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

Overview of ene.field and PACE projects

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Brussels, 23-24 November

CONTENT

1. **Fuel cell micro-CHP - What and Why**
2. ene.field project – paving the way to early commercialisation
3. PACE project – the bridge to large scale market uptake

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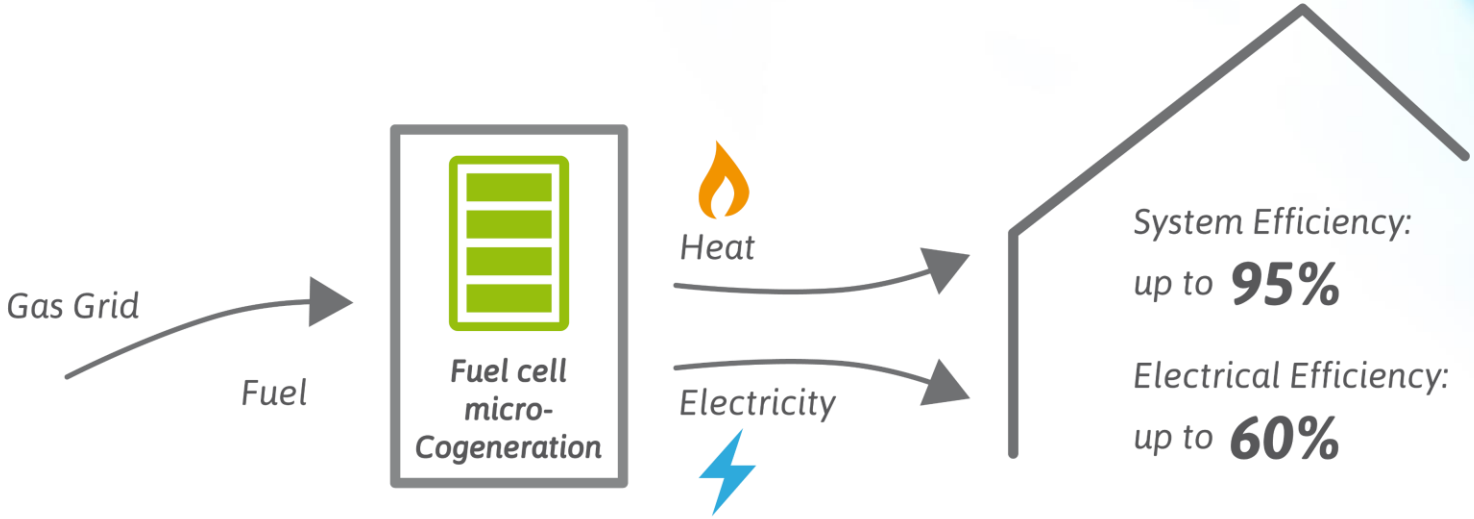
Pathway to a Competitive European Fuel Cell micro-CHP Market

What is Fuel Cell micro-Cogeneration?

Fuel Cell micro-Cogeneration is a highly efficient home energy system that simultaneously produces heat and electricity



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Why Fuel Cell micro-Cogeneration?

Heating and Powering your Home

Empowers consumers

Supports the European energy transition

Provides greater flexibility for the energy system

Fosters innovation and high-value jobs

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Pathway to a Competitive European Fuel Cell micro-CHP Market

