# IPHE Workshop: Energy and Transportation Systems – A 2020 Perspective

## Role, benefits and market potentials of stationary fuel cells in Europe's changing energy landscape

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## Advancing Europe's energy systems: Stationary fuel cells in distributed generation

A Study for the Fuel Cells and Hydrogen Joint Undertaking (FCH JU)

# Mandated by the FCH JU, the study explores paths to broader commercialisation of stationary fuel cells in Europe

## Background and objectives of the study

### Background

> Sponsored by the **Fuel Cells and Hydrogen Joint Undertaking** (FCH JU)[1)]

> Developed by Roland Berger Strategy Consultants together with **a coalition of more than 30 stakeholders** of the stationary fuel cell industry

### Objectives

> Establish a common view on future **market potential of fuel cell distributed generation**

> **Understand various technologies, potential applications, prospects and business opportunities** in light of macroeconomic scenarios

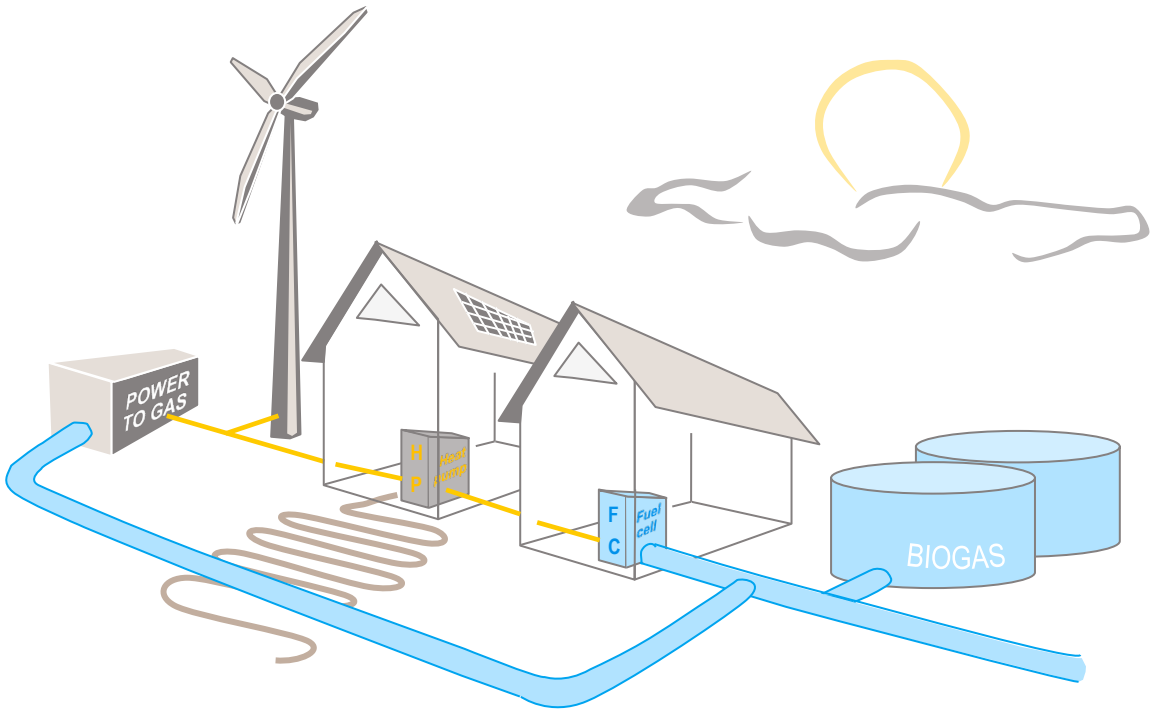
> **Document and disseminate findings of the study** to opinion leaders and decision makers in industry and policy community

1) A public private partnership between the European Commission, the fuel cell and hydrogen industry and a number of research bodies

Source: FCH JU Coalition, Roland Berger

# Fuel cells are the highly efficient and complementary choice to future energy systems based on more and more renewables

## European vision for stationary fuel cells




### Fuel cell vision

> Highly efficient conversion of natural gas (and eventually green gas or pure hydrogen)

