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Praxistest Brennstoffzelle fürs Eigenheim

# The German NIP lighthouse project callux

## *Field Test of Residential Fuel Cells*

4th IPHE Workshop – Stationary FC
Tokyo, 1st March 2011

Dr. Stephan Ramesohl
E.ON Ruhrgas AG
Head of *callux* project steering committee

# Where it all began ….


Federal Minister Tiefensee and representatives of the companies involved started the project at the Federal Ministry of Transport, Building and Urban Affairs on 23 September 2008.

# Project goals

**Prepare the market launch of gas-driven fuel cell heating appliances by**

- Demonstrating technical maturity, support further improvements to ensure marketable products
- Developing supply chains by winning binding orders for large numbers
- Enhancing product profile on the market
- Continuing work on concepts for supply structure integration
- Supporting training / further training of market partners
- Validating requirements against customers and the market
- Promoting the creation of industrial added value in Germany

# *callux* project partners

**Energy suppliers**

EnBW, E.ON Ruhrgas, EWE, MVV Energie, VNG

- have been installing and operating fuel cell heating appliances for years;
- have jointly gathered experience from installation and operation of approx. 100 fuel cell heating appliances.

# *callux* project partners

**Manufacturers**

Baxi Innotech, Hexis, Vaillant

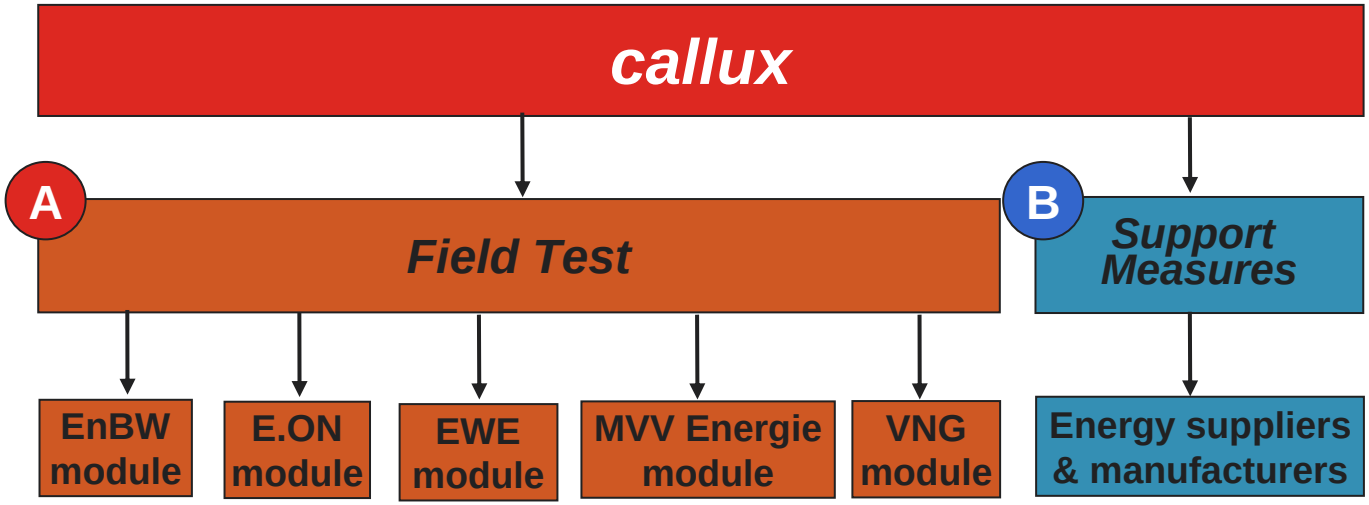
- have the know-how in Germany for the development of fuel cell heating appliances;
- based on PEM and SOFC technology (1 kWe);
- have several years of experience from operation of far more than 100 appliances.

**Project coordinator**

Zentrum für Sonnenenergie- und Wasserstoff-Forschung

- has comprehensive experience with the handling and implementation of funded projects.

# Project structure




Separate organisational structures have been set up for the joint *Field Test* and *Support Measures* projects.

# A Field test

- The field test is being carried out primarily at private (single family) homes in selected regions of Germany.
- The energy suppliers buy, install and operate the fuel cell heating appliances independently of each other.
- The field test consists of three phases; for each phase, a final assessment report has to be prepared.
- Specific target values have been specified for the field test; the target values are identical for all manufacturers.

