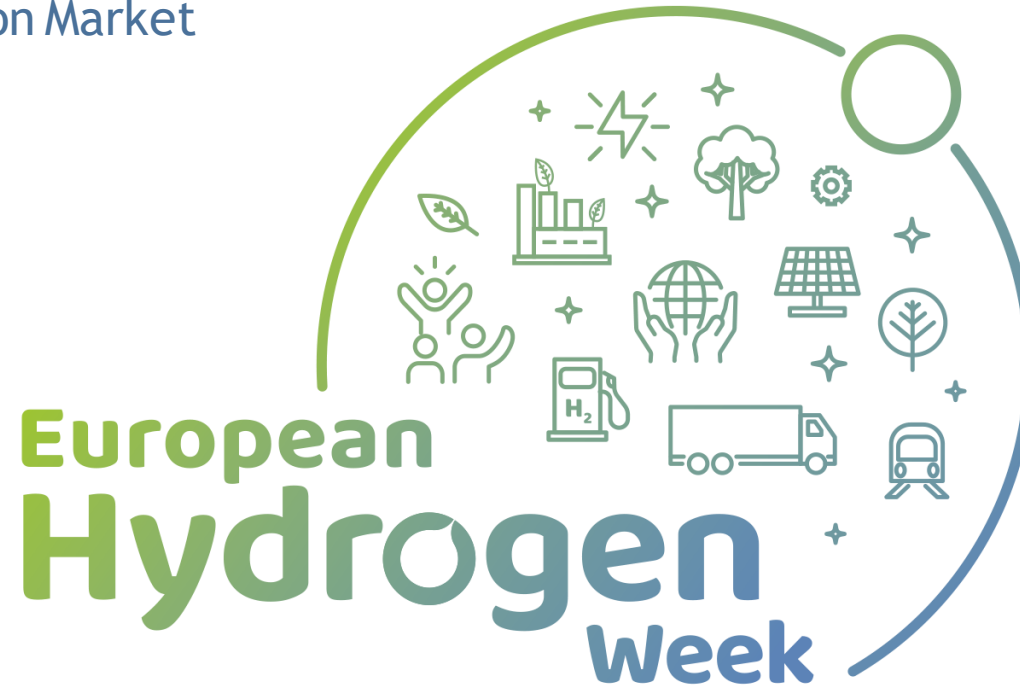


# PACE

Pathway to a Competitive European  
Fuel Cell micro-Cogeneration Market



Pathway to a Competitive European  
Fuel Cell micro-CHP Market

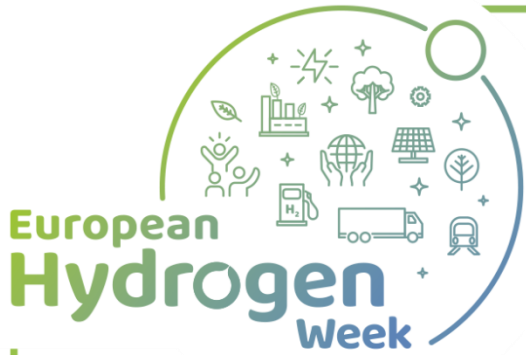


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[info@pace-energy.eu](mailto:info@pace-energy.eu)

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# What and why fuel cell micro-cogeneration?

