Fuel cells in micro-cogeneration mode: 
the technology explained

European-wide field trials for residential Fuel Cell micro-Cogeneration

PACE project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 700339. This Joint Undertaking receives support from the European Union’s Horizon 2020 research and innovation programme and Hydrogen Europe and Hydrogen Research.
What is Fuel Cell micro-CHP?

Combined Heat and Power generation

• Fuel cells can be used as Energy plants for Buildings
  • On-site energy solution to produce both electricity and heat.
  • Easy to install, silent, no rotating parts and little maintenance.
  • Flexible & modular with easy cascading for higher power demand
  • Cuts energy costs: High energy bill savings. As electricity prices rise, savings will increase.
  • Eligible for green subsidies in many EU countries.

• Reducing environmental footprint potentially to zero Carbon: much more efficient than power from the grid + a condensing boiler, it reduces CO2 and eliminates local air pollution: no combustion so no NOx, SOx and particle emissions.

• Future proof: Gas from the grid (either conventional or renewable) is converted into Hydrogen and then used to produce electricity and heat inside the Fuel Cell
What is Fuel Cell micro-CHP?

Easy cascading for higher SME demand
Principle of a Fuel Cell

- **SOFC and PEM PRINCIPLE**

**FUEL CELL STACK**

**Principle of a Fuel Cell**

- **OXYGEN** flows through the cathode, where oxygen molecules react with electrons and water to produce water.

- **FUEL** enters the anode, where it reacts with oxygen and water to produce water and electrons.

- **ELECTROLYTE** facilitates the transport of ions between the cathode and anode.

- **ELECTRONS** flow through the external circuit, driving the chemical reactions and generating electricity.
Fuel Cell ADVANTAGES

SILENT OPERATION
(NO MOVING PARTS)

HIGHER EFFICIENCY
THAN COMBINED CYCLE
GAS TURBINES (> 60% AC DELIVERED)

CLEAN EMISSIONS
NO SO\(_2\) OR NO\(_x\)

Other unique features:

WIDE RANGE OF FUELS
(Hydrogen, GAS, BIOGAS, etc.)
FUTURE PROOF, NO REGRET SOLUTION

CO\(_2\) CAPTURE “BUILT-IN”
WITHOUT LARGE INVESTMENT
OR EFFICIENCY PENALTY
Easy installation
Control and full access to the extensive data:

- Electricity you are producing
- CO₂ emissions you have saved

- For iOS and Android
- HTML₅ responsive
- Security compliance (GDPR)
- Monitoring / power profiling
Decentralized power production in the near future

Current average situation in Europe: **Centralized power production**

- **45-70% waste-heat**
- **5-8% transportation losses**
- Only 25-40% energy left for the building!

> **90% Energy @home with Fuel Cell mCHP = up to 3 times more efficient!**

**Local de-centralized power production**
Storage of renewable energy with – “Power to Gas”

The future: Smart-grids and energy-storage in Hydrogen

- Electricity Grid
  - Limited
  - Storage Capacity

- Gas grid
  - Enormous!
  - CCTC plants + CHP covering industrial demand
  - Decentralized (micro) CHP’s
  - Hydrogen and Synthetic Methane ‘Power to Gas’

Storage Capacity: Enormous!
Why Fuel Cell micro-CHP? Example Belgium

Example ‘Foets Restaurant’ Mol

- Yearly power demand 71 MWh
- Yearly power bill (2018): € 16,920,-
- Yearly power generation 65 MWh
- Yearly waste heat recovery 25 MWh
- 5 BlueGEN 1.5 kW units cascaded
- Total investment € 107,000,-
- Savings year one: € 2,770,-
- Savings after 15 years: € 128,955,-
- Carbon savings: 17.5 Tons per year
Surveys show that more than 90% of end users are pleased with the environmental performance, the comfort and warmth and running costs of their fuel cell micro-cogeneration unit.

“After the installation of the Fuel Cell micro-Cogeneration unit in my car dealership, my demand of energy decreased by 10,000 kWh per year and I save €2200 Euro in electricity cost every year.”

Yakup Ak, managing director at Autoport Cologne

“With Fuel Cell micro-CHP we have many advantages in one single compact unit. To install a unit, households need nothing more than a gas connection and an electricity connection.”

André Bartels, CEO, Carl Cordes GmbH

90% of the FC micro-CHP systems were available for at least 95% of the time.

Source: ene.field project report
“Learning points from demonstration of 1000 fuel cell based micro-CHP units”