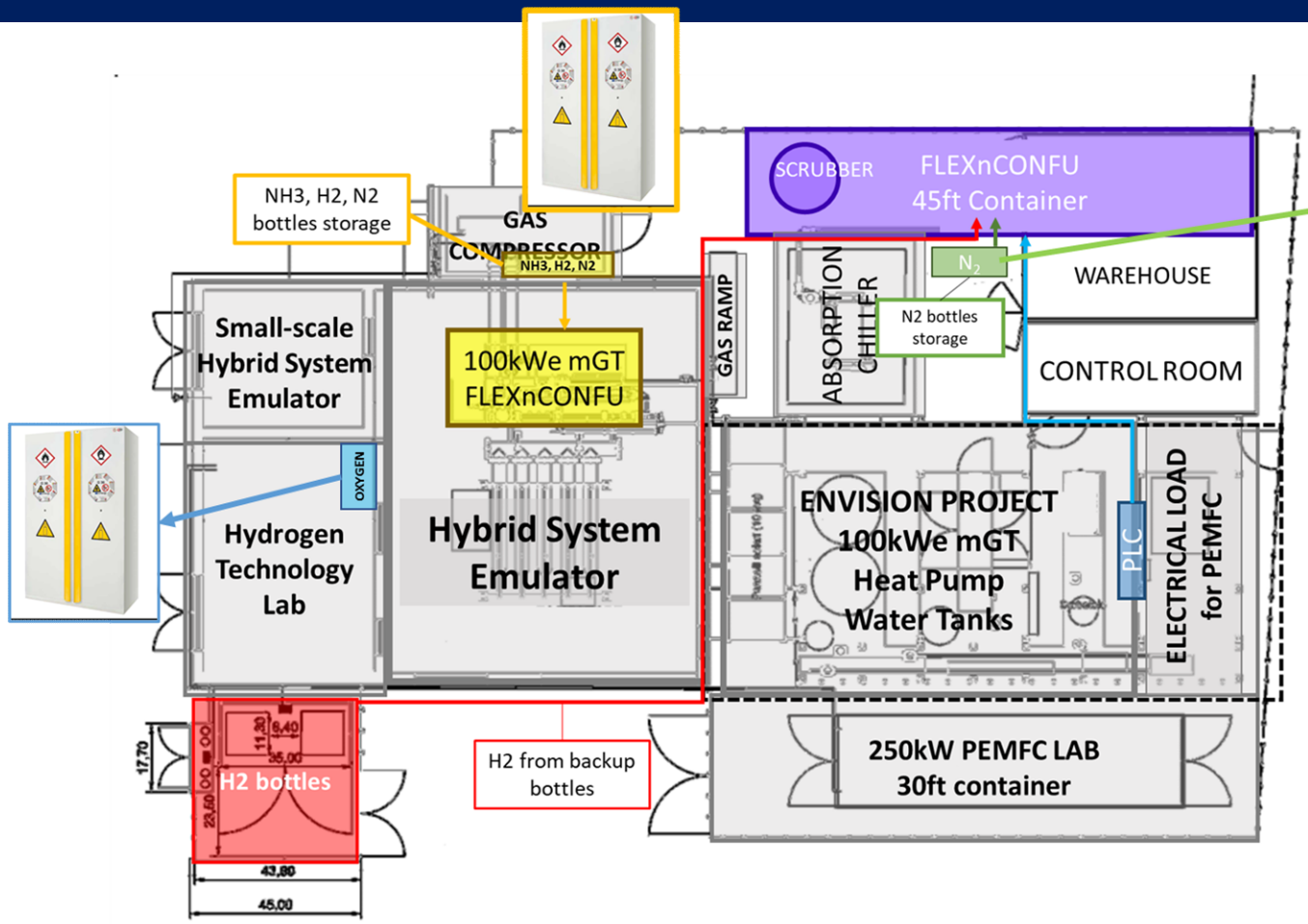
PROGETTO COFINANZIATO DALL'UNIONE EUROPEA