## Heating and Powering your home



Empowers consumers



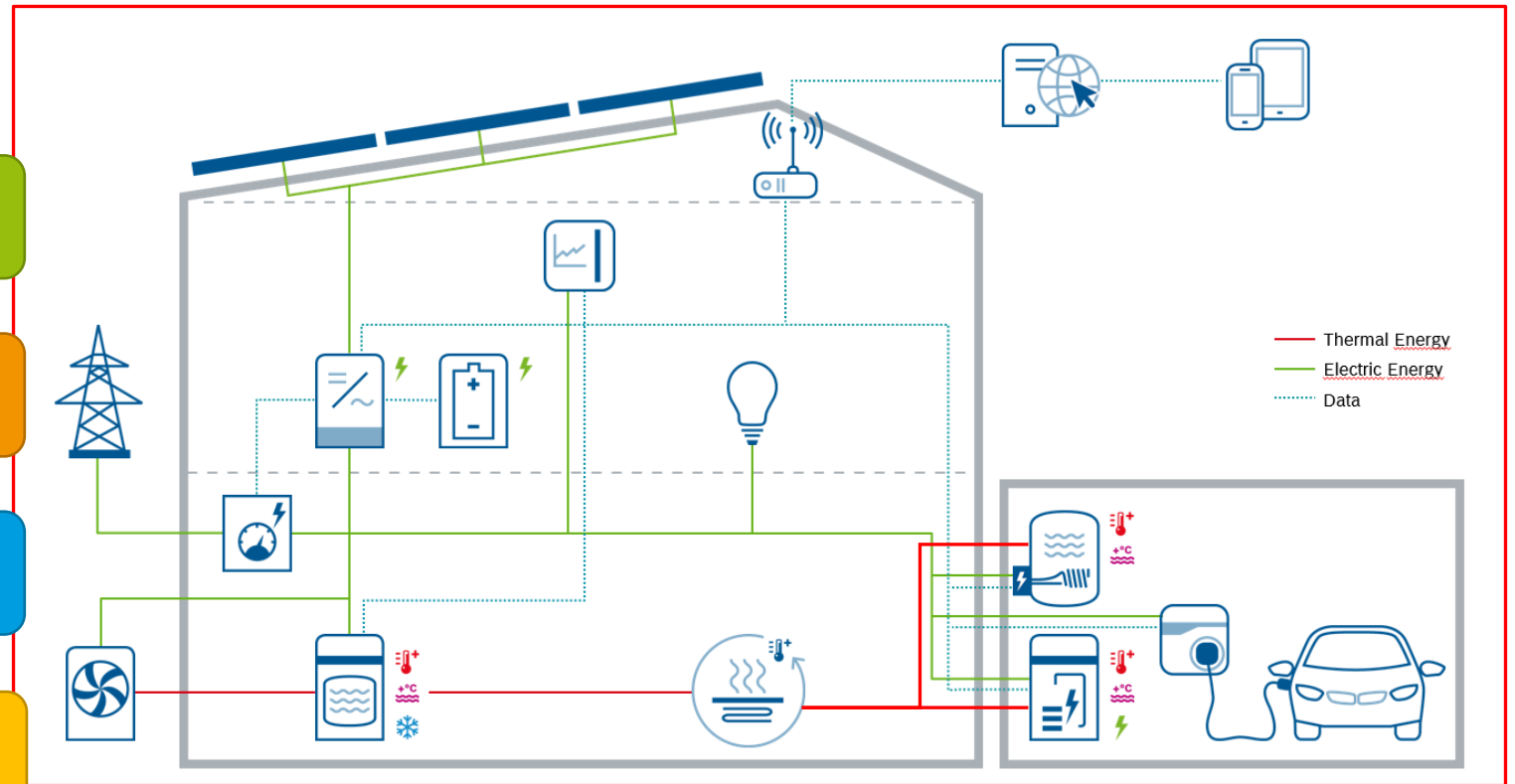
Supports the European energy transition

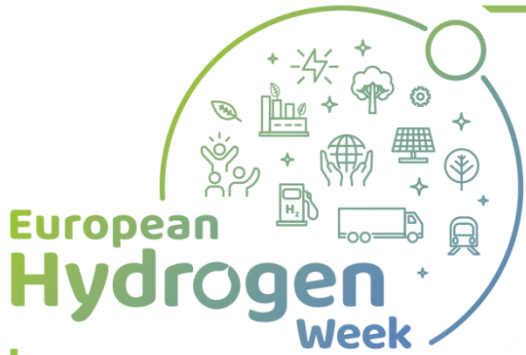


Provides greater flexibility for the energy system



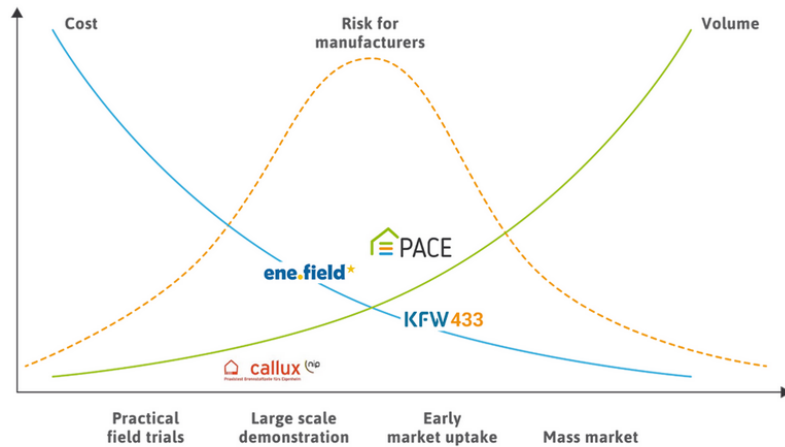
Fosters innovation and high-value jobs





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

How to overcome the point of greatest risk in new product commercialisation?



<p><b>Callux</b></p> <ul style="list-style-type: none"> <li>• Period: 2008 – 2015</li> <li>• Total budget: €75 million</li> <li>• German NIP co-financing: 50%</li> <li>• 500 systems installed in Germany</li> <li>• &gt; 5 million operating hours</li> <li>• CO<sub>2</sub> reduction by 30% on average per year</li> </ul>	<p><b>ene.field</b></p> <ul style="list-style-type: none"> <li>• Period: 2012 – 2017</li> <li>• Total budget: €52 million</li> <li>• EU co-financing (FCH JU/FP7): 50%</li> <li>• &gt; 1,000 systems installed in 11 European countries</li> <li>• &gt; 3 million operating hours so far</li> </ul>	<p><b>PACE</b></p> <ul style="list-style-type: none"> <li>• Period: 2016 – 2021</li> <li>• Total budget: €90 million</li> <li>• EU co-financing (FCH JU/Horizon 2020): 37%</li> <li>• &gt; 2,500 systems to be installed in 11 European countries</li> <li>• 500 units/manufacture</li> </ul>	<p><b>KFW433</b></p> <ul style="list-style-type: none"> <li>• Period: started in 2016</li> <li>• German NOW NIP grant scheme administered by KfW bank</li> <li>• Beneficiaries: End customers</li> <li>• Eligible size: 0.25 kW<sub>e</sub> – 5 kW<sub>e</sub></li> <li>• Grant value per system: €5,700 – €28,000</li> </ul>
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Reduce costs and improve competitiveness

Improve products' performance

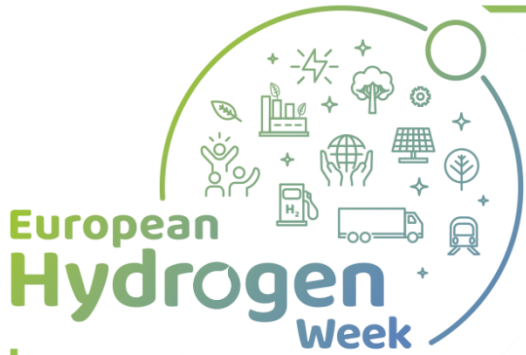
Establish Fuel-Cell micro-Cogeneration as a standard technology

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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- Call year: 2016
- Call topic: Large scale demonstration of  $\mu$ CHP fuel cells
- Project dates: 01/06/2016 - 30/06/2022
- 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, HSLU, SOLIDpower, Sunfire, Viessmann, Hexis