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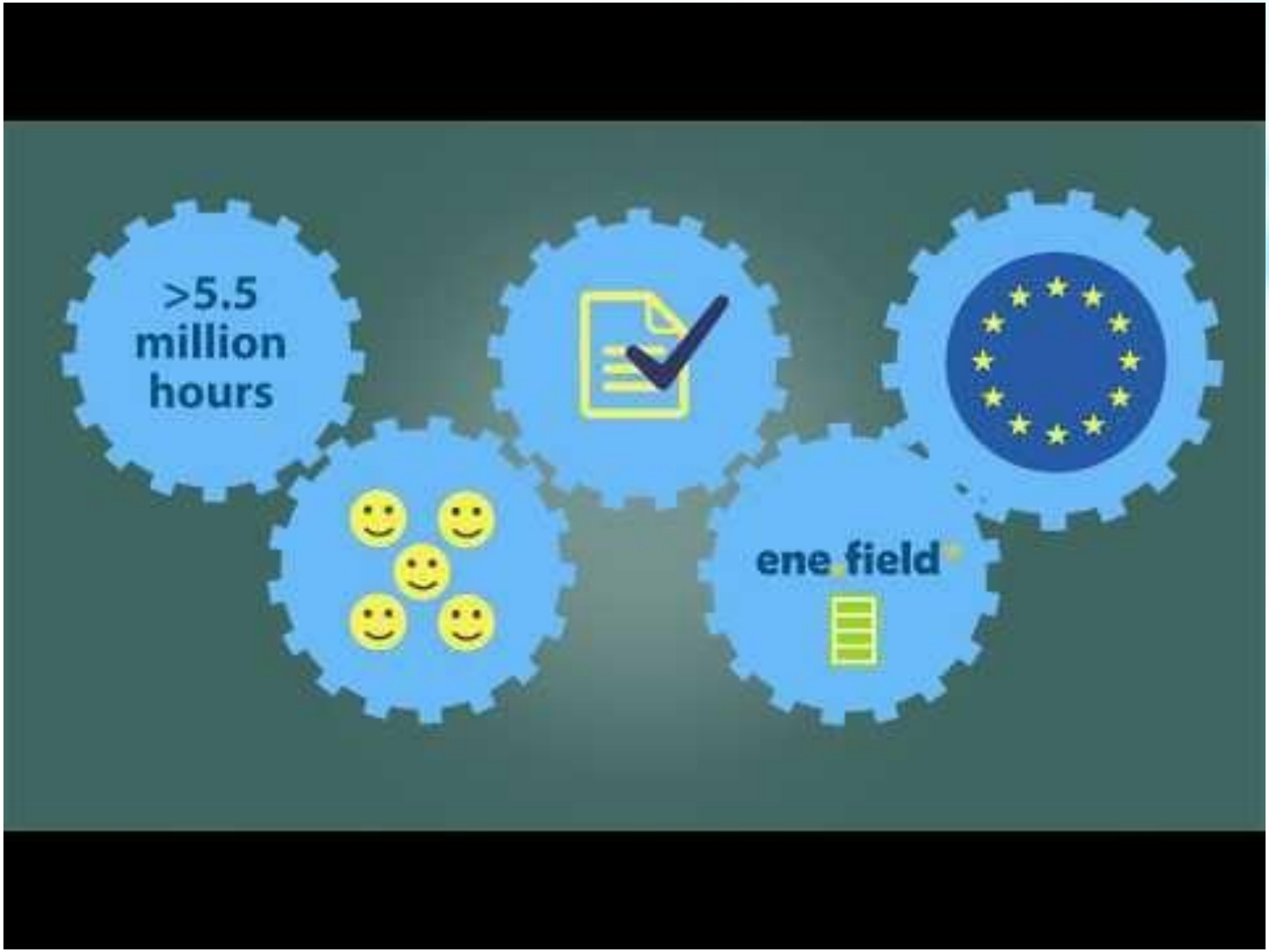
Pathway to a Competitive European Fuel Cell micro-CHP Market

PROJECT OVERVIEW

ene.field project	
Call year	2012
Call topic	Field demonstration of small stationary fuel cell systems for residential and commercial applications
Project dates	01/09/2012 – 31/10/2017
% stage of implementation	100% as of 01/11/2017
Total project budget	EUR 52,487,443.06
FCH JU max. contribution	EUR 25,907,168.77
Other financial contribution:	EUR 26,580,274.29
Partners:	Ballard, Baxi Innotech, Bosch, British Gas, Ceres Power, COGEN Europe, DBI, DCHT, Dolomiti Energia, DONG Energy Power, DTU, EIFER, Elcore, Element Energy, Engie, Environment Park, Energy Saving Trust, GWI, Hexis, HyER, Imperial College London, Politecnico di Torino, RBZ, SenerTec, SOLIDpower, Vaillant, Viessmann.

ene.field is a European platform for Fuel Cell micro-Cogeneration



Introduction to ene.field project

- ene.field is the **largest European demonstration** of the latest home energy solution for private homes, fuel cell micro-CHP.
- Project duration of **5 years** (2012-2017).
- **1,046 Fuel Cell micro-CHP systems have been deployed** across 10 key European countries.
- More than **5.5 million hours of operation** & **4.5 GWh of power produced**
- Outputs of the project include: Detailed performance data, lifecycle cost and environmental assessments, market analysis, commercialisation strategy.