# B Support measures

**Work package 1: market partners**

- Develop a training module to establish a specific qualification for the trades involved

**Work package 2: market research**

- Analyse requirement profiles and market entry barriers

**Work package 3: infrastructure**

- Develop a standardised interface for data transfer between fuel cell heating appliances and energy management systems

# Support measures

**Work package 4: communication**

- Ensure the project partners communicate comprehensively and beyond specific project modules or work packages

**Work package 5: scientific support**

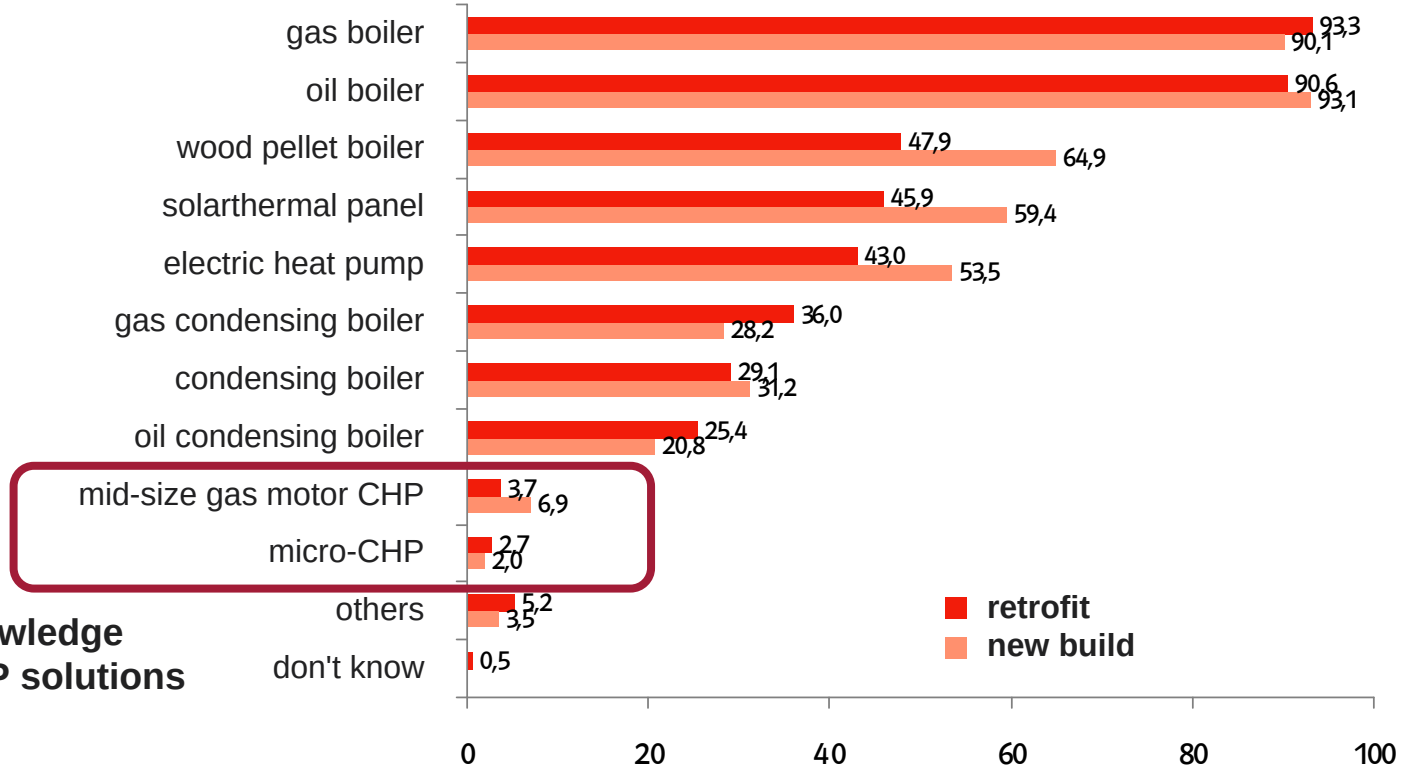
- Investigate joint scientific questions affecting test implementation and evaluation