> In distributed generation, i.e. at the site of consumption

> Lowering the carbon footprint of energy supply

> Playing a complementary role to renewables[1)]

1) E.g. Stationary fuel cells as operating reserve with good performance at partial loads, complementary cycles of heat-driven CHP with electric heating demand

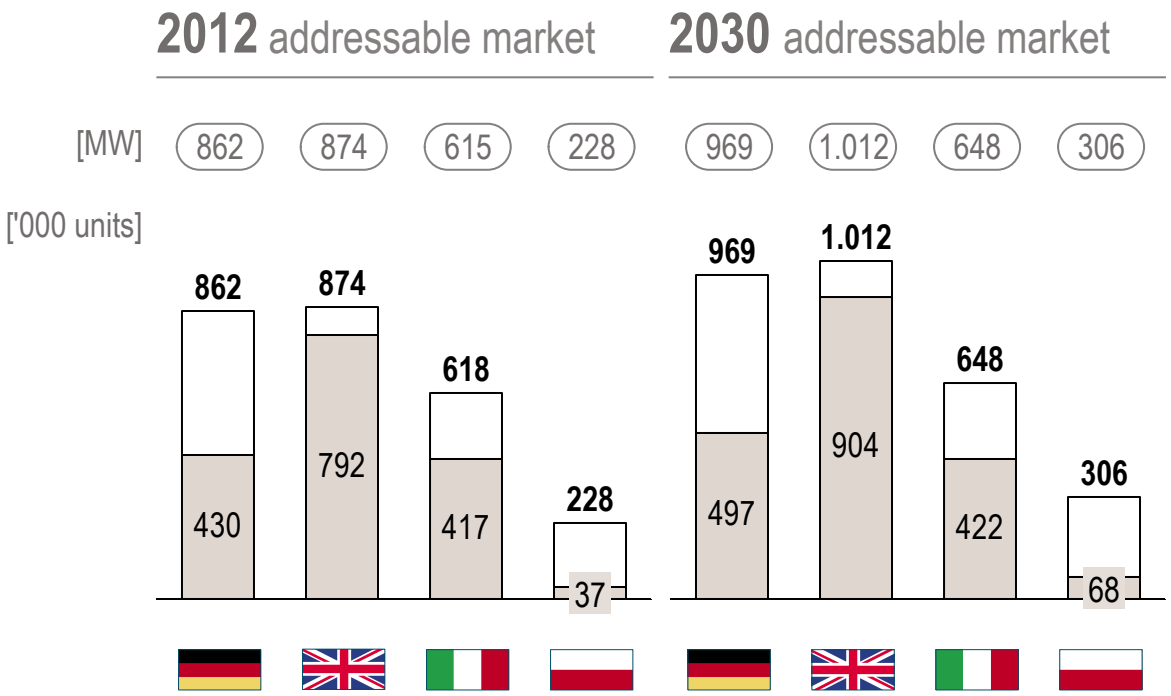
Source: FCH JU Coalition, Roland Berger

# In the residential segment, fuel cell mCHPs can tap a mass-market of more than 2.5 m units annually in core European countries

## Overview of annually addressable market in four focus countries

### Residential

- **Integrated fuel cell mCHPs** for the heating market
- **Primary markets** include all dwellings with gas heating
- **Conversion markets** comprise buildings with non-gas technologies
- **New installations and replacements** drive volume[1)]




Conversion markets [installable capacity] Primary markets [same as conversion] Primary and conversion markets [installable capacity]

1) As another type of fuel cell systems, add-on mCHPs for base-load power target all buildings with access to gas, irrespective of replacement cycles.