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Overview of systems in ene.field

- **10 active suppliers** directly involved in the project and in direct interaction with their customers
- Applications suitable for both **residential use and small commercial buildings**

Elcore 2400	Dachs InnoGen	Cerapower FC10	Logapower FC10	Vitovalor	SteelGen	Galileo 1000 N	Vaillant G5+	PEMmCHP G5	BLUEGEN	ENGEN 2500	Inhouse 5000+
											
HT PEM	LT PEM	SOFC	SOFC	PEM	LT SOFC	SOFC	SOFC	LT PEM	SOFC	SOFC	LT PEM
300W	**700W**	**700W**	**700W**	**700W**	**700W**	**1kW**	**1kW**	**2kW**	**2kW**	**2.5kW**	**5kW**
Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural Gas	Natural gas+ Biogas	Natural Gas	Natural Gas + Biogas	Natural Gas	Natural Gas	Natural gas + Biogas + H2
Wall	Floor	Floor	Floor	Floor	Wall	Floor	Wall	Floor	Floor	Floor	Floor
Elcore	**SenerTec**	**Bosch Thermotechnik**		**Viessmann**	**Ceres Power**	**HEXIS**	**Vaillant**	**Ballard Power**	**Solid Power**		**RBZ**

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ene.field findings I: customer satisfaction

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

"With FC m-CHP we are less dependent on rising energy costs. We are excited about having our own power plant, which saves us around €700 annually on our electricity bills and 2 tonnes of CO2 per year", Mr Dilger, Germany

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

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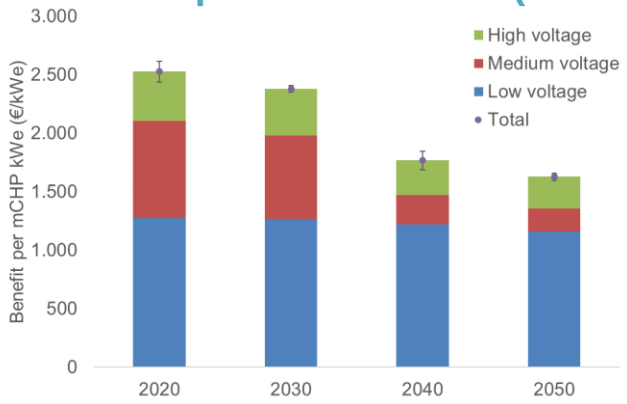
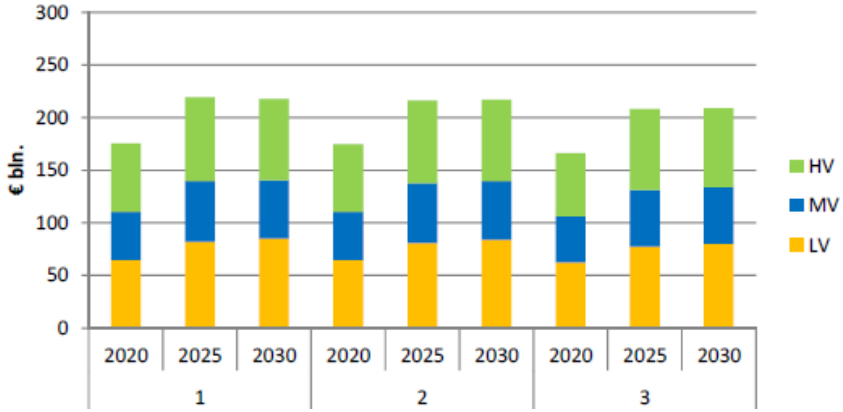
ene.field findings II: micro-CHP delivers important distribution network cost reductions

Micro-CHP distribution network cost reductions per kW installed (2020-2050)



Cumulative distribution network reinforcement costs in EU-28 up to 2030



Up to 31 GW

micro-CHP potential in 2030

€ 62 bn

in avoided grid investments associated with micro-CHP

Up to 28%

of EU's projected grid reinforcements needs potentially delivered by micro-CHP

Upper graph source: For the full report "Benefits of Widespread Deployment of Fuel Cell micro-CHP in Securing and Decarbonising the Future European Electricity System" authored by Imperial College London click here.

Lower graph source: Imperial College London, NERA Economic Consulting, DNVGL, «Integration of Renewable Energy in Europe»,June 2014. Full report is available here.

