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PHAETHON CoE

INTELLIGENT, EFFICIENT AND SUSTAINABLE ENERGY SOLUTIONS

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PHAETHON R&I Centre of Excellence

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Transformation to Excellence

- **Upgrade FOSS** Research Centre for Sustainable Energy of the University of Cyprus established in 2014
  - Secured over €25 million from EU research programmes and industrial funding
  - Participation/coordination in over 80 national/international research projects
  - Strong research programme, research distinction and awards, over 400 research publications
- to **PHAETHON** a **world-class autonomous and self-sustained** Centre of Excellence (CoE)
  - Conduct state-of-the-art research on **intelligent, efficient and sustainable energy solutions**
  - Become a world-class Innovation Hub, **enhancing socio-economic development at national and regional** levels

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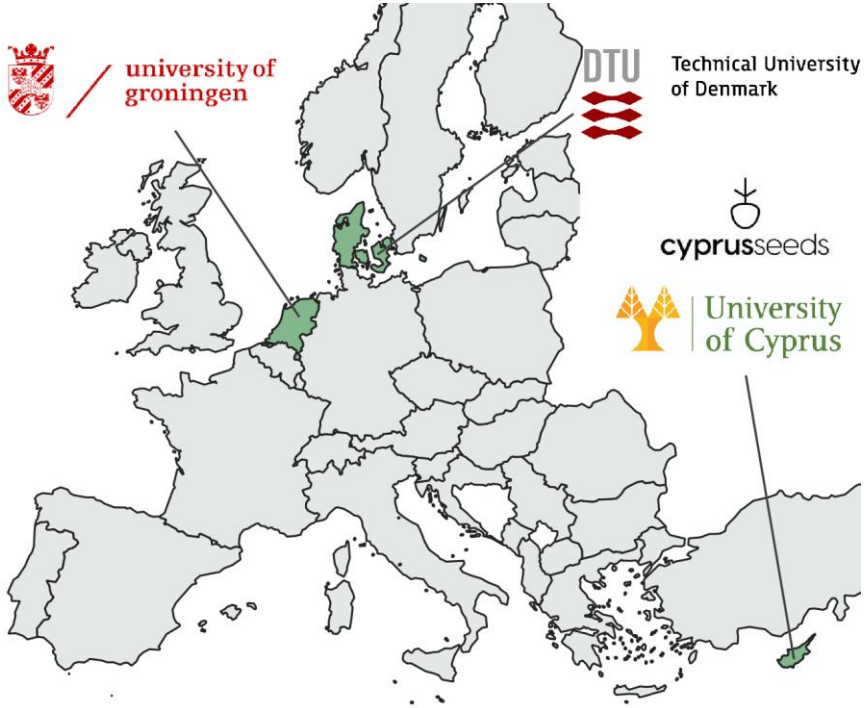
PHAETHON Teaming Project

- Start: September 2023
- Duration: (at least until) 2033
  - Teaming: 6 Years
  - Sustainability Plan: 10 Years
- Budget: €50mln
  - €15mln EU funding
  - €30mln Complementary funding
  - €5mln Building



Teaming Consortium

The project will receive funding from the European Union's Horizon Europe Research and Innovation programme