Source: IHS; National statistics institutes; Shell; Roland Berger

# In industrial distributed generation, fuel cells can tap a gas-fired installed capacity of more than 2.4 GW in core EU markets

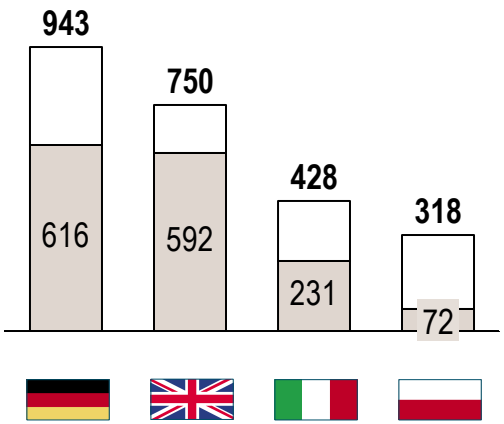
## Overview of annually addressable market in four focus countries

### Industrial

- **Fuel cell CHPs and prime power** in power ranges above 400 $kW_{el}$ for industrial applications
- **Primary markets** include gas-fired distributed generation
- **Conversion markets** comprise non-gas distributed generation
- Forecast based on expected market growth

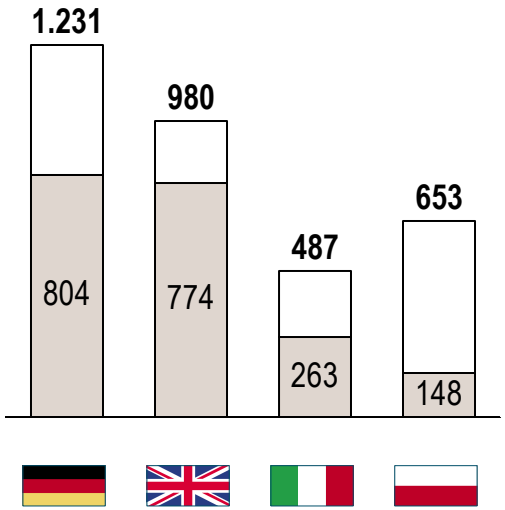
**2012** addressable market[1)]

[MW]




**2030** addressable market[1)]

[MW]