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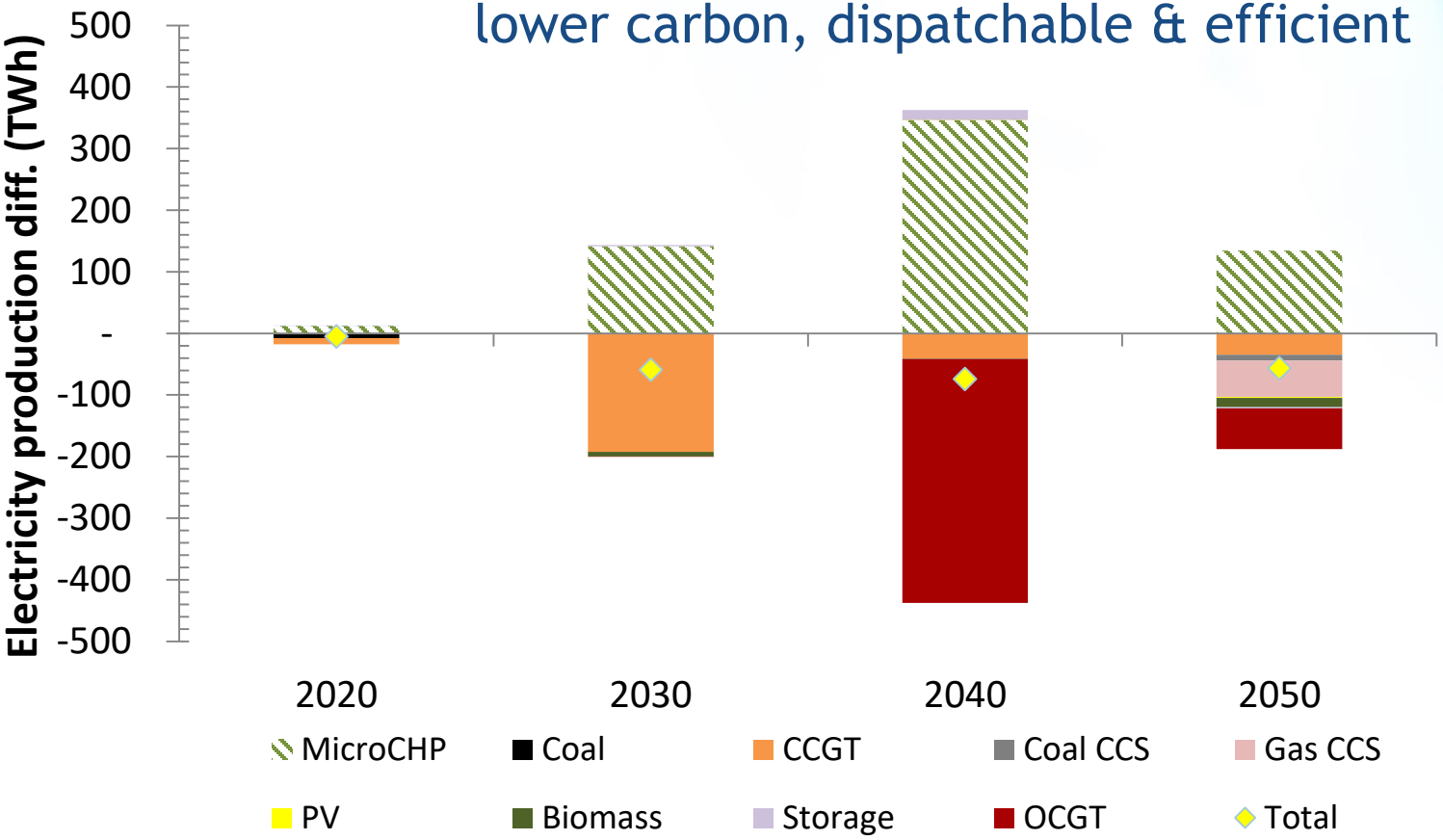
ene.field findings III: micro-CHP displaces more carbon intensive power, while reducing grid losses