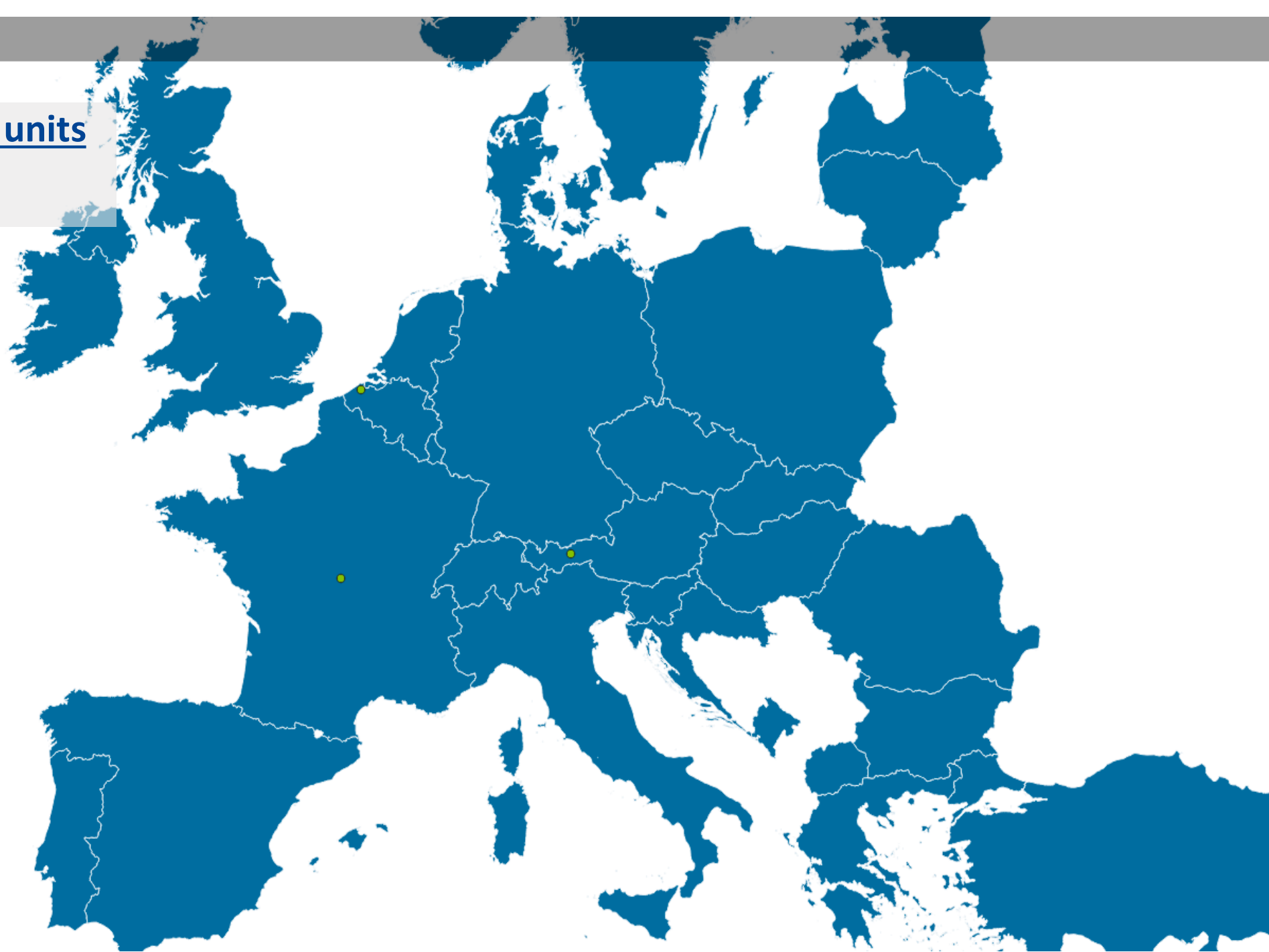


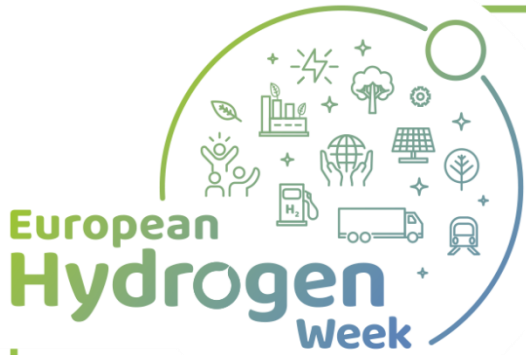
# Overview of FC micro-CHP systems in PACE

Buderus: Logapower FC10.2	Buderus: System Logaplus	BlueGEN	BlueGEN BG15	Dachs 0.8	eLecta	Vitovalor 300- P, PA2 and SA2	Sunfire-Home 750
100	200	750		200	300	>750	500
SOFC	SOFC	SOFC	SOFC	PEM	PEM	PEM & SOFC	SOFC
0.7kW	1.5kW	1.5kW	1.5kW	0.75kW	0.75kW	0.75kW	0.75kW
1-2 family homes (up to end 2018)	1-2 family homes, residential buildings and SMEs with high electricity demand	SMEs, apartment buildings and multifamily homes		1-2 family houses (for new and existing buildings)		Domestic and small commercial	Residential building (with LPG supply)

