



Pathway to a Competitive European
Fuel Cell micro-CHP Market

Current FC mCHP Prevalence and Customer Perceptions

George Carew-Jones – Element Energy



PACE project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No 700339.

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How many Fuel Cell micro-CHPs are there in the world?

Current FC mCHP Prevalence and Customer Perceptions

- Circa. **10,000 units** have been installed across **Europe** to date, including:
 - **1168** units installed under **PACE** by end of April 2020;
 - **>1000** units installed under the preceding **ene.field** project;
 - **>4500** units installed under the German **KfW433** Programme.

ene.field★
Fuel Cells x Combined Heat and Power

KFW



- Circa. **400,000 units** have been installed in **Japan** to date as part of the **ene.farm** project.
- Additional markets with units deployed: USA (e.g. New Jersey Clean Energy CHP fund); Canada.

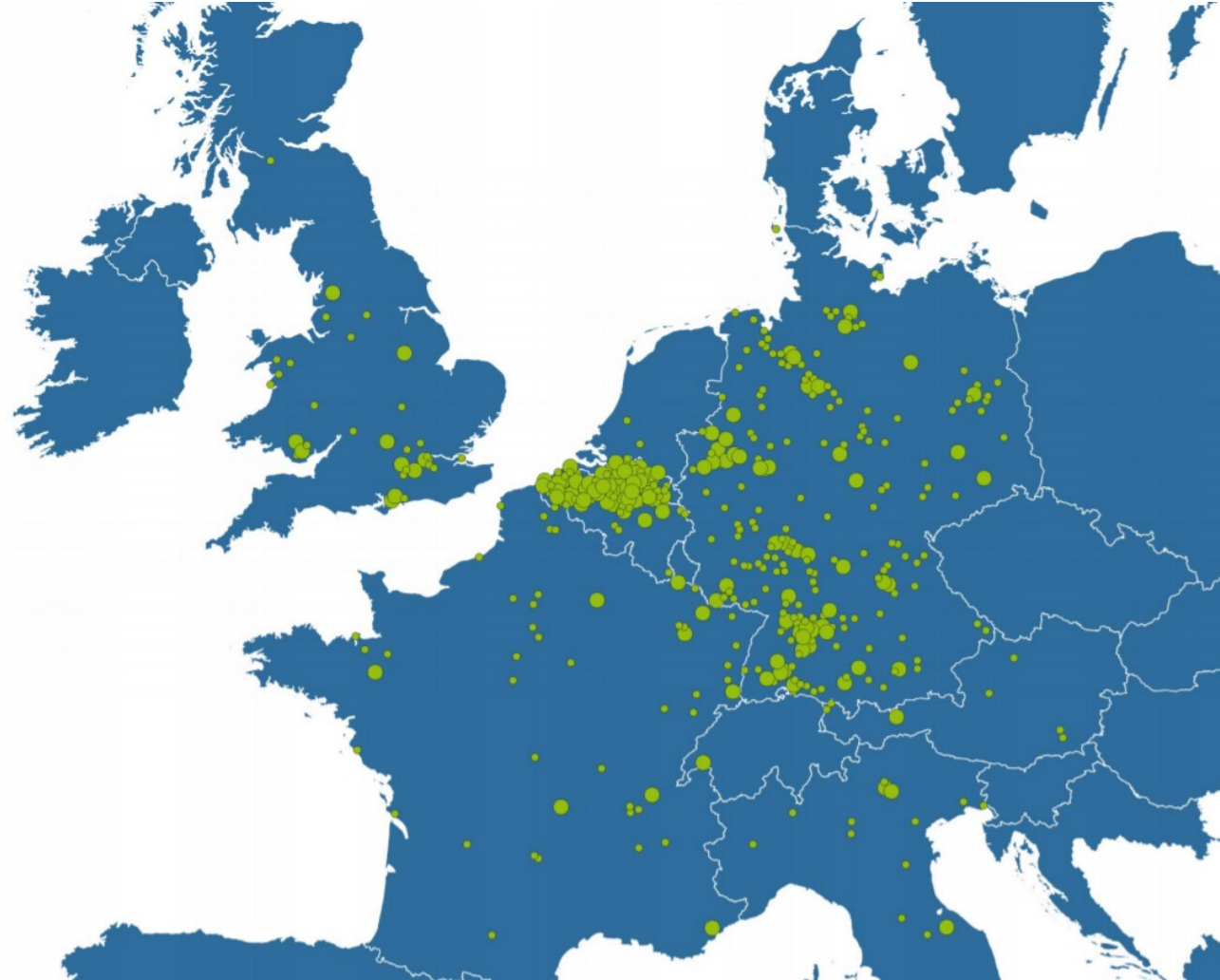


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Fuel Cell micro-CHP distribution in Europe is ramping up in key markets