Electricity from micro-CHP vs. centralised generation

lower carbon, dispatchable & efficient



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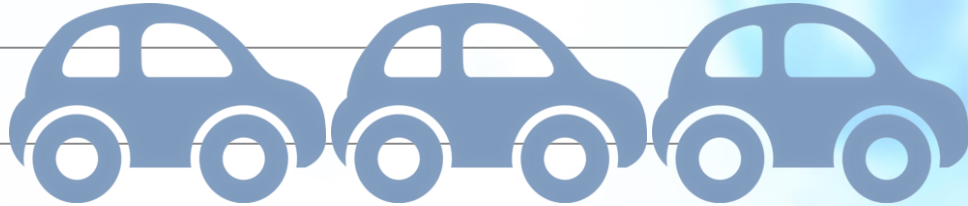
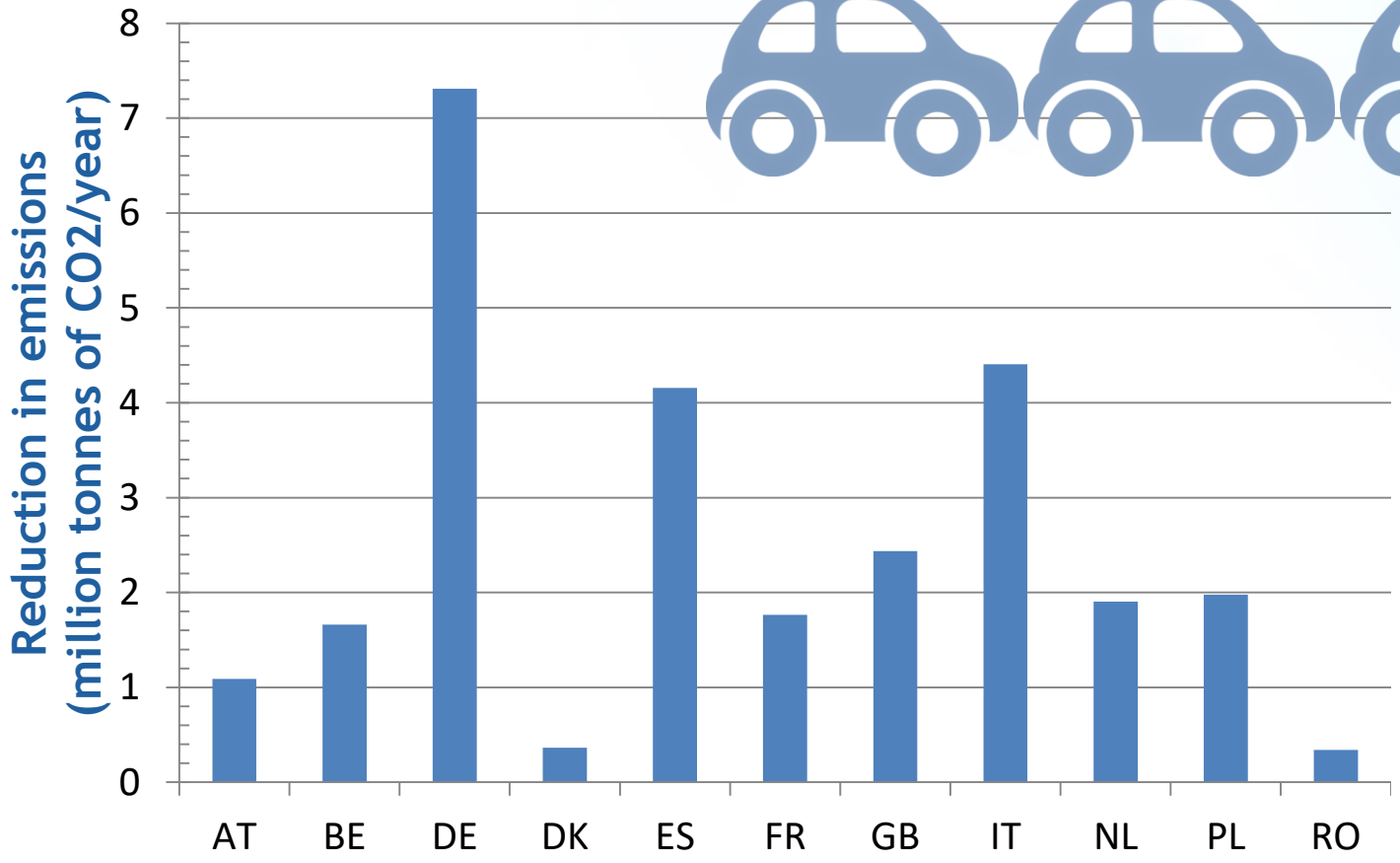
ene.field findings IV: CO2 emission reductions

Decarbonisation benefits of **more than 32 mil tonnes of CO2 emissions across Europe in 2030 :**