**Work package 6: project coordination**

- ZSW as the project coordinator to provide support to the project partners

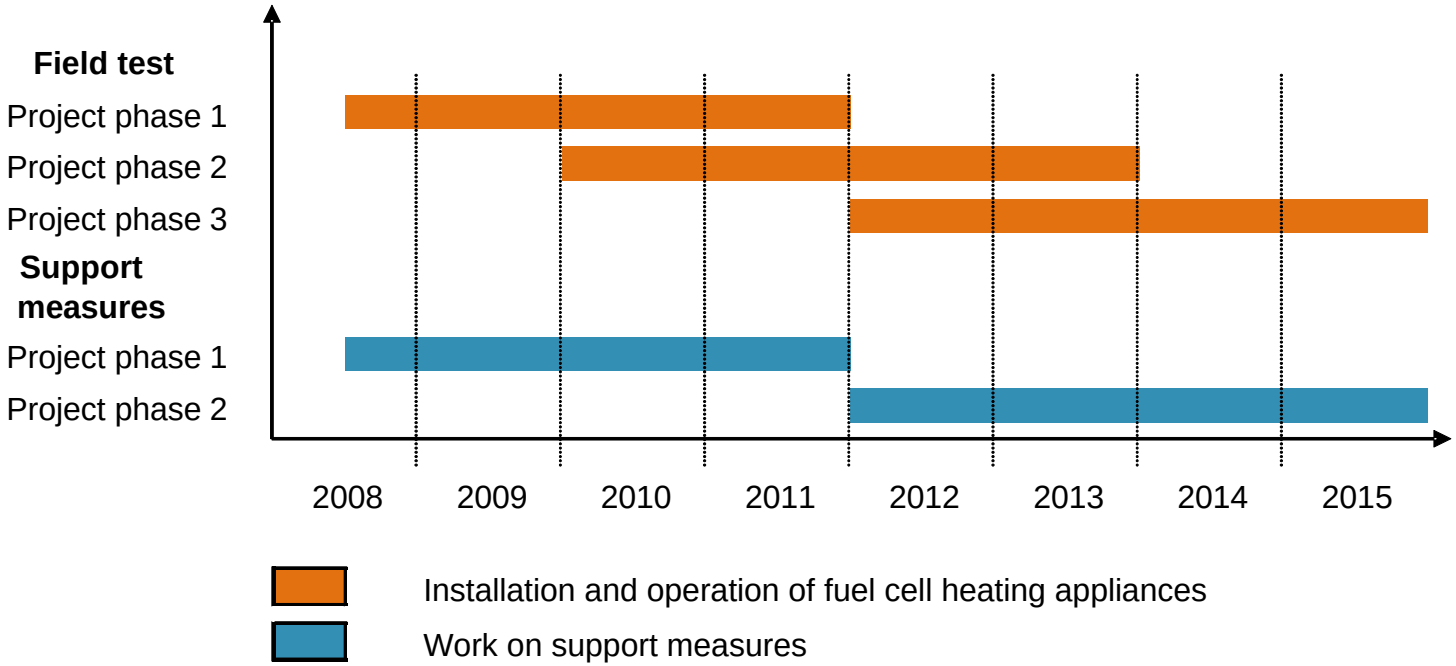
# Support measures – trying to understand the customer