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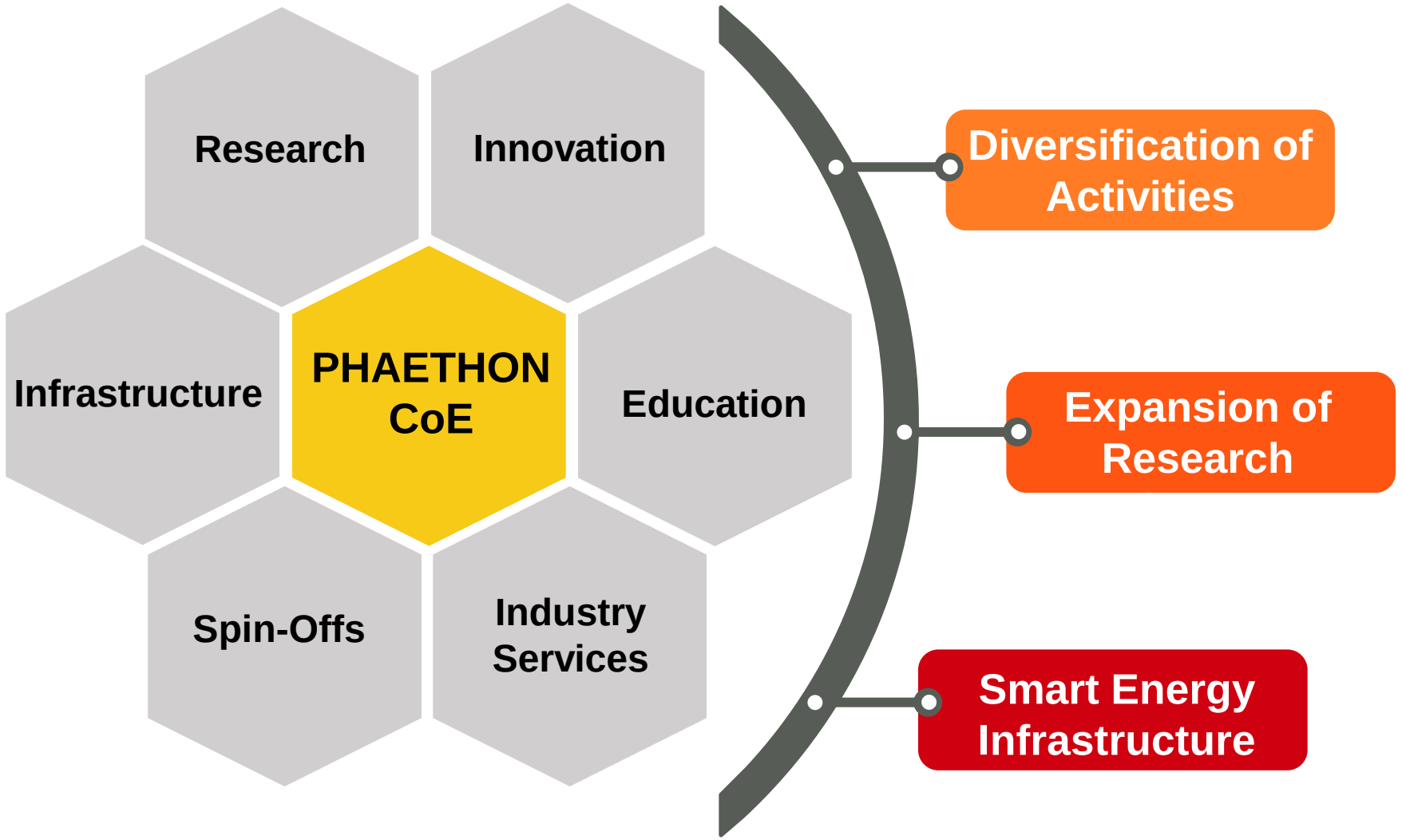
Diversification of Activities



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Five Core Research Themes

1. **Renewable energy sources and grid integration**
   Solar energy, Photovoltaic technologies, Grid integration technologies
2. **Storage and e-mobility**
   Renewable energy storage, Battery energy storage systems, Smart charging and V2G
3. **Green hydrogen**
   Green hydrogen production, Green hydrogen storage, Hydrogen conversion and use
4. **Smart grids and intelligent energy**
   Digital energy technologies, Energy flexibility and analytics, Novel energy markets
5. **Energy socio-economics, multi-level governance and environmental sustainability**
   Socio-economic impacts, Energy governance, Environmental assessment

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Research Excellence

- Cutting-edge research targeting the main research challenges of the energy sector.
  - Renewable generation, integration, smart grid technologies, energy storage, carriers and social acceptance.

Renewable energy sources

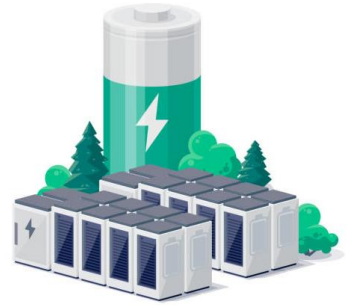
- Solar energy
- Photovoltaic technologies
- Grid integration of renewables

Smart grids

- Digital energy technologies
- Energy flexibility and analytics
- Novel energy markets

Storage and e-mobility

- Battery energy storage systems
- Renewable energy storage
- Smart EV charging technologies



Green Hydrogen

- Novel production techniques
- Storage and transportation
- Hydrogen conversion and use

Energy socio-economics and environment

- Social aspects and acceptability
- Energy multi-level governance
- Environmental sustainability

State-of-the-Art Infrastructure

Novel infrastructure (10,000 m²) to serve needs of tomorrow and highest technology readiness.