Current FC mCHP Prevalence and Customer Perceptions

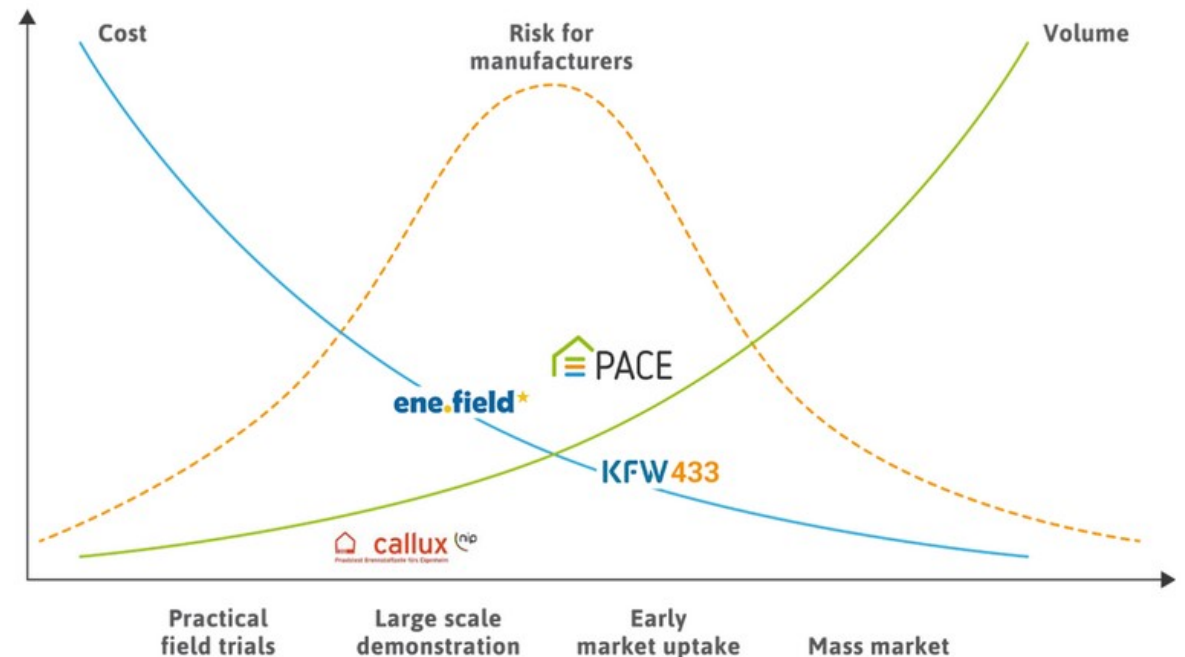
- **More than 10,000 units have been installed across Europe** in households and SMEs.
- This map shows the distribution of the first **857 units** installed as part of the PACE project up to October 2019.
- Units have been installed in **9 different countries**
- **Top 3 countries by installations** (as of April 2020):
 1. Belgium
 2. Germany
 3. France



Stationary fuel cells are at a critical stage in market adoption

Current FC mCHP Prevalence and Customer Perceptions

- The technology has passed the phases of **field trial** and **large-scale demonstration** and is now in a phase of **early-to-mass market uptake**.
- **European manufacturers are showing their commitment** and industrial leadership by launching new products on the market.
- Between 2016-2020, more than **EUR 350 million** was pledged or already invested in stationary fuel cells.
- Further **policy support and incentives are needed to create a level playing field with incumbent and other low carbon technologies**.