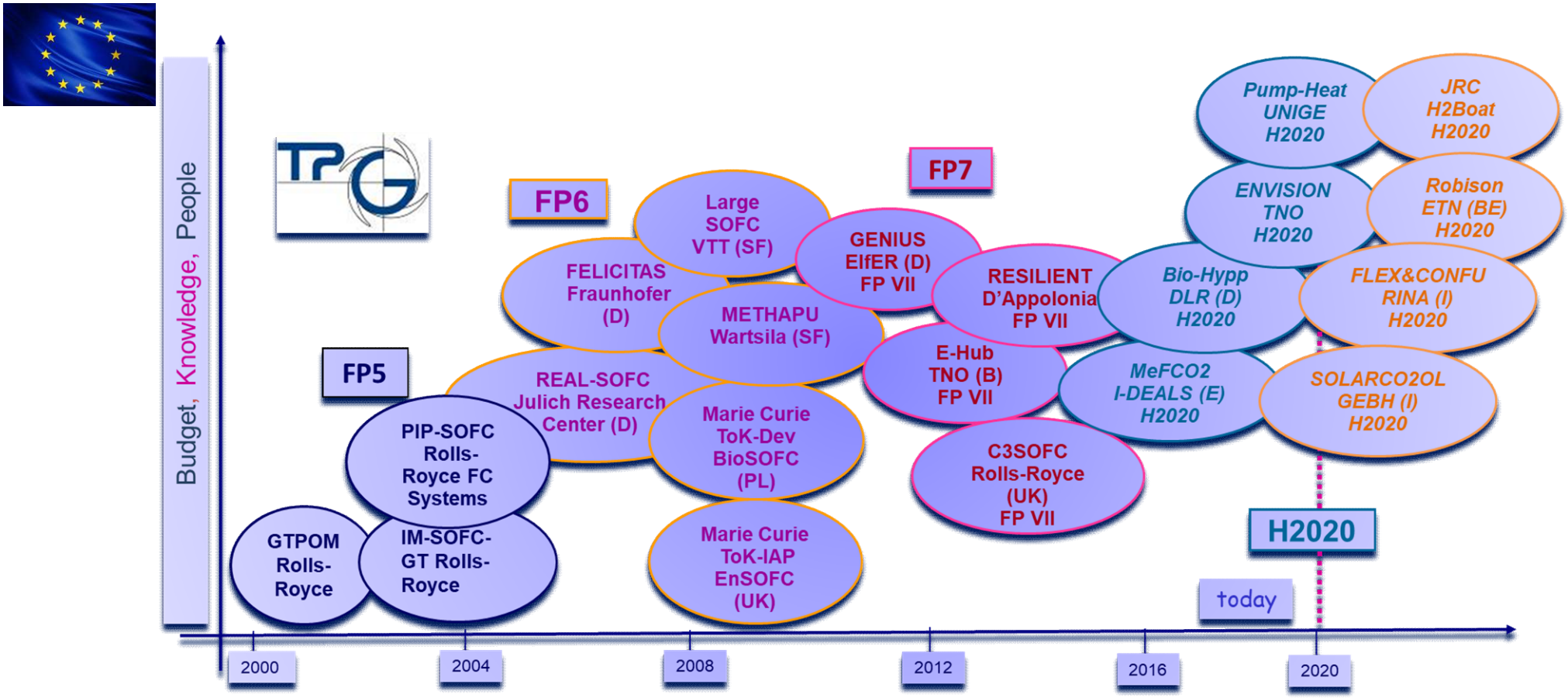
FONDO EUROPEO DI SVILUPPO REGIONALE

POR LIGURIA FESR 2014-2020
ASSE 1 - Ricerca ed Innovazione

IES LAB: Innovative Energy Systems, FC & Hydrogen

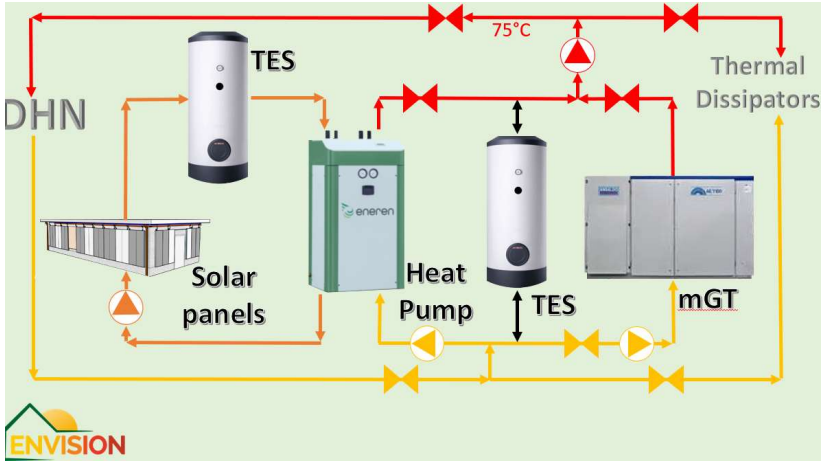
UNIVERSITÀ DEGLI STUDI DI GENOVA

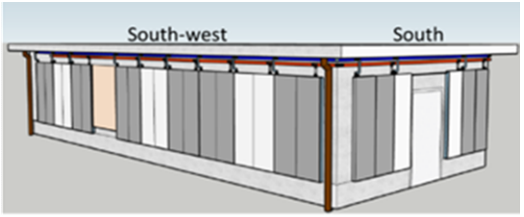


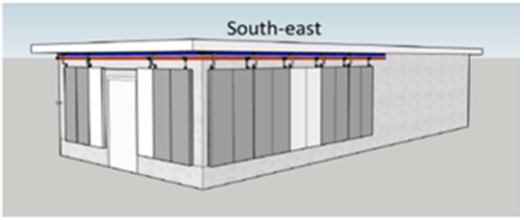

Budget, Knowledge, People
FP5
FP6
FP7
H2020
today
PIP-SOFC Rolls-Royce FC Systems
GTPOM Rolls-Royce
IM-SOFC-GT Rolls-Royce
REAL-SOFC Julich Research Center (D)
FELICITAS Fraunhofer (D)
Large SOFC VTT (SF)
METHAPU Wartsila (SF)
Marie Curie ToK-Dev BioSOFC (PL)
Marie Curie ToK-IAP EnSOFC (UK)
GENIUS ElfER (D) FP VII
E-Hub TNO (B) FP VII