**Share of knowledge of German house owners concerning heating technologies**

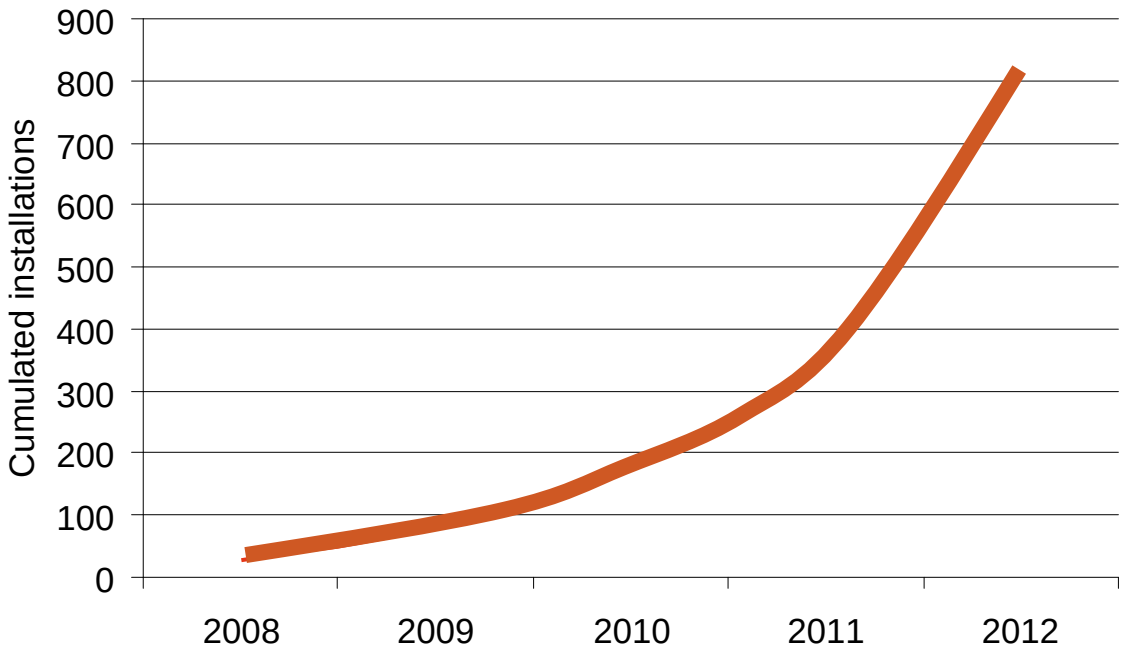



**insufficient knowledge on efficient CHP solutions**

# Project timeline

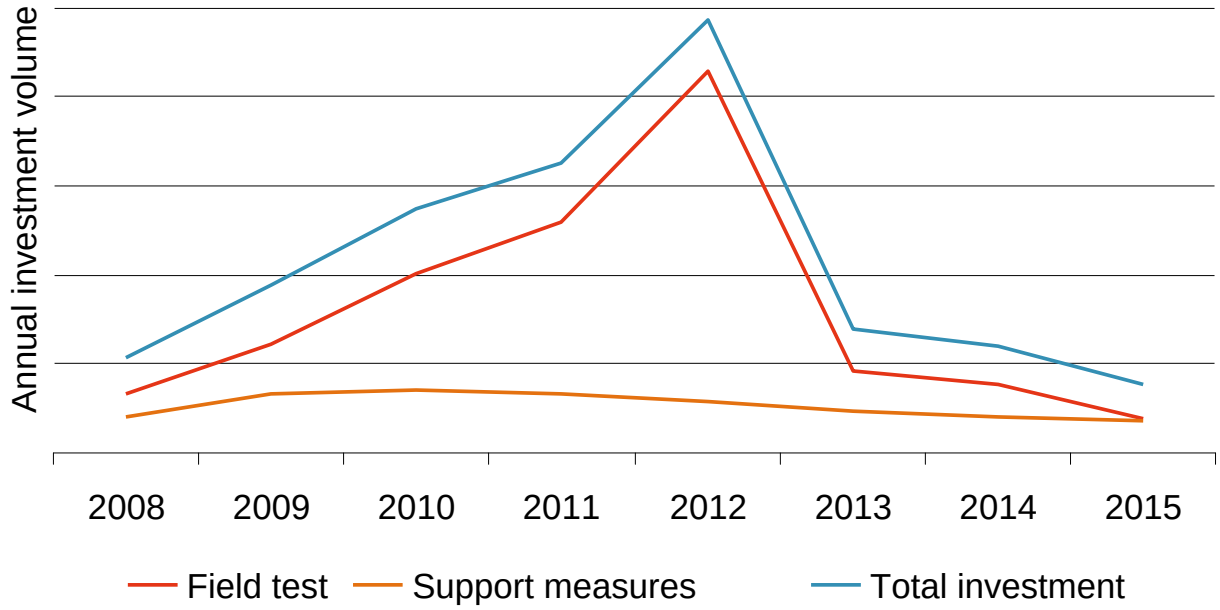


# Planned numbers of appliances



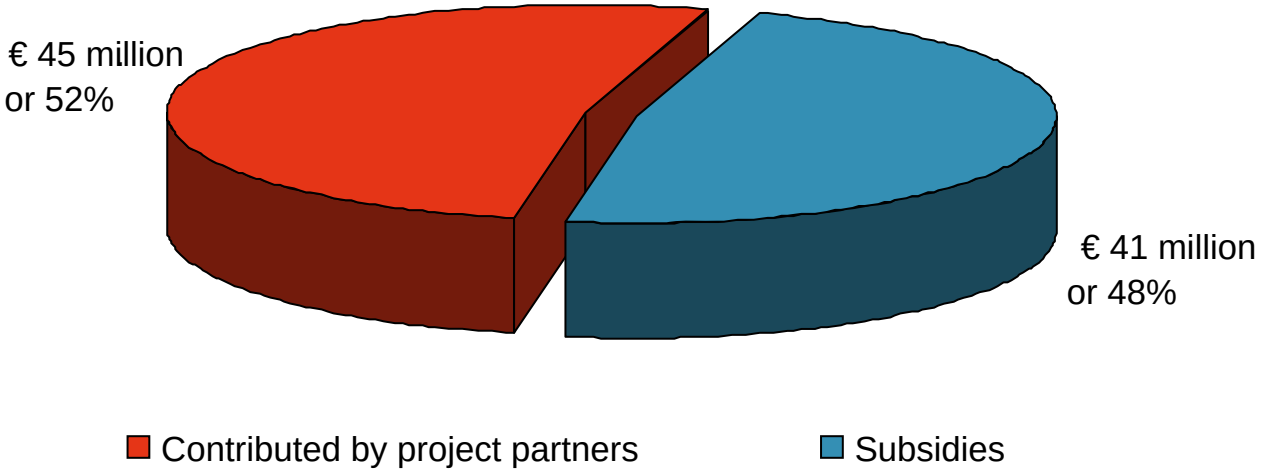

Approx. 800 fuel cell heating appliances are to be installed under the *callux* field test by 2012 and to be operated in some cases until 2015.

# Investments




The investments will be made over the entire project term depending on the number of fuel cell heating appliances to be installed.

# Project financing




*Callux* has a total investment volume of more than €80 million, of which 52% are contributed by the project partners.

