

Tech Offer

Innovative integrated Micro-Hybrid Turbine

Applications:

- Decentralized & mobile power generation from a wide range of gaseous & liquid fuels
- Combined heat & power for small settlements, or mobile applications with high peak-load/low base-load demand

Benefits

- Significantly higher efficiency of 40%+, compactness & power density
- Extremely long service life of approximately 60,000 operating hours
- Multi-fuel capability with low emissions & long maintenance intervals

Projekt Status

- Extensive tests of components and prototypes running at h_da

Patents

- [US12252994B2](#), granted 18-Mar-2025
- Corresponding pending [EP4237668A1](#)
Priority date 28-Oct-2020

Offer

- Intellectual Property rights can be licensed or transferred
- Cooperation for further development welcome

Scientists at Darmstadt University of Applied Sciences (h_da) have developed an innovative turbine arrangement that mechanically integrates a micro gas turbine (Brayton cycle) with an Organic Rankine Cycle (ORC) expansion turbine on a single common shaft. Unlike conventional combined-cycle plants, which are mechanically decoupled or only economically viable at large scale (>5 MW), this "Micro-Hybrid-Turbine" achieves high efficiency and compactness even at small and medium power outputs.

The arrangement consists of a compressor, a recuperator that preheats compressed combustion air using exhaust heat, a combustion chamber, the gas turbine, an additional heat exchanger transferring residual exhaust energy – typically over 50% of total fuel energy – to a low-boiling working medium, and an ORC expansion turbine driving a shared generator together with the gas turbine.

By running both turbines on the same shaft, the two processes are synchronized to complement each other's power output, reducing bearing friction losses and enabling functional synergies such as vacuum-assisted ORC condensation and air-bearing support. Suitable working media include low-boiling alcohols, ammonia, landfill gases, hydrocarbons or refrigerants (e.g. acetone, methanol, ethanol), chosen for high evaporation enthalpy and minimal maintenance.

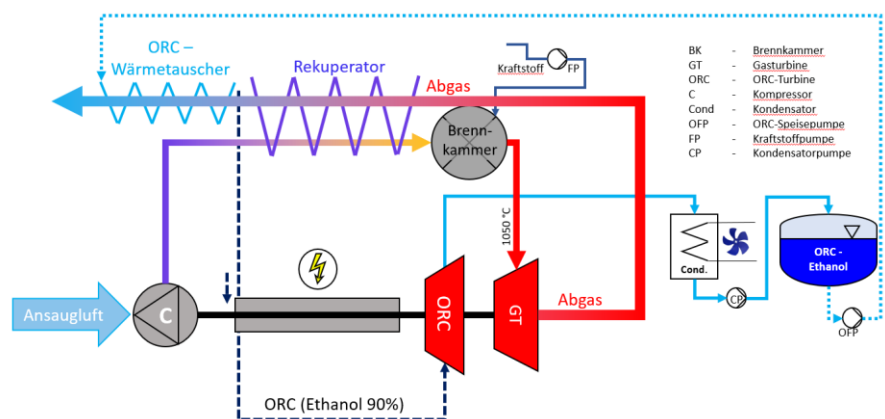


Figure: Schematic diagram of the turbine arrangement

Two design variants exist: a separate residual exhaust-gas heat exchanger downstream of the recuperator, or a combined hybrid heat exchanger integrating recuperation and ORC evaporation in one compact unit, optionally enabling inverted-Brayton-cycle operation. The system is designed for continuous full-load operation — overcoming the partial-load limitation of prior mechanically coupled concepts — achieving efficiencies significantly above existing microturbine systems

Its fuel flexibility and compactness make it well suited for decentralized energy supply, grid stabilization amid growing renewable volatility, and emission reduction from agricultural and waste-water processes. Applications such as biogas systems, ship propulsion, district heating or emergency power generators are possible as well.

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