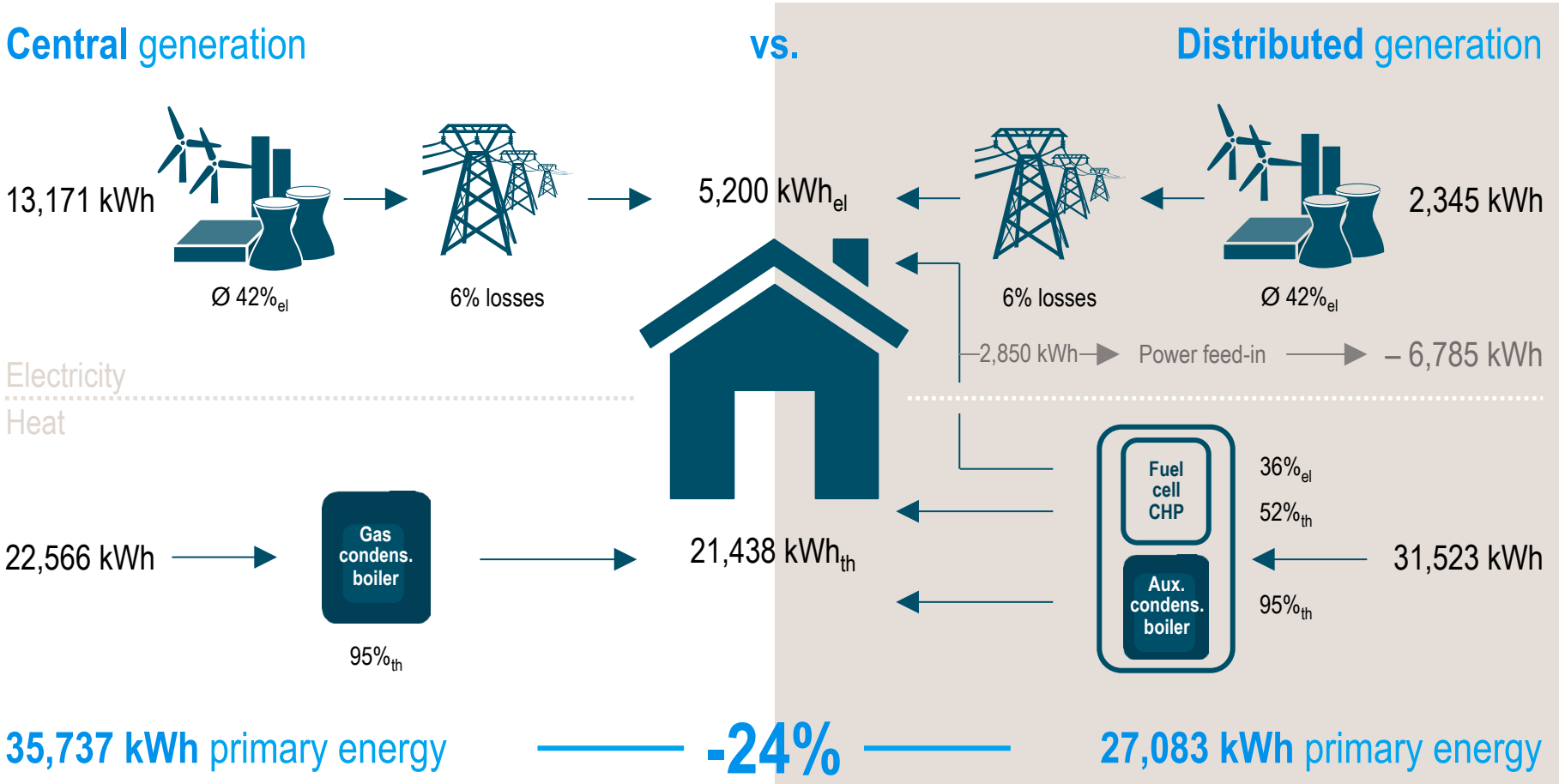

Conversion markets [installable capacity] Primary markets [same as conversion]

1) Addressable market derived from installed distributed capacities

Source: IHS; National statistics institutes; Oxford Economics; Roland Berger

# Typically, distributed CHP is more efficient than central generation due to superior technologies and avoidance of transmission losses

## Comparison of central and distributed generation in terms of energy efficiency[1)]

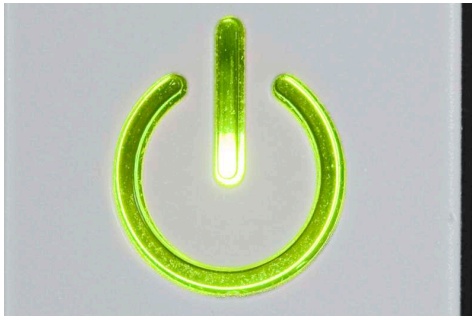



1) Exemplary case of a German, partially renovated 1/2-family dwelling in current conditions (2014), total-balance or power-credit methodology

Source: FCH JU Coalition, Roland Berger

# However, to become economically competitive, capital costs must be reduced substantially by increasing production volumes

