

## Press release

### Development of a highly efficient gas turbine power plant

#### EU project HERMES aims for climate-neutral power generation with new generation of gas turbines

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Climate-neutral, emission-free and highly efficient - this is what the power generation of the future could look like with a new generation of supercritical gas turbine power plants. The prerequisite is that they are operated with storable, renewable energy sources instead of natural gas and in the supercritical range, and that the CO<sub>2</sub> required in the process is recycled. Power generation with gas turbines offers significant advantages, such as efficiency, reliability, rapid variability of output to stabilize the power grid, and balancing of demand fluctuations. To further increase efficiency and eliminate pollutant emissions, the consortium partners in the EU HERMES research project want to take gas turbines to a new technical level. The new technology and operation with CO<sub>2</sub>-neutral storable energy sources instead of conventional natural gas are also intended to contribute to security of supply and climate protection.

The highly efficient gas turbine power plant envisaged is to be operated in a closed cycle with methanol as a renewable fuel for basic tests in the laboratory. To this end, the researchers are developing a novel, cost-effective process for producing renewable methanol on a small scale. For methanol synthesis, water is first split into its components hydrogen (H<sub>2</sub>) and oxygen (O<sub>2</sub>) using electrolysis with renewably generated electricity. The hydrogen is synthesized together with carbon dioxide (CO<sub>2</sub>) to form methanol. The methanol serves as fuel for the gas turbine, where it is reacted with the pure oxygen from electrolysis and supercritical CO<sub>2</sub> (sCO<sub>2</sub>).

## **Supercritical CO<sub>2</sub> boosts efficiency**

This should result in emission-free and very efficient combustion with an efficiency of at least 65%. To put CO<sub>2</sub> into a supercritical state, it is subjected to a temperature of 31 °C and a pressure of 73 bar, in which it resembles a liquid more than a gas. The sCO<sub>2</sub> ensures that temperatures do not become too high when methanol is burned with pure oxygen instead of ambient air. Methanol as a fuel should be interchangeable with other renewable energy sources such as hydrogen, methane, ethanol, ammonia or dimethyl ether. The researchers also want to investigate xenon as an alternative to sCO<sub>2</sub>. The research project also includes decentralized carbon capture and storage. The stored CO<sub>2</sub> will be used to produce the methanol. In the overall process, both the CO<sub>2</sub> and the sCO<sub>2</sub> will be cycled so that no additional CO<sub>2</sub> is released into the atmosphere. Dynamic simulation tools such as digital twins and machine learning algorithms will help evaluate the system for different scenarios.

Possible applications for the highly efficient gas turbine power plant include energy-intensive industries such as: for the production of cement, steel, ceramics or glass, as well as decentralized power and heat generation for city districts, for example: for large building complexes or critical infrastructures such as hospitals, etc.

## **OWI and TEC4FUELS investigate fuels and materials**

OWI Science for Fuels gGmbH and TEC4FUELS GmbH are involved in HERMES as consortium partners. TEC4FUELS identifies renewable fuels suitable for use in supercritical gas turbine operation and tests their suitability in an application-oriented hardware-in-the-loop test rig in the laboratory. In the test rig, methanol, for example, flows through fuel-carrying

components of the gas turbine system under forced conditions for 100 to 200 hours. This provides insights into the compatibility of the fuel with the materials as well as their service life with regard to aging behavior and wear.

OWI Science for Fuels conducts experiments in a pressure cell using the heat-flux method to determine the laminar combustion velocity of different fuels, thus creating basic conditions for the flexible use of different fuels. For a consistently high efficiency of the system, flames in the combustion chamber must be as homogeneous and stable as possible, even when using different fuels with their different energy contents and properties. In parallel, OWI is still investigating the ignition behavior of the gaseous fuels in order to identify optimum turbine starting conditions.

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Further information at <https://hermes-energy.eu/>



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### The HERMES-Consortium

- Universiteit Twente
- Ethnocon Metsovion Polytechnion
- Exergia Energy and Environment Consultants AE
- TEC4FUELS GmbH
- OWI Science for Fuels gGmbH
- Imperial College of Science Technology and Medicine
- CERFACS, Centre Européen der Recherche et de Formation Avancée en Calcul Scientifique
- Paul Scherrer Institut
- OPRA Engineering Solutions B.V.
- Ecole Polytechnique Fédérale de Lausanne
- Politechnika Wroclawska



### About OWI Oel-Waerme-Institut GmbH

OWI is an independent non-profit research institute. In cooperation with industrial partners and research institutes OWI develops concepts and technologies in the field of energy-efficient use of conventional and alternative fuels. The aim of the research activities is to develop advanced technologies and solutions for a future sustainable heat supply and mobility contributing to reduced pollutant- and greenhouse gas emissions. OWI is an affiliated institute to RWTH Aachen University and sees itself as a mediator between fundamental research and application. Within the framework of technology transfer OWI works on projects which are financed from public funds as well as on industrial research agreements. Clients range from manufacturers of domestic heating systems to companies of the automotive supply industry, the petroleum industry and the industrial furnace engineering to several other industries. [www.owi-aachen.de](http://www.owi-aachen.de)

### About TEC4FUELS GmbH

Tec4Fuels is a competence center for conventional and alternative fuels and their application in existing and new technologies. The company provides services in research and development of technical components and products, systems and energy carriers as well as their application in the energy market for Fuels. Tec4Fuels also offers R&D-related consulting and other services in addition to testing procedures and fuel checks. These include testing and certification, brokerage, and product manufacturing and distribution. [www.tec4fuels.com](http://www.tec4fuels.com)

TEC4FUELS supports its customers in the following areas:

- Test and inspection procedures  
Development of special hardware-in-the-loop (HiL) systems and execution of test procedures for quality assurance of technical

components as well as conventional and alternative fuels, combustibles and lubricants

- Fuel check for emergency power systems  
Monitoring the quality of fuel supplies in emergency power systems to maintain availability and operational safety
- Technical consulting  
Consulting in fundamental questions of innovation management through preliminary, concept and series development to aftersales

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