# Baxi Innotech fuel cell heating appliance: GAMMA 1.0


**CHP section**

| | |
|---|---|
| Type | low-temperature PEM fuel cell (70°C) |
| Performance (e/th) [1)] | max. 1.0 kWe/1.7 kWth |
| Modulation range | approx. 100 – 30% PeN |
| Fuel | natural gas, biomethane |
| Electrical efficiency (NCV) | 32% |
| Total CHP efficiency | > 83% |

**Integrated auxiliary boiler**

| | |
|---|---|
| Type | condensing boiler |
| Performance | 3.5-15 kW or 3.5-20 kW |
| Efficiency | 109% ($\eta$N at 40/30°C) |

**Complete system:**

| | |
|---|---|
| Total efficiency | > 95% (to EN 50465 with 60/40°C flow/return) |
| Dimensions (mm) | 600 long x 600 wide x 1,600 high |
| Weight | approx. 230 kg |
| Housing | painted, fully insulated |
| Natural gas pressure | 20/25 mbar (EN 437) |
| Electrical connection | 230 V/50 Hz |
| Operating mode | power-controlled, heat-controlled, energy manager-controlled; central control (virtual power station) |

[1)] group H-gas

# Hexis fuel cell heating appliance: Galileo 1000 N


**CHP section**

| | |
|---|---|
| Type | solid oxide fuel cell (SOFC) |
| Power (e/th) [1)] | max. 1.0 kWe/2.0 kWth |
| Modulation range | 100-50 % |
| Fuel | natural gas, biomethane |
| electrical efficiency (NCV) | > 30% |
| Total CHP efficiency | > 90% |

**Integrated auxiliary boiler**

| | |
|---|---|
| Type | condensing unit |
| Performance | 4-20 kW |
| Efficiency | 109% ($\eta$N at 40/30°C) |

**Complete system:**

| | |
|---|---|
| Total efficiency | > 95% (to EN 50465 at 60/40°C flow/return) |
| Size (mm) | 550 long x 550 wide x 1,600 high |
| Weight | approx. 170 kg |
| Housing | painted, fully isolated |
| Natural gas pressure | 20-25 mbar (EN 437) |
| Electrical connection | 230 V/50 Hz |
| Operating mode | heat-controlled, energy manager-controlled; remote control also possible |