RESILIENT D'Appolonia FP VII
C3SOFC Rolls-Royce (UK) FP VII
Bio-Hypp DLR (D) H2020
MeFCO2 I-DEALS (E) H2020
Pump-Heat UNIGE H2020
ENVISION TNO H2020
JRC H2Boat H2020
Robison ETN (BE) H2020
FLEX&CONFU RINA (I) H2020
SOLARCO2OL GEBH (I) H2020
2000
2004
2008
2012
2016
2020

IES LAB: Innovative Energy Systems, FC & Hydrogen

UNIVERSITÀ DEGLI STUDI DI GENOVA

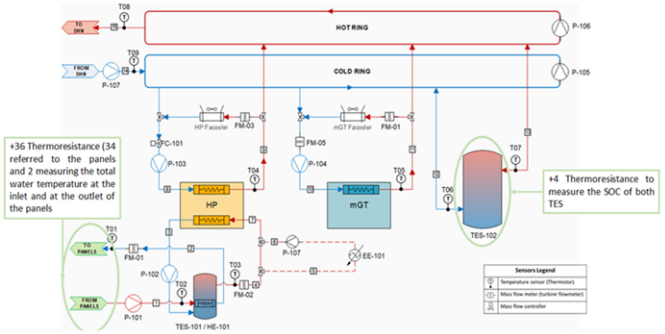






15 June, 2022

'ENVISION' Solar Façade Panels



All the data coming from the integrated system are finally collected in the control room where the system model has been implemented.

The whole model, including EMS, aims to simulate daily polygeneration micro-grid operation.


