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Driving the energy transition with zero emissions

For 75 years, WTZ Roßlau has been building expertise in engine and mechanical engineering research. Today the institute plays a leading role in the development of engines that convert energy from alternative fuels. A reference plant is currently being built to demonstrate zero-emission energy supply in action.

Sustainable, decentralized energy supply is one of WTZ Roßlau gGmbH's major research and development areas. The three letters "WTZ" have been recognized around the world for 75 years – standing as they do for the internationally respected expertise of the Scientific-Technical Centre Roßlau. In 1950, former Junkers engineers founded the "Diesel Engine Design and Development Office Roßlau," which in 1964 became the "Scientific and Technical Centre for Diesel Engines". Customers from across Eastern Europe in particular came here to have engines developed for ships, locomotives, and combined heat and power plants.

Today the mid-sized research company is focused on the zero-emission propulsion systems of the future. Green hydrogen – produced using renewable energy – is considered the lifeblood of the energy transition, and WTZ is currently building a demonstration facility that will provide CO_2-neutral energy using green hydrogen. The facility is expected to be completed by mid-year. "Then we'll be able to show anyone interested what future-oriented solutions could look like," says Martin Steiner, head of the Energy Systems department.

He cites industrial parks, hospitals, swimming pools – and increasingly, data centers – as potential target groups. After all, Germany is looking to reduce its reliance on foreign data centers, so numerous new buildings are planned in this sector in the future.

Solutions for low-sun, low-wind periods

"Operators of energy-intensive systems need to be ready for Germany's Climate Protection Act, which requires the country to be climate-neutral by 2045. Large-scale energy providers are already investing in renewables," says Martin Steiner. He also points to a weather phenomenon that is specific to this region – low-sun, low-wind periods. In early November 2024, a persistent weather system led to a temporary drop in both solar and wind power generation. When that happens, the power supply has to come from fossil-fueled plants and electricity imports.

"We can't yet store enough summer-generated renewable power to last through winter," Steiner explains – and presents a possible solution: "In summer, surplus green electricity is used to split water into pure oxygen and hydrogen through electrolysis. These gases are stored in tanks and, when needed – for example, during a low-sun, low-wind period – can be converted back into electricity and heat by a motor developed at WTZ."

The hydrogen-oxygen cycle motor

Developed at WTZ as part of the HYPOS research consortium (Hydrogen Power Storage & Solutions East Germany), this innovation in engine technology generates electricity from green hydrogen and oxygen. The zero-emission APC (Argon Power Cycle) engine for converting hydrogen back into power was the highlight at the 2019 Dessau Gas Engine Conference, an event that WTZ hosts each year. "In this newly developed combustion process, both hydrogen and oxygen are used in a closed cycle," explains Carsten Tietze, design engineer and innovation manager. "No CO_2 or nitrogen oxides are produced in the hydrogen-oxygen cycle engine – the elements needed to create them simply aren't present in the combustion process. And when the hydrogen runs out, the engine can run on natural gas, too."

To demonstrate that the engine's only by-product is pure water, flowers were watered with it during the official presentation. In practice, this water stays in the closed cycle and can be reused for electrolysis.

Innovative hydrogen storage

WTZ first envisioned a reference plant for zero-emission energy supply five years ago and began installing solar panels on the roofs of its production halls. "Now we want to prove that our concept works," says Carsten Tietze, who secured the funding for the project. Going by the name of "CO_2-neutral energy supply in energy-intensive industries," or "energy4CHP" for short, the project is funded by Germany's Federal Ministry of Education and Research and will rim through the end of 2025.

Test engineer Samuel Brinnig is leading the setup of the demonstration facility. The LOHC hydrogen storage system is currently being installed – LOHC stands for Liquid Organic Hydrogen Carrier. "It's an oil-like carrier fluid," Brinnig explains. "Hydrogen is bound to the carrier, which allows it to be stored at higher density and released when needed."

An alternative storage method involves compressing the hydrogen under high pressure – like the H_2 tanks which are already on site outdoors. WTZ is also developing a new cost-effective oxygen storage system as part of the joint energy4CHP project. At the same time, the team is working on ways to improve the efficiency of the electrolysis process.

“We need to keep costs in mind for potential customers,” says Martin Steiner. He adds that the research project is also exploring how a CO_2-neutral energy system like this can be made economically viable.

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Photos (all K. Graubaum):

Engine: Samuel Brinnig, Martin Steiner, and Carsten Tietze of WTZ Roßlau (from left) present the zero-emission APC engine – the centerpiece of the demonstration plant for CO_2-neutral energy supply.

Storage: Carsten Tietze, Samuel Brinnig, and Martin Steiner (from left) standing next to the LOHC hydrogen storage unit currently being set up.

Engine presentation: The water produced by the zero-emission cycle engine is so pure it was used to water flowers during the presentation.

Additional assets available online: Photos (3)

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