[1)] group H-gas

# Fuel Cell Heating Appliance of Vaillant:

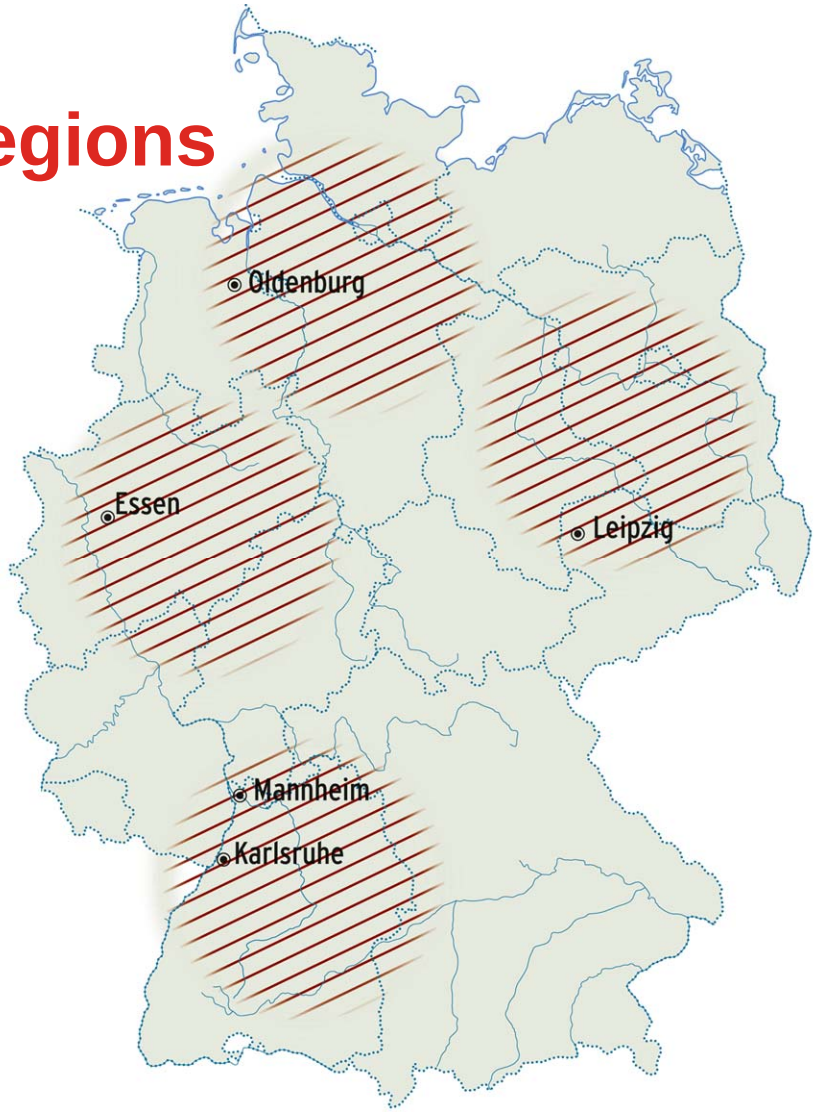

| | |
|---|---|
| **CHP** | |
| Type | solid Oxide Fuel Cell (SOFC) |
| Power output (el/th) [1)] | max. 1,0 kWel / 2,0 kWth |
| Area of application | single family home |
| fuel | natural gas, biomethane |
| el. efficiency (Hu) | 30% |
| Total efficiency CHP | 80 – 90% % |
| **External peak heater** | |
| Type | condensing boiler |
| Power output | flexible according to demand |
| Degree of utilisation | 109% ( $\eta$N at 40/30°C) |
| **Total Appliance:** | |
| Size (mm), LxBxH | 800 x 600 x 1240 |
| weight | ca. 150 kg |
| casing | coated, fully enclosed |
| Natural gas pressure | 20-25 mbar (EN 437) |
| Electrical connection | 230 V/ 50 Hz |
| Operating mode | heat-controlled, energy manager-controlled, control as well by remote access |

[1)] Type H-Gas

# Focus on four regions

**Regional focus areas have been formed in**

- Lower Saxony / Hamburg
- North Rhine Westphalia
- Baden-Württemberg
- Brandenburg / Saxony



# Selection of test sites

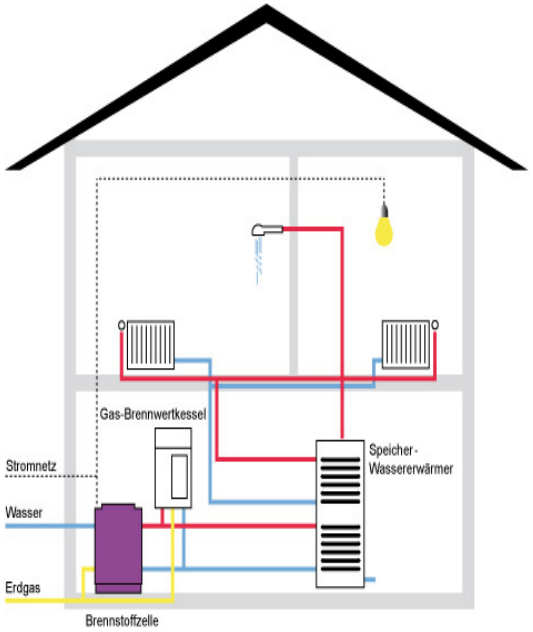



figure: www.initiative-brennstoffzelle.de

**Residential fuel cell heating appliances**

- may be used in single- and multi-family homes;
- may replace existing heating systems;
- are very energy-saving and have low emissions.

**Preconditions for operation are**

- a minimum heat requirement of the building (space heating, hot water production);
- connection to natural gas and power grids.

# Examples

Single-family home in Ötisheim
(Baden-Württemberg)

Day-care facility in Oberderdingen
(Baden-Württemberg)

# Examples

Single-family home in Mannheim
(Baden-Württemberg)

