EMPOWER

EUROPEAN METHANOL POWERED FUEL CELL CHP

Project ID	875081
PRR 2024	Pillar 4 – H_2 end uses: stationary application
Call topic	FCH-02-7-2019: Development of highly efficient and flexible mini CHP fuel cell system based on HTPEMFCs
Project total cost	EUR 1 499 876.25
Clean H_2 JU max. contribution	EUR 1 499 876.25
Project period	1.1.2020–30.11.2023
Coordinator	Teknologian tutkimuskeskus VTT Oy, Finland
Beneficiaries	Blue World Technologies ApS, Catator AB, THT Control Oy, Universidade do Porto

https://cordis.europa.eu/project/id/875081

PROJECT AND GENERAL OBJECTIVES

Empower was a project dedicated to developing a highly efficient and versatile mini combined heat and power (CHP) system based on high-temperature proton-exchange membrane fuel cells (HT-PEMFCs). The primary objective of the project was to design and demonstrate a methanol-fuelled mobile CHP system utilising HT-PEMFC technology for simultaneous heat and electricity generation.

Designed to function as a backup or off-grid solution in both industrial and residential settings, the Empower system aimed to provide utility-grade electricity, with waste heat repurposed for space heating and providing domestic hot water. The overarching goal was to enhance the efficiency of systems, specifically targeting the mini-CHP market, while ensuring cost-competitiveness and a low carbon footprint.

The methanol-fuelled CHP system was developed to replace diesel generators, lowering CO_2 emissions, reducing noise and generating heat. Methanol's liquid form enables cost-effective storage and seamless distribution through existing infrastructure, fostering renewable production and reducing dependence on imported fossil fuels.

NON-QUANTITATIVE OBJECTIVES

- Increase visibility and awareness of renewable methanol potential.
- Arranged an international summer school on hydrogen technologies.
- Developed business analysis for renewable methanol use in CHPs and other applications.
- Supported knowledge exchange and production ramp-up through stakeholder searching and information linkage.
- Introduced concept to produce affordable, secure electricity with low carbon footprint.

PROGRESS AND MAIN ACHIEVEMENTS

- Improving materials for fuel cell stacks and refining their quality control methods;
- Studying the novel concept of aqueous-phase reforming as a technology utilised prior to the reforming of methanol;
- Development of a highly efficient gas-phase reformer;
- Development of a custom-made fuel cell system for demonstration purposes;
- Development of a mobile CHP container, acting as a platform for fuel cell systems;
- Integration and short-term testing of CHP system;
- Conduct of final demonstration activities focusing on stand-alone demonstration of the performance of fuel cell systems in relevant conditions;
- Proving the scalability, cost reduction, low carbon footprint and business potential of the project concept.

FUTURE STEPS AND PLANS

"The project has finished.

Opportunities for further research include:

- Integration of a 5 kW fuel cell system with a heat pump for 20–30 kW heat production;
- Design of a bipolar plate to ensure gasket stability;
- Design of a mechanical endplate and compression system;
- Refinement of gasket material;
- Selection of balance-of-plant components for the fuel cell system;
- Integration of a thermoelectric generator in the fuel cell system;
- Use of a Gaussian process regression unit for reforming methanol.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?
Project's own objectives	Stack electrical efficiency (LHV for reformate gas)	%	55	53.7	⚙
	Degradation of the system	%	0.4	1.06	⚙
	Fuel-processing efficiency	%	85	> 85	✓
MAWP (2014–2020)	CAPEX	€/kWh	5 500	2 600	✓
	System electrical efficiency (LHV for methanol)	%	37–67	38.1	✓

Clean Hydrogen Partnership
Co-funded by the European Union