- Comprise of 4 laboratories:
  1. Renewable and Grid Integration
  2. Future Storage
  3. Smart Grid
  4. Digitalised Energy
- Consist:
  - test-facilities
  - test-beds
  - pilots

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State-of-the-Art Infrastructure

Net-Zero Building:
- 3,000m²

Comprising of:
- Laboratories
- Research Office
- Innovation
- Education Hubs

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Educational and Training Centre

Educational Centre

- ✓PhD programme
- ✓MSc in Sustainable Energy
- ✓MOOCS (online courses)

Skills Development Centre

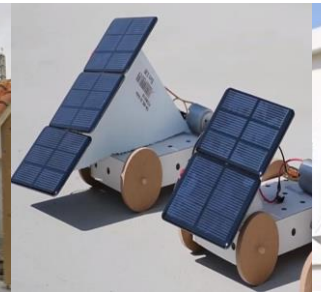
- ✓Advanced scientific courses
- ✓Technical skills training
- ✓Summer training school
- ✓Entrepreneurship programme

Vocational Training Centre

- ✓Photovoltaic technologies
- ✓Battery storage
- ✓Green Hydrogen
- ✓Smart energy solutions





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Hydrogen Technical group (HI-TECH)

Hydrogen Technical Team of Phaethon CoE*

	Name	Area of Expertise	Hydrogen Topic
1	Dr Alexandros Arsalis	Thermodynamics/ Energy Systems	Design, modelling, optimization, and experimental characterization/testing of novel green hydrogen energy systems (including electrolysis, hydrogen storage, fuel cells, and auxiliaries) from the kW to the MW scale.
2	Dr Andreas Olympios	Techno-economic modelling, Energy conversion & storage, Smart control, Energy systems	Design and operation optimisation tools for the integration of green hydrogen into multi-vector energy systems. Identification of: (i) synergistic benefits with electrical and thermal energy storage; and (ii) energy system value of green hydrogen.
3	Fanourios Kourougianni	Thermodynamics, Energy in Buildings	Designing and modelling green hydrogen energy subsystems, encompassing the three key phases of generation, storage, and utilization. Moreover, the integration of these subsystems to create hydrogen-based multi-energy systems
4	Georgios Yiasoumas	Electrical/Power Engineering, Energy Communities	Applications of hydrogen in an energy community context
5	Dr Giorgos Makrides	Renewable energy source power systems (focal point photovoltaics), Grid integration of variable renewable sources, Smart grids, Machine learning and data-driven analytics	Green hydrogen as a form of storage for the electricity network and coupling with other forms of storage such as batteries etc
6	Prof. George Georghiou (CEO of Phaethon CoE)	Renewables and in particular photovoltaics, Grid integration of RES, Electromagnetic Fields and Novel Applications, Plasma at atmospheric pressure, Multiphysics Modelling	Green hydrogen as a form of storage for the electricity network and coupling with other forms of storage such as batteries etc
7	Dr Charalambos Konstantinou	Fluid flow and fracturing of porous media, microbial processes in soils/rocks, reservoir and water systems engineering, data inference and machine learning	Geological hydrogen storage in depleted reservoirs, salt caverns, enhanced natural gas/oil production with hydrogen injection and storage (piston-like injection), policy schemes
8	Prof. Panos Papanastasiou	Applied and Computational Mechanics, natural gas exploration, production and monetization	Hydrogen underground storage, Energy Project Economics and Finance

***member of Phaethon that will work on Social, Economics, Environment, Policy are not included in the list**

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Green Hydrogen

Modeling & optimization of novel energy systems based on various technologies

- Solar Photovoltaics
- Electrolyzers
  - Proton Exchange Membrane Electrolyzers
- Hydrogen Storage
  - Compressed
  - Metal Hydride
- Fuel cells
  - Proton Exchange Membrane Fuel Cells
  - Solid Oxide Fuel Cells
- Integration with heat engines
  - Gas turbines
  - Steam turbines
- Integration with refrigeration engines
  - Heat pumps
  - Absorption chillers