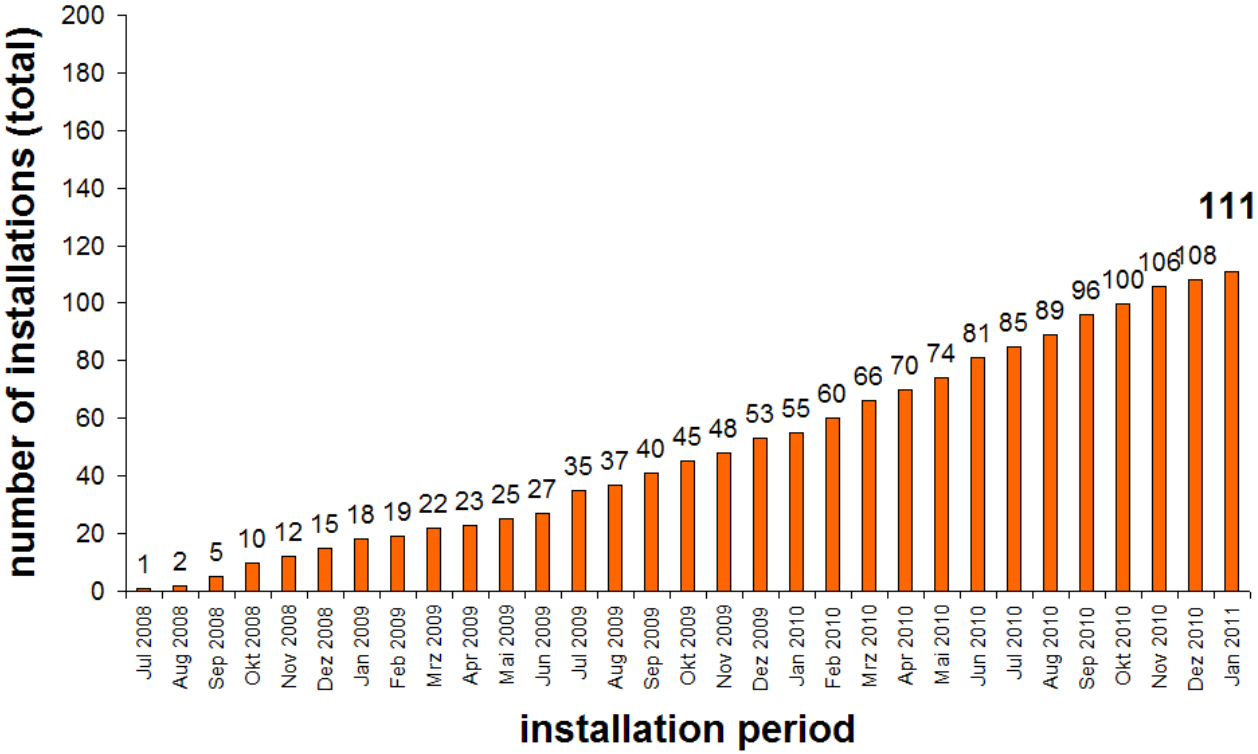
Single-family home in Müncheberg
(Brandenburg)

# Examples

Single-family home in Westoverledingen
(Lower Saxony)

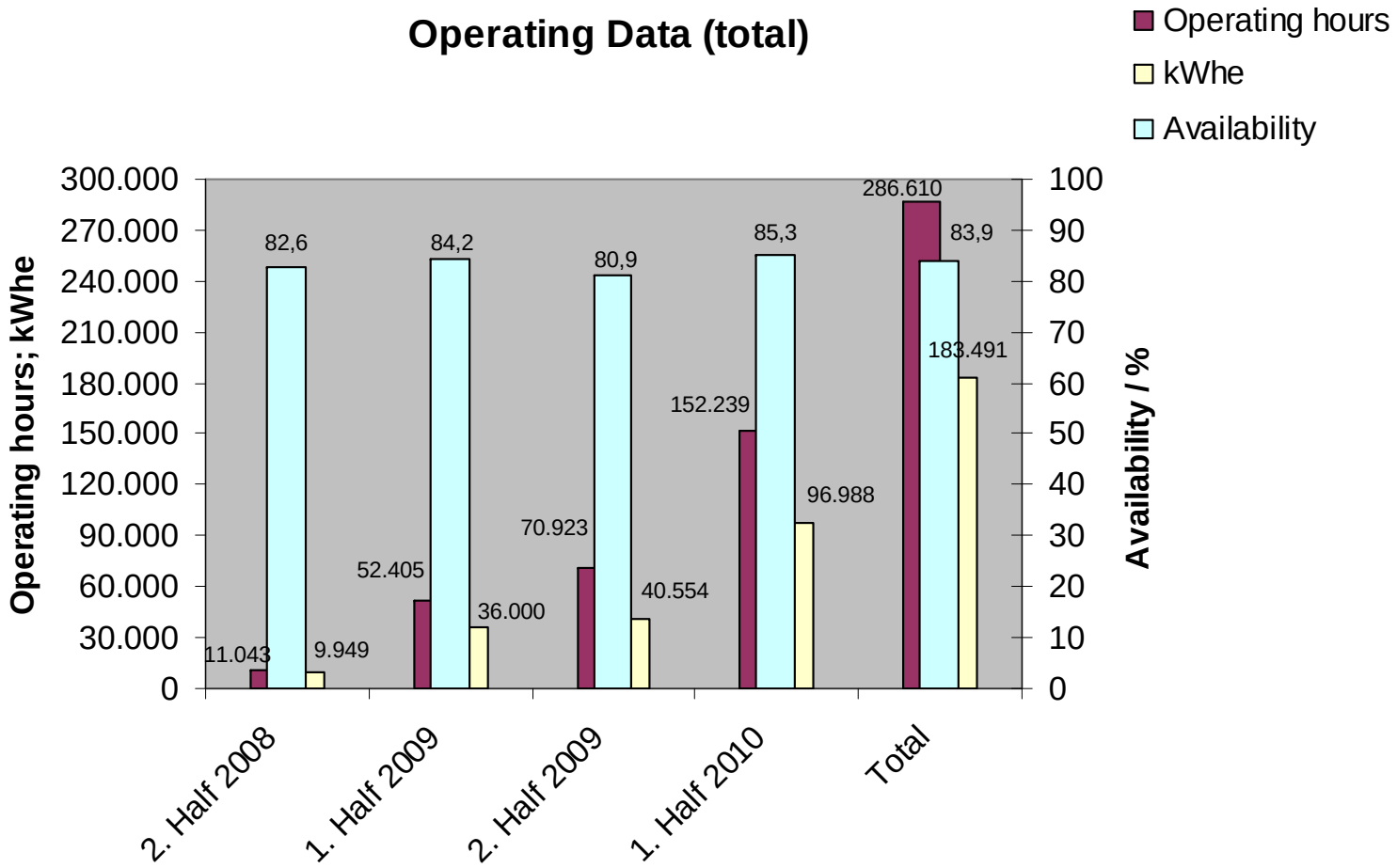
Single-family home in Oldenburg
(Lower Saxony)