HP

mGT

Electrical grid

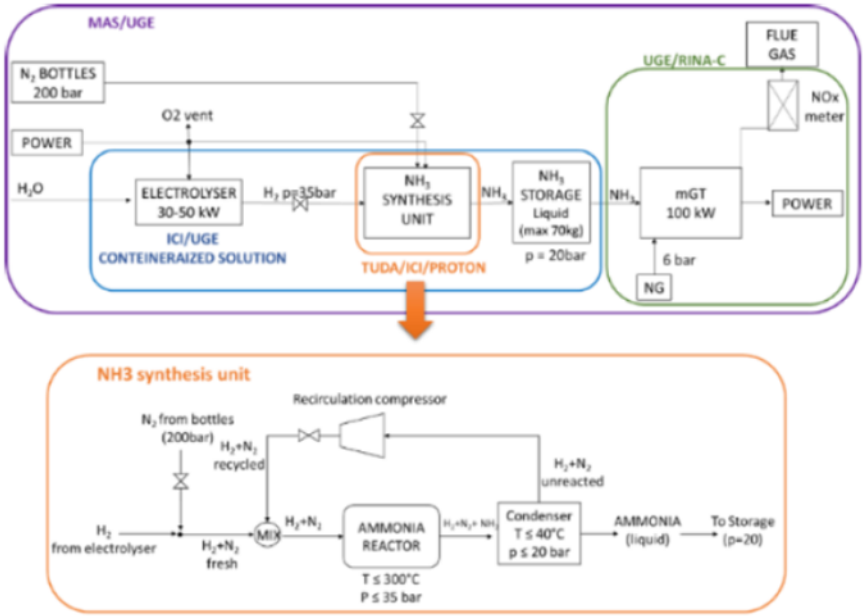

Energy Management System

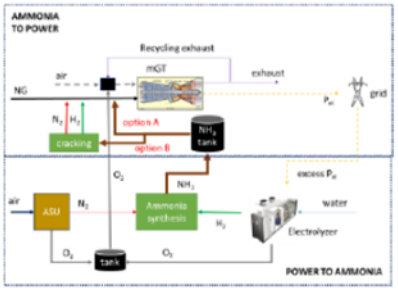

Prosumers

ENVISION

POWER TO AMMONIA TEST RIG

- Study the use of ammonia as hydrogen carrier, using a micro gas turbine
- A modular and containerized solution will be connected to an existing mGT, installed within a smart grid, properly modified for ammonia combustion.





PROTON VENTURES

ICI CALDAIE

TECHNISCHE UNIVERSITÄT DARMSTADT

Università di Genova

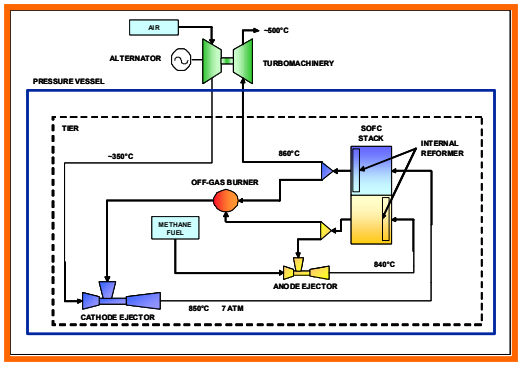
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 884157

IES LAB: Innovative Energy Systems, FC & Hydrogen

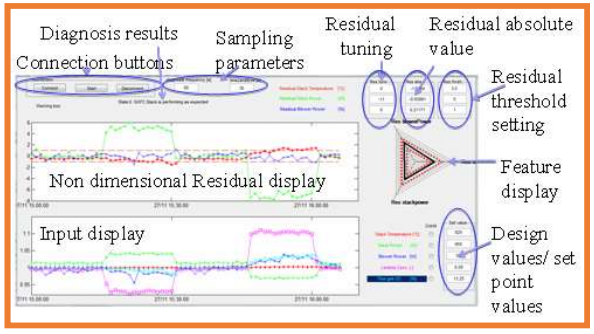
UNIVERSITÀ DEGLI STUDI DI GENOVA

Test rig and Experimental activities

Perfomance and Transient Analisys: Component and System Modelling and validation



Monitoring and Diagnosis: On-line FDI Algorithm

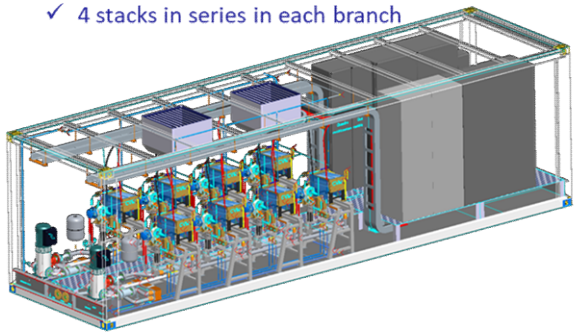


IES LAB: Innovative Energy Systems, FC & Hydrogen

UNIVERSITÀ DEGLI STUDI DI GENOVA

HI-SEA Laboratory:
Hydrogen Initiative for Sustainable Energy Application

- Rising interest in fuel cell technology for automotive applications and shipping
- **HI-SEA Joint Laboratory** between **Fincantieri** and **University of Genoa**: specific for assessment of FC technology in shipping
- Test rig TRL 5
  - ✓ 8 PEMFC stacks supplied by Nuvera Fuel Cells
  - ✓ ~30 kW per FC stack → **250 kW system**
  - ✓ 2 independent branches with DC/DC
  - ✓ 4 stacks in series in each branch