Number of installed PACE units

- 1998, October 2021



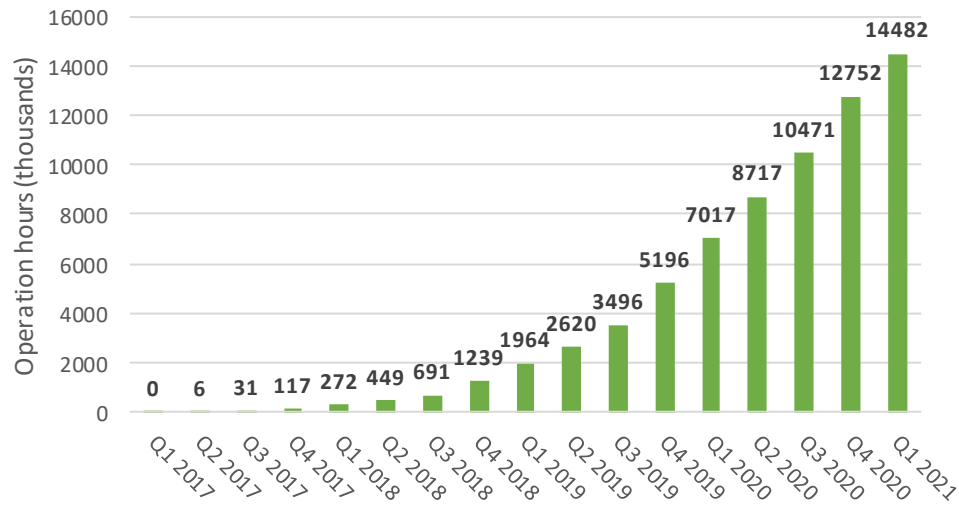


# Data collection



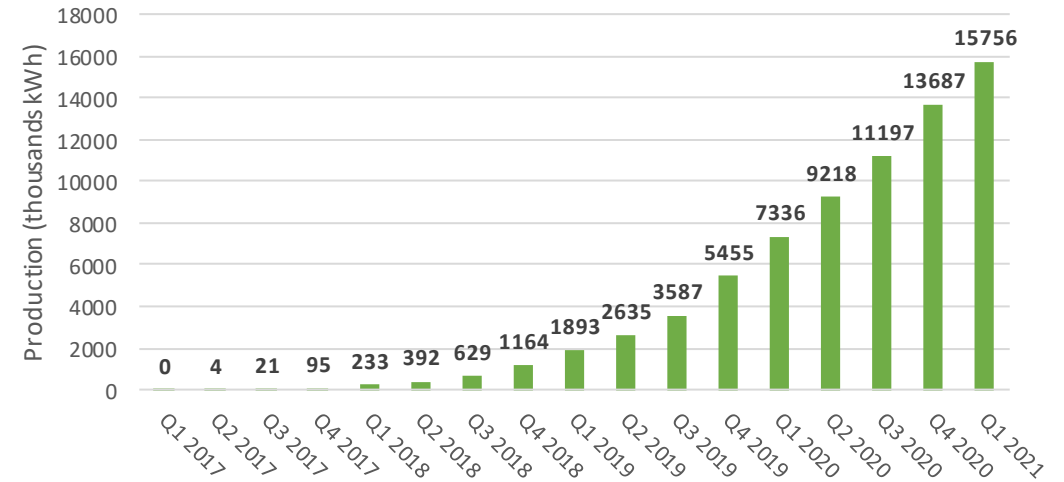
Number of units	Total operating hours	Total kWh produced	Efficiency (gas to power utilisation)	Availability
<b>1849</b>	<b>14.481.826</b>	<b>15.756.048</b>	<b>35-60%</b>	<b>97 -99%</b>

Hours in operation (cumulative)



Electricity produced (cumulative)

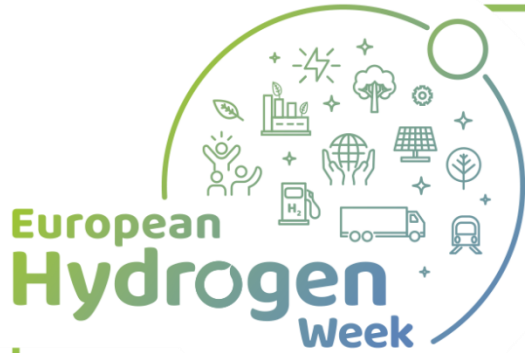
(as of April 2021)



Source: PACE D2.7. – 2nd report on performance validation of units installed

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# D1.11 - Report from Regulatory Barriers Group

A Regulatory Barriers Working Group was created within the PACE project to identify key barriers to the promotion of FC mCHP technology in Europe and to propose solutions. Below are the 5 key pillars and the main regulatory barriers within these.

## Financial Incentives



- No common subsidy scheme across Europe
- FC mCHP technology is not considered eligible for existing subsidy schemes