→ equivalent to 25% of Belgium's emissions in 2015

→ equivalent total yearly emissions of more than 5,3 million cars





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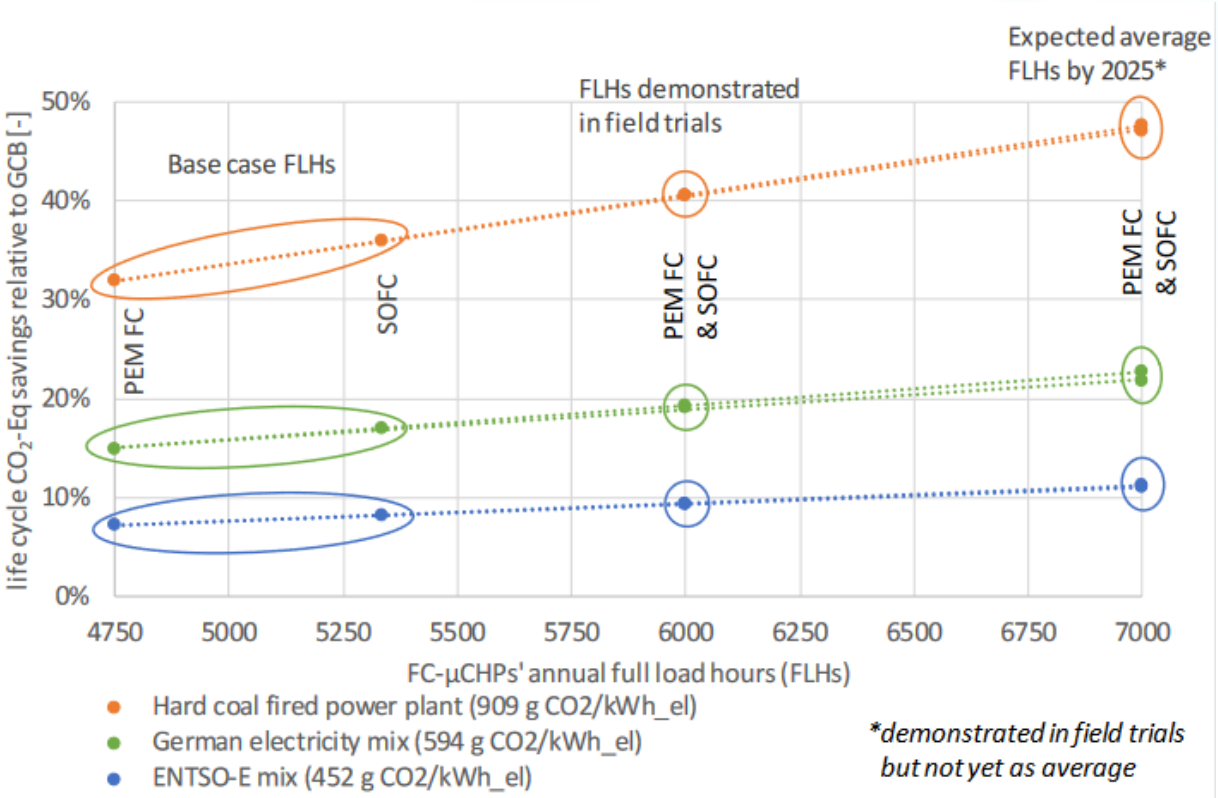
ene.field findings V: environmental life cycle assessment

- LCA GHG generally lower for fuel cell micro-CHP than alternative home energy solutions considered (i.e. gas condensing boiler, heat pump)
- Higher benefits for higher utilisation of the fuel cell & for more carbon intentisve power mixes



To read the Executive Summary of the "Environmental Life Cycle Assessment" click here.
Case: "Not well-insulated" "single family-home" in "Central Europe"

The flexibility challenge

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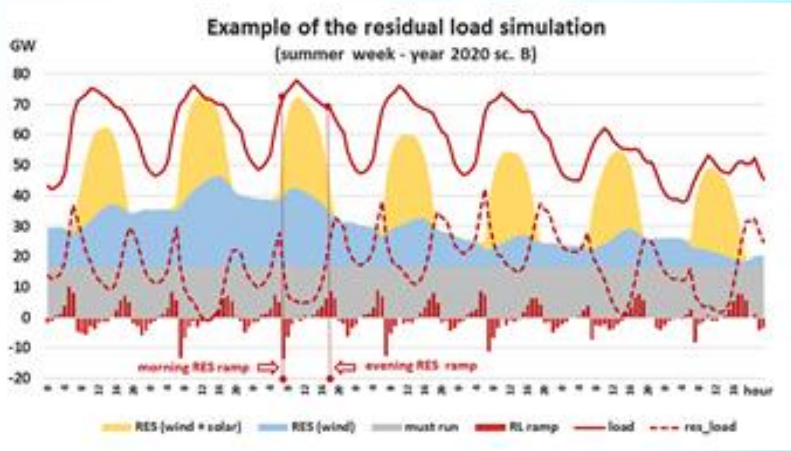