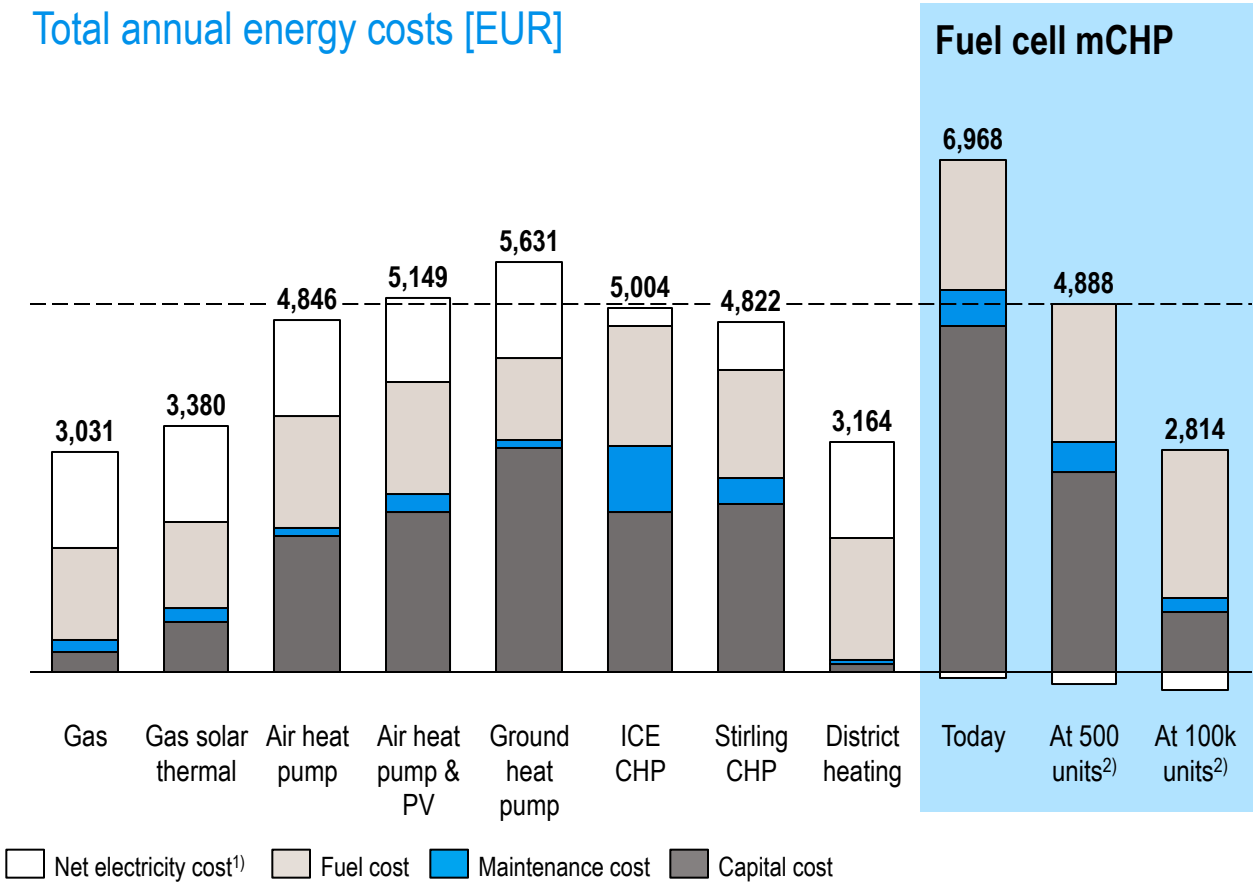
## Use-case specific economic benchmarking



**MUNICH**

**Fuel cell micro-CHP system**

| | |
|---|---|
| Electric capacity | 1 $kW_{el}$ |
| Thermal capacity | 1.45 $kW_{th}$ |
| Electric efficiency | 36% |
| Thermal efficiency | 52% |
| System lifetime | 15 years |
| Required stack replacements | 2 |




1) Negative electricity cost reflect higher earnings from power feed-in than residual purchase of grid power. 2) Cumulative production volume per company.

Source: FCH JU Coalition, Roland Berger

# To enable conducive policy framework, industry must take the lead – Policy commitment subject to specific targets that need to be met

## General recommendation and support framework

### Fuel cell industry

> Commit to and deliver **cost degression targets…**

> Commit to and demonstrate **further quality improvement…**

> **Deliver on ongoing field tests** and demonstration projects

**… to sustain/reach market readiness**

### Policy makers

> Commit to **CHP in general and fuel cells in particular…**

> Commit to **establish larger scale diffusion…**

> Commit to **establish support mechanisms…**

**… to enable industry actions**

> **Lead** has to be set **at industry level**, i.e. industry takes action and policy makers set up a framework

> **Policy commitment is subject to industry commitment**, i.e. industry targets must be reached

> If selected **industry segments cannot meet targets policy support will not continue**

> Industry targets are set as **target cost/price, target quality, target efficiency/durability at number of produced systems** or units, i.e. at company level system cost are decreased by 40% when 500 systems are brought to the market

Source: FCH JU Coalition, Roland Berger

# European Roadmap for residential mCHP fuel cells

| Phase | Practical field trials | Large scale demonstration | Market uptake | Mass market |
|---|---|---|---|---|
| Examples | Callux, ene.field, FuelCell@Home, Danish Fuel Cell Programme, etc. | PACE | Incentive schemes of EU member states | Full competitive without any funding |
| What to do? | Complete and succeed! | Further cost reduction and improvements | Industrial ramp up | |
| | | Develop market frame conditions | | |

Volumes

**Roadmap for residential segment: large scale demonstration and development of markets in parallel**