HERMES

Highly Efficient super critical zeRo eMission Energy System

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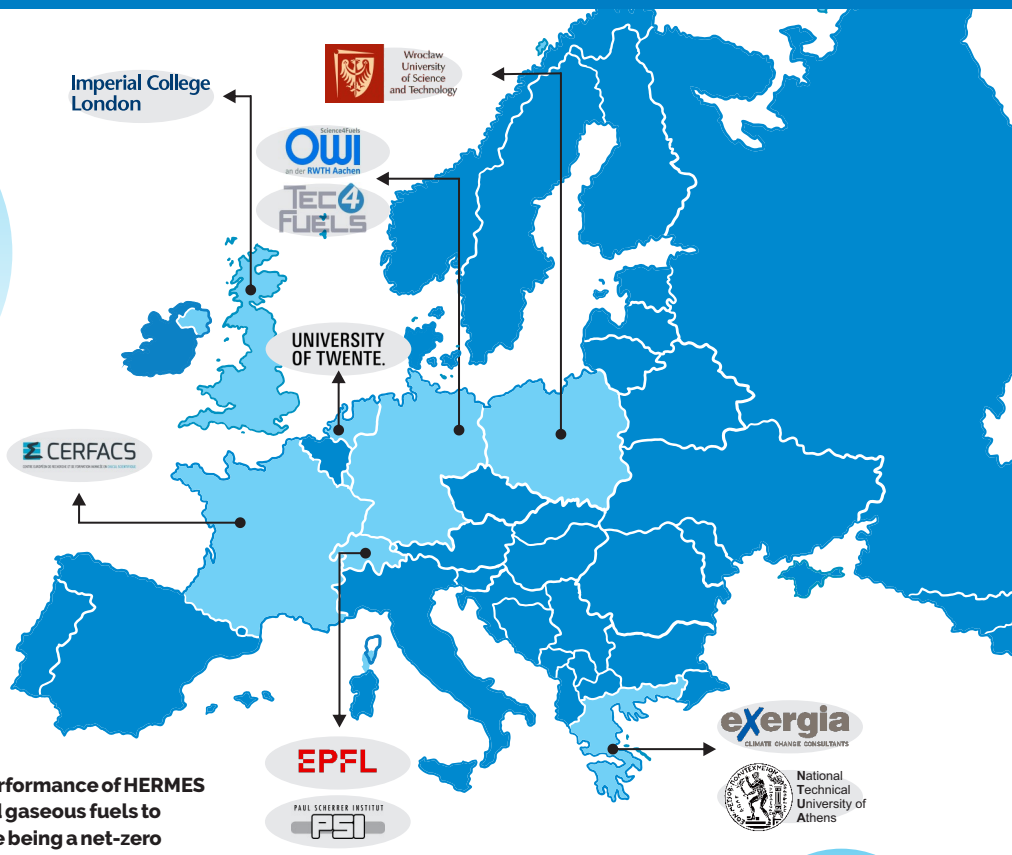

HERMES (Highly Efficient Super Critical ZERO eMission Energy System) is a HORIZON Europe project aiming at pioneering a zero-emission, highly efficient directly fired supercritical power system, operating in closed loop on renewable fuels. HERMES contributes to the renewable future with a high-efficiency robust engine ready to replace fossil fuel combustion engines.

The overall objective of the project is to assess the performance of HERMES system operating on a variety of renewable liquid and gaseous fuels to provide electricity with an efficiency above 65%, while being a net-zero GHG emission system. Renewable methanol and green hydrogen will be used to demonstrate HERMES concept. Within the 36 months of its duration, key objectives of the HERMES project work are to:

- Synthesize renewable fuels for interchangeable GT (Gas Turbine) operation and analyze their value chains, using decentralized CCUS (Carbon Capture, Utilization and Storage) that locally exploits the CO_2 stemming from GT operation,
- Develop and demonstrate a closed-loop, fuel flexible, highly efficient, zero emission supercritical system operating on liquid and gaseous renewable fuels through both numerical and experimental campaigns
- Assess the operation of the HERMES system under a range of operating conditions via advanced modelling tools accounting for the supercritical combustion of a palette of renewable fuels in GTs
- Assess the technology maturity leap forward and provide system integration
- Study the development of appropriate business models to support the valorization of the HERMES system

Project Pillars

Pillar 1: Synthesis of renewable fuels for interchangeable GT operation and their value chains.
This pillar concerns a) the development and validation of decentralized small-scale renewable fuel synthesis process using decentralized CCUS that locally converts the CO_2 from GT operation and b) the assessment of renewable fuel interchangeability including synthesis and storage processes based on renewable fuel value chains, their localized synthesis and compatibility with GT supercritical combustion.

Pillar 2: Fundamentals of zero-emission highly efficient supercritical combustion of renewable fuels.
The scientific and technical objectives of this pillar are a) the development and validation of a closed-loop, fuel flexible, highly efficient, zero emissions renewable energy system, and b) the development and validation of the supercritical combustion modelling tools based on the experimental data and extension of the models to conditions out of the range for the experimental devices.

Pillar 3: System integration and assessment for the technology maturity leap forward. This is the final pillar of the project and the objectives are a) prototyping and blueprints of the zero emission supercritical system components, b) the assessment of system integration and performance scenarios based on Machine Learning, c) the assessment of the techno-economic, environmental and social benefits of the HERMES system via Life Cycle Assessment (LCA) and Key Point Indicator (KPI) approached, and d) the examination of business opportunities considering resistance to new energy technologies.

HERMES output

HERMES goes **beyond the current state-of-the-art**. It develops a research framework encompassing (a) **determination of carbon-neutral and carbon-free fuel properties** and development of **methods and tools** for assessing the performance of combinations of such fuels in **high pressure supercritical combustors,** (b) **validation** of renewable **fuels in terms of fuel economy and pollutant formation** stemming from the use of such fuels in combustors operating under **high pressure conditions,** and (c) approach to **support decision making** regarding the widespread deployment of these fuels to facilitate transition to a **climate friendly economy.**

HERMES Consortium

Partners from seven European countries (NL, GR, DE, FR, UK, CH, and PL) closely collaborated together to form the 10-partner consortium. It is comprised of five leading Universities, three research centers, and two SMEs. The project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101083748.

10 partners

7 countries

2,594,660 EU Funding

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10/2025 end date

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