## Electricity Tariffs



- Different incentives exist in different countries
- Process for reaching an agreement to export electricity is long and arduous

## Grid Connection



- The process for connecting units to the grid needs to be simplified
- Evolving grid codes impacts confidence in the market

## Building Standards



- The potential to operate on green gases is unrecognised
- Units are often unfairly penalised in regulations

## Customer Information



- Penalisation of the technology in unit labelling regulation
- Regulation fails to recognise their energy efficiency

### Key Recommendations:

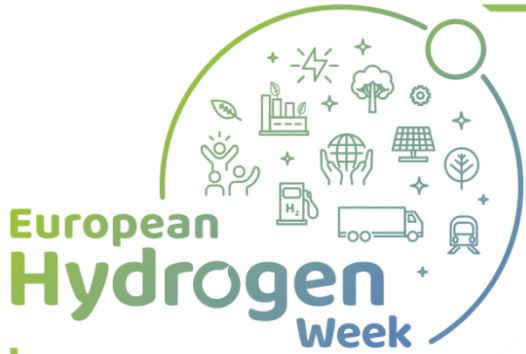
- A standardisation of regulation across Europe is essential to overcome barriers across all five pillars
- Communication between states and the sharing of best practice examples will help to simplify the process for potential customers
- Engaging potential customers and highlighting the advantages of this technology will help to encourage confidence in the market while regulations are being updated