PEM-FC PLANT
Stacks power 130 kW + 130 kW
Two DC/DC converters 350-600 V
AC/DC 60 kW

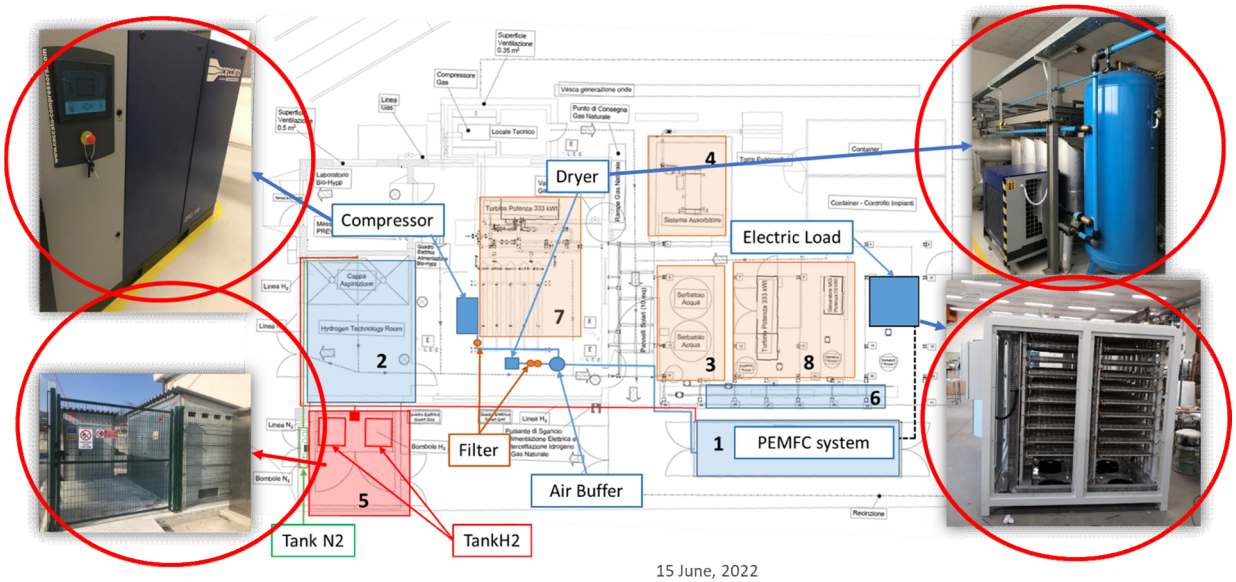
STUDIES
Single PEM stack of 30 kW
PEM-FC system H2/AIR of 260 kW
Series/parallel operation
Battery simulation
Fault simulation

IES LAB: Innovative Energy Systems, FC & Hydrogen

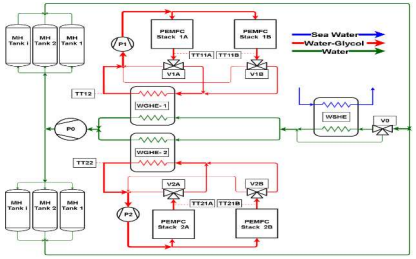
UNIVERSITÀ DEGLI STUDI DI GENOVA

Laboratorio congiunto UniGE – Fincantieri, operativo dal 2016

- **240 kW di PEM fuel cells alimentate a idrogeno**
- Design del sistema per applicazioni marine
- Commissioning del sistema, perfezionamento componenti ausiliari
- Test in condizioni statiche, dinamiche e simulazioni di vari profili di carico
- Definizione di procedura di recupero da inattività e definizione di protocolli di prova per PEMFC navali



- Modelli dinamici per integrazione termica di PEM Fuel Cells e sistema di stoccaggio H2 in idruri metallici.
- Analisi per condizioni operative in ambito navale **(imbarcazione ZEUS, progetto PON *TecBia*)**



Progetto PON TECBIA (2019-2022)