Currently available funding sources

Current FC mCHP Prevalence and Customer Perceptions

- **Feed in tariffs (FiTs)** currently exist for FC mCHP units in Belgium (Flanders Region), Germany, Luxembourg, Poland and the UK.
- **Tax incentives/exemptions** also exist in Germany and Luxembourg; and an **installation subsidy** exists in Belgium (Flanders Region).
- The current number of funding incentive schemes are **limited** in scope and European prevalence.
- **Additional possible funding mechanisms:** certification schemes, capex support, fuel subsidies, self-production incentives.

Multiple possible FC mCHP business models exist

Current FC mCHP Prevalence and Customer Perceptions

[1]	Traditional business model	Service-based business model	Demand side flexibility-based business model
Value offered	<ul style="list-style-type: none"> Heat to user Electricity to user 	<ul style="list-style-type: none"> Heating and electricity as a service to the user 	<ul style="list-style-type: none"> Heat/electricity to user Grid flexibility services
Additional side benefits	<ul style="list-style-type: none"> Ability to electrify home (eg. additional heat pump, electric vehicle) 	<ul style="list-style-type: none"> Maintenance responsibility shifted to energy service company 	<ul style="list-style-type: none"> Additional income to unit owner from grid services
Partners involved	<ul style="list-style-type: none"> User Unit manufacturer 	<ul style="list-style-type: none"> User Energy service/performance company 	<ul style="list-style-type: none"> User Unit manufacturer Grid operator (DSO)
Sales channels	<ul style="list-style-type: none"> Manufacturer to user directly or via third parties (e.g. installers/architects) 	<ul style="list-style-type: none"> Commercial: Service company to end-user Industrial: Developer to end-user 	<ul style="list-style-type: none"> Manufacturer to user Grid operator to consumer

- €3500/kWe could be avoided in power distribution costs across the EU through using FC mCHP [2]

Stationary fuel cells are a fully mature technology

Current FC mCHP Prevalence and Customer Perceptions

- All PACE five **manufacturers** are now offering new '**Generation 2**' or '**Generation Y**' units, which:
 - Have a higher overall **efficiency**;
 - Have improved **design** (for modulation, remote access etc);
 - Are cheaper and easier to **mass produce**;
 - Have generally lower **maintenance** requirements and higher **stack lifetimes**.
- Proven **exemplary performance** of stationary fuel cells during previous deployment:
 - > 5.5 million hours of **operation** and 4.5 GWh of **power produced** under **ene.field** ^[1].
 - >4 million hours of **operation** and 2.5 million kWh of **power produced** under **Callux** project in Germany.