# WP4 - Scope and context

## The challenge

- Identify additional income streams from the participation of mCHP in grid service markets – take advantage of **mCHP flexibility**
- ‘Grid services’ analysis covered traditional markets (e.g. frequency balancing) and emerging markets (e.g. congestion)
- Also analyse hurdles, opportunities, readiness: develop roadmap and recommendations
- **Approach:** Model-based optimisation taking into account thermal storage, building thermal inertia, electricity demand, heat demand; literature review; interviews
- **Considered:** Mix of Member States and regimes (e.g. Eastern & Western Europe, spark spreads, generation mix)



# WP4 - Results in 2021

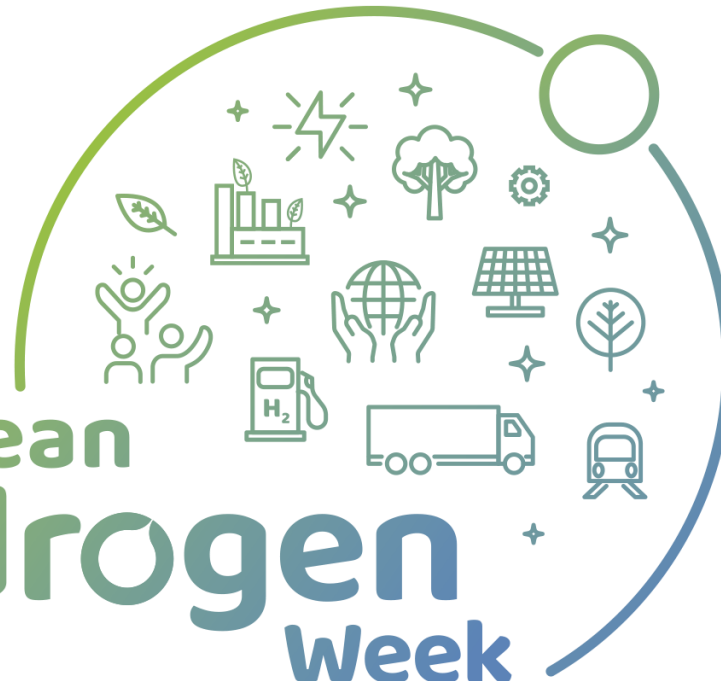
## Headlines

- The greatest opportunity comes from **maximising self consumption** – up to 2'239 Eur/year for three family house
- **Up to 301 Eur/year** as additional income from **frequency balancing**
- **Grid reinforcement avoidance** from demand-side flexibility benefit of up to **500 Eur/kW**
- Widespread **realisation in 5-8** years with no intervention
- Aggregation of > **1000 units required** to make business case for small scale flexibility
- Integration in **HEMS is best option**
- Single biggest **hurdle** for mCHP is **cost-benefit** for capex vs revenue per unit of flexibility

# Optional extra / backup slide

Del.	Status	Achievements in 2021
D4.3	Complete	<p>Economic value of FC mCHP participation in power and grid service markets</p> <ul style="list-style-type: none"> <li>• Completed economic value analysis for three countries</li> <li>• Considered grid services and avoidance of grid extensions</li> <li>• Examined legal and commercial hurdles to participation in grid service markets</li> </ul>
D4.6	Final draft	<p>Roadmap to capitalize and move further the potential of FC mCHP for demand response as part of a VPP</p> <ul style="list-style-type: none"> <li>• Analysed OEM and aggregator perspectives</li> <li>• Proposed generic steps for improving mCHP participation in grid service markets</li> </ul>
D4.5	Complete	<p>European Grid Service Markets Symposium</p> <ul style="list-style-type: none"> <li>• Symposia in 2019 and 2020 were in scope of WP4</li> <li>• However, symposium was also held in 2021, creating an opportunity for further networking / dissemination on PACE</li> </ul>

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