- Laboratorio H2 UniGe
- **Test di sistema PEM Fuel Cells (70 kW) alimentate a H2 e batterie che saranno installate a bordo della nave Fincantieri ZEUS**
- Test in condizioni statiche e dinamiche per Fuel Cell
- Integrazione tra Fuel Cells e batterie per profilo di carico navale

The Zero Emission Ultimate Ship (ZEUS)

The First H2 PEMFC Propulsion Italian ship

TPG-UNIGE is partner in the National funded **TecBIA** project (2018-2022), which aims to build the **ZEUS** research vessel and study low environmental impact technologies for on-board clean energy production:

- **25-metre** length and **170 tons** weight
- **diesel engine**
- **144 kW PEMFCs fed by pure H2**
- Hydrogen stored in **metal hydrides (50 kg)**
- **150 kWh** of Lithium-ion **batteries**

Consiglio Nazionale delle Ricerche

FINCANTIERI The sea ahead

UNIVERSITÀ DEGLI STUDI DI GENOVA

UNIVERSITÀ DEGLI STUDI DI NAPOLI "FEDERICO II" DIPARTIMENTO DI INGEGNERIA CHIMICA, DEI MATERIALI E DELLA PRODUZIONE INDUSTRIALE

RINA

Isotta Fraschini IF MOTORI

UNIVERSITÀ DEGLI STUDI DI PALERMO

CETENA S.p.A.

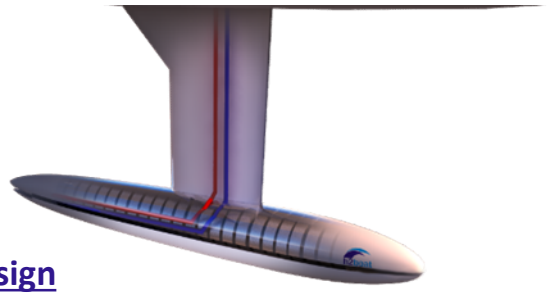
Integrated testing of ZEUS systems

Main tests

- ✓ Startup of single components
- ✓ Communication with control system
- ✓ FC test – constant and dynamic load
- ✓ BAT test – charge, discharge, load following
- ✓ Parallel test – FC and BAT

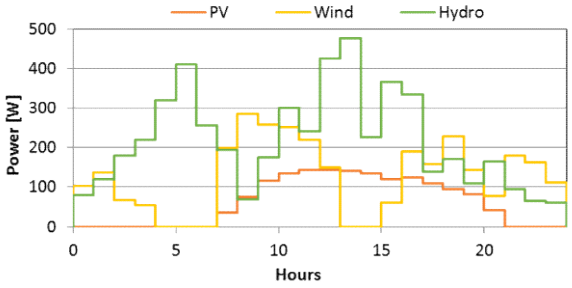
TPG spinoff company – H2Boat

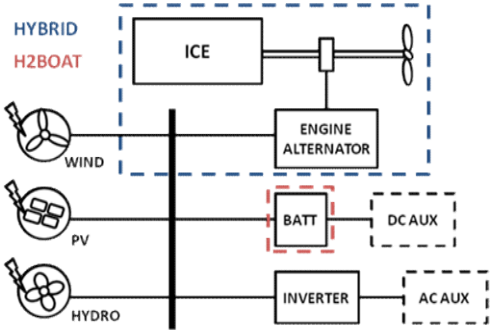
h2boat
hydrogen to boat



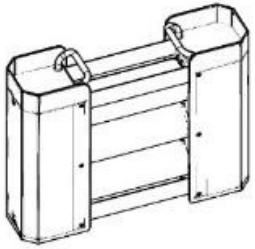
Patented Design
Special Metal Hydride hydrogen storage system integrated inside the keel for sailboats

Hydrogen to Boat
is an innovative system designed to provide electrical energy for auxiliary systems and also for the propulsion of sailboat up to 40 ft (12 m).





RES
Dynamic analysis of RES production onboard boats



H2Boat solution
Design and analysis of electric systems for sailboats through dynamic simulations, laboratory test campaign and prototypes construction

Unige OpenLab: Invito a conoscere le infrastrutture di ricerca del territorio

UNIVERSITÀ DEGLI STUDI DI GENOVA

Progetto Multi-Dominio per Smart Communities: Production, Energy Harvesting, Mobility & Security

Contatti:

Università di Genova: Prof. Loredana Magistri
http://www.tpg.unige.it/TPG/