For our transition to a complex energy system, with increasing penetration of intermittent renewables, Fuel Cell micro-CHP:

- is a valuable demand-side measure for managing grid stability
- overcomes the challenge of increasing penetration of electric heating
- is low carbon and renewable when utilising bio-gas and H2
- in an existing, extensive natural gas network
- contributes towards a cleaner, healthier environment

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The renewables challenge

Heat Roadmap Europe: *"Electrifying heating & cooling with heat pumps could double the electricity demand (in Europe)"*

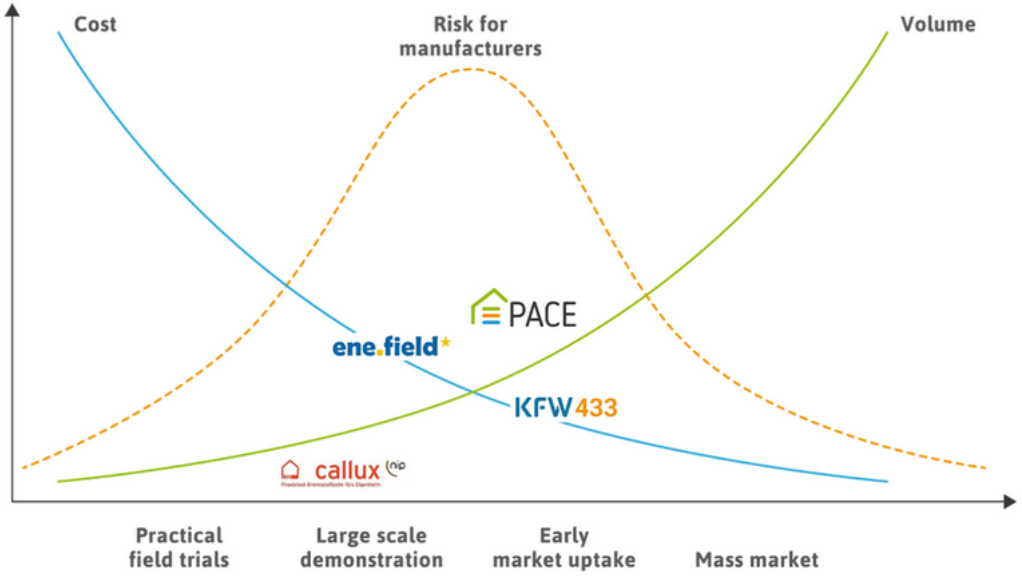
UK Policy Exchange: "*Switching 80% of homes to heat pumps would require an additional **105GWs** of electricity generation **capacity** (an increase of 175% above current peak power demand) as well as significant investment to reinforce the power distribution network.*"

Fuel Cell microCHP can help offset the additional **generation** and **network capacity** requirements if electric heat pump penetration is to significantly increase

Fuel Cell mCHP can be a tool to optimise an energy system with a much higher penetration of renewables coupled with new electrical demand

https://policyexchange.org.uk/publication/too-hot-to-handle/
Too Hot to Handle? How to decarbonise domestic heating
policyexchange.org.uk

Driving the Fuel Cell micro-Cogeneration sector closer to mass market uptake



callux

Callux

- Period: **2008 – 2015**
- Total budget: **€75 million**
- German NIP co-financing: 50%
- **500 systems installed in Germany**
- > 5 million operating hours
- **CO_2 reduction by 30% on average per year**

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- Period: **2012 – 2017**
- Total budget: **€52 million**
- EU co-financing (FCH JU/FP7): 50%
- **> 1,000 systems** installed in **11 European countries**
- > 3 million operating hours so far

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- Period: **2016 – 2021**
- Total budget: **€90 million**
- EU co-financing (FCH JU/Horizon 2020): 37%
- **> 2,500 systems** to be installed in **11 European countries**
- **500 units/manufacturer**

KFW 433

KFW433

- Period: **started in 2016**
- **German NOW NIP grant scheme** administered by KfW bank
- Beneficiaries: **End customers**
- Eligible size: 0.25 kWe – 5 kWe
- Grant value per system: **€5,700 – €28,000**

Fuel Cell micro-Cogeneration units have demonstrated initial technology readiness in previous European and national demonstration projects

Reduce costs and improve competitiveness

Improve products' performance

Establish Fuel-Cell micro-Cogeneration as a standard technology

Raise awareness on Fuel-Cell micro-Cogeneration

Demonstrate product readiness as a key component in the delivery of EU's energy goals