- <u>Applications</u>
  - Residential & Commercial Buildings
  - Power plants
  - Decentralized, Microgrids (both autonomous & grid-connected)
  - Combined-Heat-and-Power, Combined-Cooling-Heating-and-Power, Cogeneration

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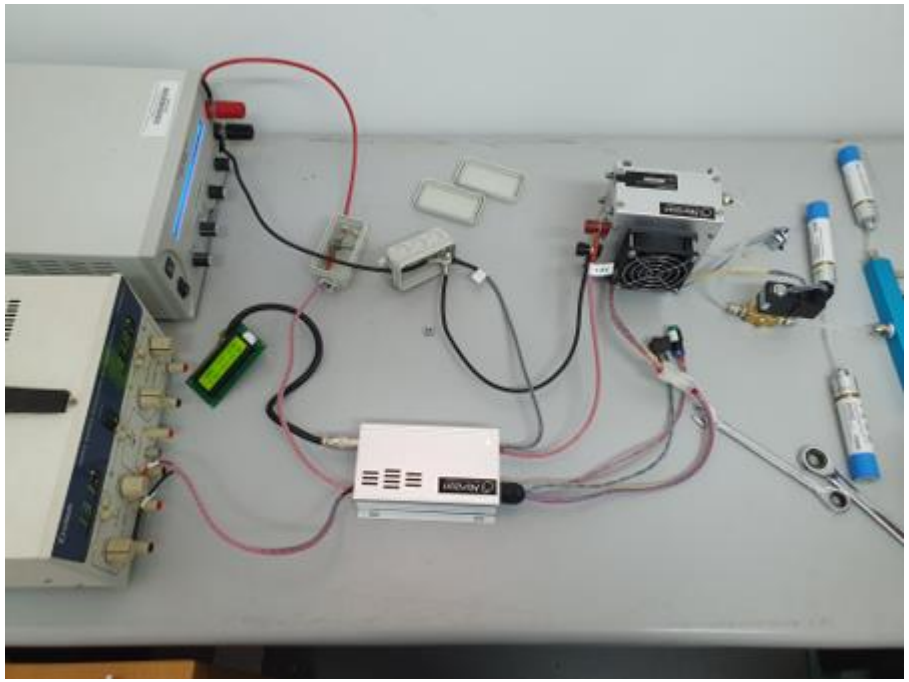
Green Hydrogen

Experimental work

- Existing green hydrogen equipment
  - 100 W PEM fuel cell stack
  - Metal hydride hydrogen storage sticks (10 L x10)
  - Hydrogen generator PEM electrolyzer
  - Auxiliary components (AC/DC converter, controllable loads)



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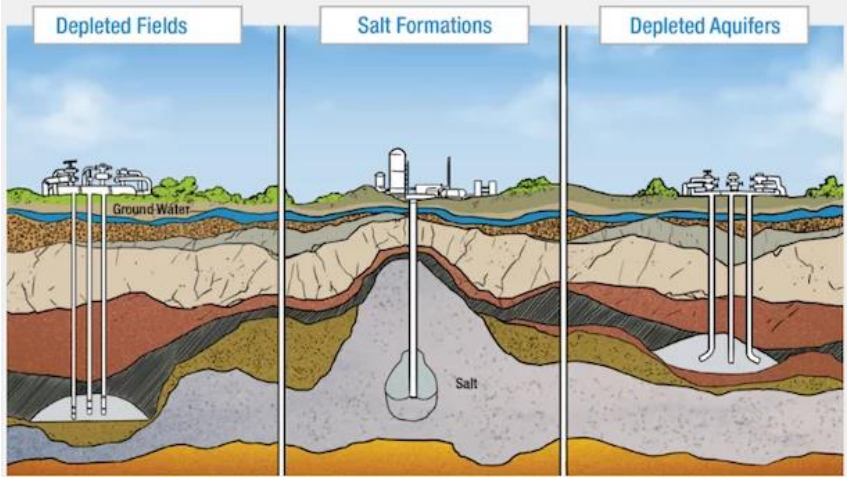
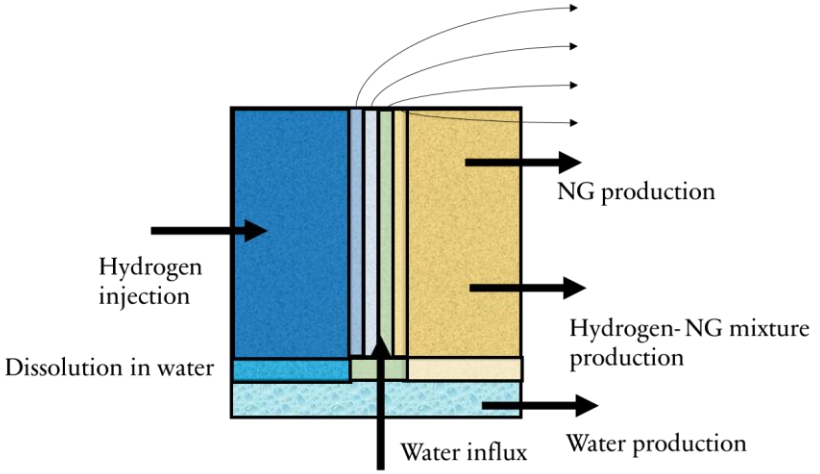
Green Hydrogen