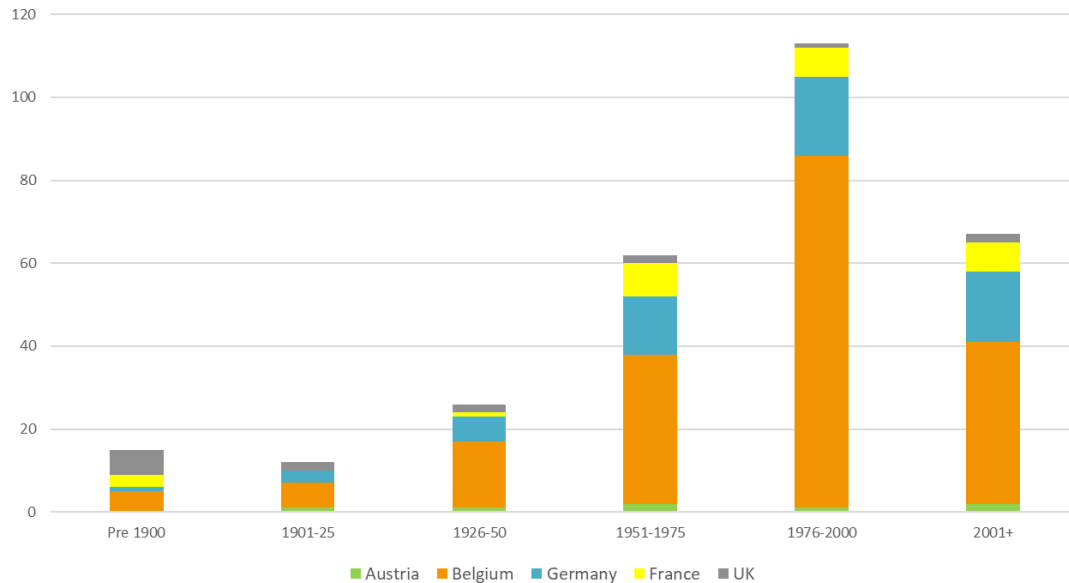


Customer Perceptions – typical customers are looking for a replacement option

Current FC mCHP Prevalence and Customer Perceptions

- Customer perception data analysis was conducted based on **313 surveys completed** by PACE customers up to September 2019.

Age of Building



- What is the typical PACE **customer profile**?

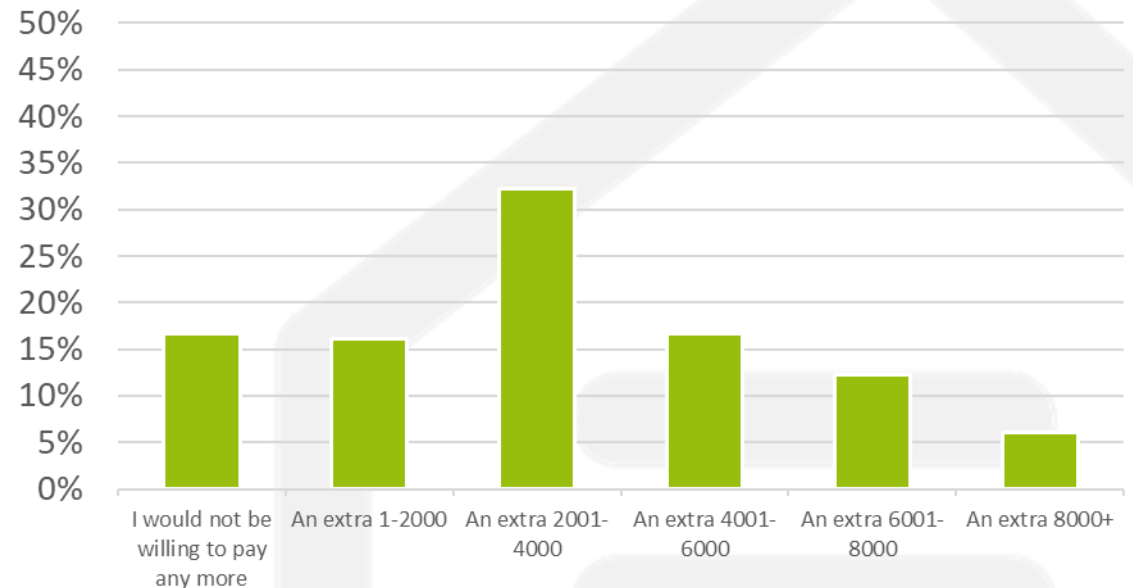
- 78% of customers live in a **2-4 person household**;
- 94% of customers are **residential** (ie. 6% purchased units for their businesses)
- 91% of customers **own the building** they are installing a FC mCHP in;
- Customers tend to have a household **income above the European average**;
- The vast majority of customers purchased a FC mCHP unit as a **replacement** to their existing heating system.