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Pathway to a Competitive European Fuel Cell micro-CHP Market

PROJECT OVERVIEW

PACE project	
Call year	2016
Call topic	Large scale demonstration of µCHP fuel cells
Project dates	01/06/2016 – 28/02/2021
% stage of implementation	30% as of 01/11/2017
Total project budget	EUR 90,307,094.50
FCH JU max. contribution	EUR 33,932,752.75
Other financial contribution:	EUR 56,374,341.75
Partners:	BDR Thermea, Bosch, COGEN Europe, DTU, Element Energy, EWE, SOLIDpower, Viessmann

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Pathway to a Competitive European Fuel Cell micro-CHP Market

PACE at a glance

Promoting a successful transition to the large scale uptake of Fuel Cell micro-Cogeneration across Europe

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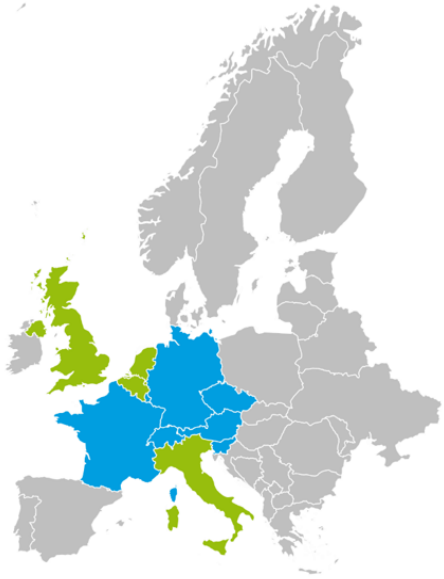
Pathway to a Competitive European Fuel Cell micro-CHP Market



Field trial + installer training + targeted market & policy development activities

Field trial + local installer training

8
Partners
Representing manufacturers, utilities & research community

> 2,500
Fuel Cell micro-Cogeneration units
To be deployed across Europe between 2016-2021

>500
Systems per manufacturer
Established production capacity per manufacturer

10
Countries
Where the units will be installed

4
Countries
Selected for policy & market development (Belgium, Italy, Netherlands and UK)

€90m
Total budget
Including €33.9m Horizon 2020 funding via FCH JU

Coordination & Dissemination Partner: COGEN EUROPE

Manufacturers: SOLID POWER, VIESMANN, BOSCH Invented for life, BDR THERMEA GROUP

Research Partners: elementenergy, DTU

Utility: EWE

>10,000
FC micro-cogeneration units/year post 2020

Policy recommendations for FC m-CHP

- Consumer and energy system benefits of micro-CHP systems should be fully recognised and rewarded by policy at the EU and national levels
- Methodologies in key policy mechanisms (energy labelling, building codes, Covenant of Mayors) should fully reflect the benefits of FC micro-CHP
- Electricity market design should fairly allocate grid charges to micro-CHP, while not forgetting its benefits in terms of reduced grid and generation costs.
- Simplified administrative procedures to access the grid or different support scheme should be introduced for the potential users or FC micro-CHP
- The decarbonisation and flexibility potential of gas networks (renewable gas) with fuel cell micro-CHP should be taken into account, as part of a comprehensive energy and climate strategy

The market uptake of Fuel Cell micro-CHP requires a coherent, steady and predictable policy framework in recognition of the benefits for energy transition

To read all the policy recommendations from the ene.field Final Policy Report, please click on this link: **Fuel Cell micro - CHP in the Context of EU Energy Transition - Policy Analysis & Recommendations**

ene.field & PACE take-home messages

- Fuel cell micro-Cogeneration is **reliable**, it **works** and is now **available** in key European markets.

- Major European manufacturers, supported by the Fuel Cell & Hydrogen Joint Undertaking at the EU level and key European national governments, are now committed to **bringing the technology closer to mass market by increasing scale and achieving further product cost reductions.**

- Experience from **Japan**, i.e. Ene-Farm programme, shows that significant cost reduction of fuel cell micro-CHP is possible, as over 7 years (2009-2016) **the Ene-Farm project triggered fuel cell micro-CHP cost reduction by more than 50%.**

- ene.field environmental and economic assessments have highlighted **clear benefits of fuel cell micro-Cogeneration for EU climate and energy objectives.**

- It is key to put in place the **right policy framework** to encourage wide deployment of this technology in Europe.

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Thank You!

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