Underground Storage

- Storage will be crucial for developing the hydrogen economy at scale and to increase integration of renewables in energy systems
- Underground hydrogen storage extends capabilities to time scales of seasonal and strategic storage and comes at lower cost
- Technologies exist for underground storage of natural gas, CO2 geological storage
- Unknown issues related to hydrogen permeability, sealing, injectivity capacity, deliverability, chemical reactions, biological processes, contamination
- Working to identify proper rock formations
  - Underground Cavities
    - Natural existing Cavities
    - Created cavities in salt formations by drilling and washing out the brine (disposed in the sea)
  - Porous formation
    - in depleted reservoirs or with EGR, depleted aquifers
- Screening tools based on Material Mass balance Equation





Thank you!

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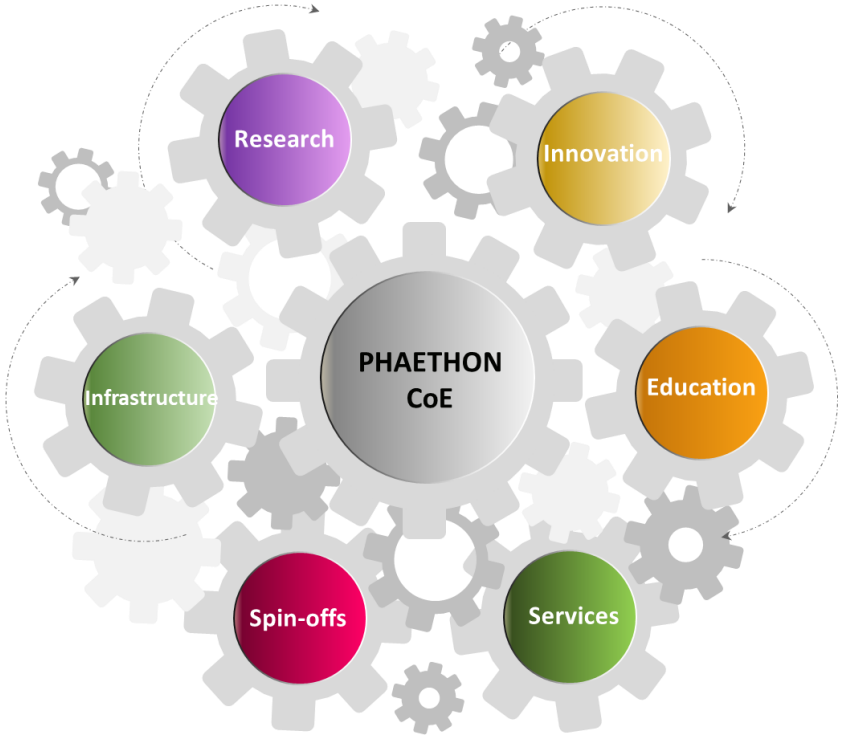

Paving the way for sustainability and always serving the society!