Customer Perceptions – environmental concerns motivate FC mCHP purchases

Current FC mCHP Prevalence and Customer Perceptions

- The three most common primary reasons for buying a Fuel Cell micro-CHP are:
 1. **Overall cost** savings (23%);
 2. **Energy** savings (19%);
 3. **CO₂** emissions reduction (18%).
- Customers generally self-identified as **‘green’** and as **‘early adopters of new technology’**.
- 77% were willing to **pay a ‘little more’** for a product that was less harmful to the environment, but few were willing to pay a ‘lot more’
- **>50%** would be **willing to pay an additional €2,000 or more** assuming operational savings (€ 30/month) and reduced carbon emissions (-20%)

Compared with a conventional boiler, how much more would you be willing to pay for a FC mCHP, assuming you made a total saving of €30/month (€360 a year) and reduced your carbon emissions by 20%.



- So, whilst carbon reduction is important, cost is also still a key factor



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Overview of Project Resources

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- The PACE partners have produced a number of **public deliverables** as part of the project in order to provide more **information on different topics**.
- Reports that will be covered today:
 - D1.7 – Summary report on **specifications for newest models**
 - D1.9 – **Training materials** for installers
 - D2.11 – **Customer perceptions** of FC mCHP (already outlined_
 - **D3.2 – Project emerging conclusions**

PACE Project Reports

Overview of Project Resources



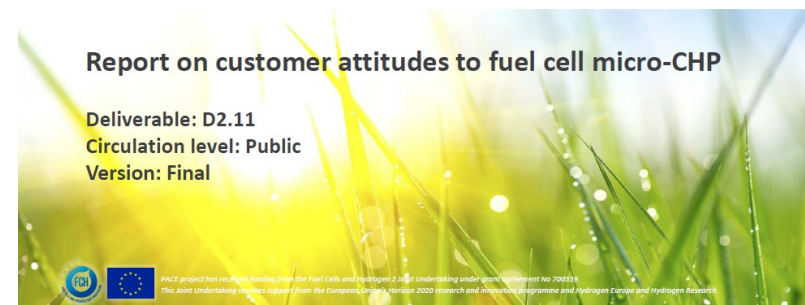
D1.7- Summary report on specifications for newest
model deployment in PACE (April 2020)
Element Energy



Deliverable 1.9 – Report 1 on Training and Certification
Element Energy – March 2020



The bridge to large scale market uptake
European-wide field trials for residential Fuel Cell micro-Cogeneration



D1.7 – Summary Report on Generation Y Systems

- This report provides information on the **next generation** ('Generation Y' or 'Generation 2') **FC mCHP systems** being deployed by all 5 unit manufacturers in PACE. This information includes:

- **Technical specifications** of the new units;
- **Improvements** made from the previous unit generation;
- **Feedback** from existing **customers**;
- **Marketing materials** for units and where/how to **contact** manufacturers

Overview of Project Resources



- Operation with liquid gas (propane/butane) and therefore a clean alternative to fuel oil.
- Heat extraction also possible at high return temperatures (up to max. 65 °C). Ideal for existing buildings.
- Continuous operation possible, as no regeneration times are required.
- "Made in Germany" - from development to the finished product

Sunfire-Home in Action



Fuel Cell Success Story

House Type: Private
Installation Year: 2019
> Renovation of an old listed building



Two BlueGEN for a villa

Here, two BlueGEN BG-15s supply a historic villa with highly efficient energy. Despite the exterior of the house dating from a different time, modern technology in the form of the BlueGEN units ensures a highly efficient energy supply.

"I have a green heart, and so I want to use clean energy for our house."

Customer's wish

- A sustainable overall energy concept for the new heat and power supply
- A reduction in electricity costs

Technical requirements

- Challenge: Monument protection
- Installations: wall heating, brine water heat pump, sauna & oven with 9 kW elect. Power and an electric car

The efficient villa of the Wintzen family

Since 2012 Patricia and Bernd Wintzen have lived in the Villa Hedges in Viessen. The red brick and the white frames of the windows immediately catch the eye. But although the villa is more than 100 years old, it is by no means from another time. On the contrary, two innovative BlueGEN BG-15 fuel cells provide the Wintzen family with clean, efficient and low-cost electricity.



Built in 1908, the villa with 350 square metres of residential space has been a listed building since 1989. And this was a particular challenge in the refurbishment, not least because insulation of the exterior facade is only possible on the back of the house due to the monument protection and was implemented in 2017. Due to the lack of insulation and the single glazing, the entire house requires heating throughout the winter months in order to avoid cooling, even individual rooms. From the central stonewall, the heat is redistributed into the adjoining rooms, even when the landlords are traveling.

Product Highlights



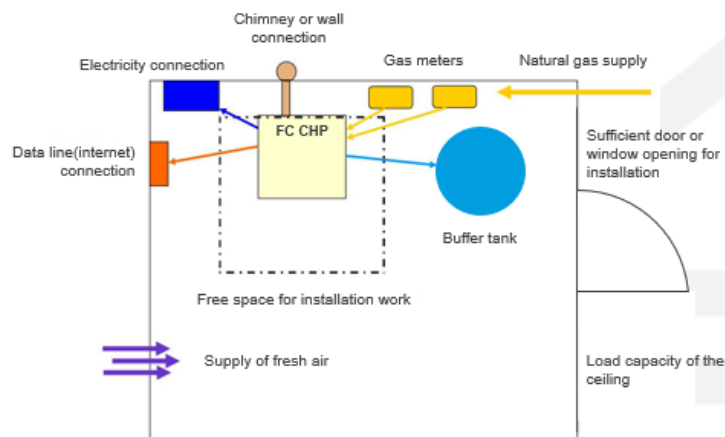
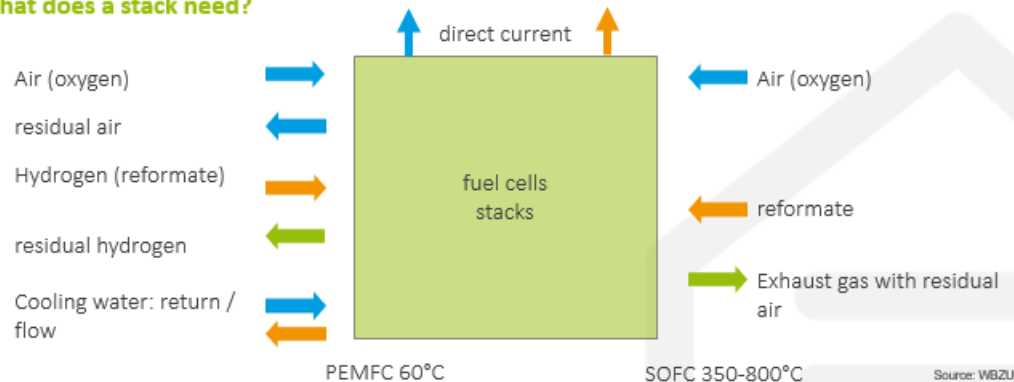
Fair event and training with installers' feed back



Installers' feedback to newest model: High quality and very flexible



What does a stack need?



D1.9 – Training Materials for Installers

Overview of Project Resources

- This report is targeted at training **schools and associations** that provide **training to installers** of FC mCHP units.
- There are **3 modules** included, which provide an **overview of the technology**, its **benefits to consumers**, and **considerations for its installation**:
 - Module 1: Basics
 - Module 2: Planning Installation
 - Module 3: Electrical and Heating Installation
- The report also includes information on **how to interact with customers** and **checklists** for installation.

- Links to reports:

- D1.7 – Summary Report on **Generation Y** Systems:
 - <http://www.pace-energy.eu/new-generation-of-fuel-cell-micro-cogeneration-units-on-the-market-with-higher-performance-for-greater-customer-benefit/>
- D1.9 – **Training Materials** for Installers:
 - ... [link being made]
- D2.11 – Literature Review on **Virtual Power Plant** Potential for FC mCHP:
 - ... [link being made]
- **D3.2 – Emerging Conclusions of PACE Project:**
 - ... [link]



Pathway to a Competitive European
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