# Public Fleet Report - Fleet Stock (total)

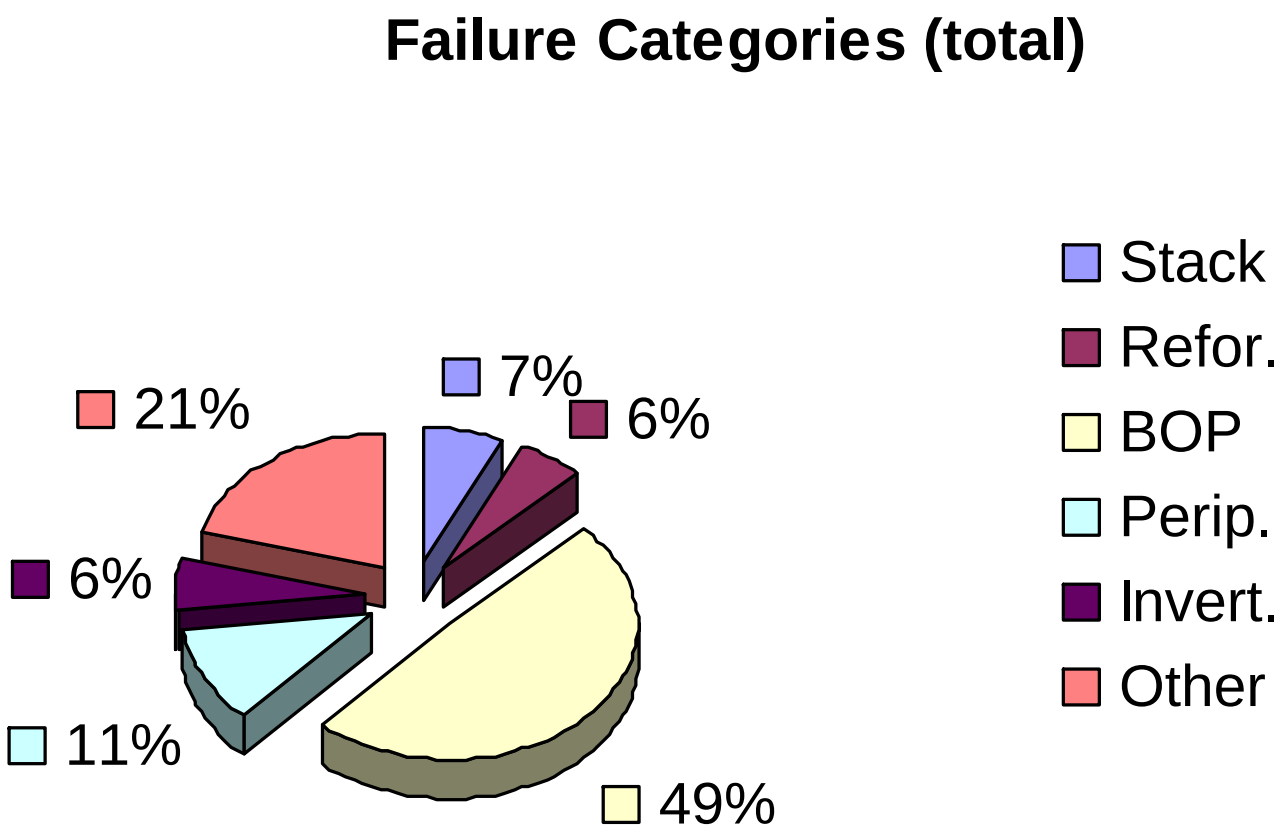



Today 111 fuel cell heating appliances are in operation (1/2011)
Due to technical problems the actual installation rate is behind the initial schedule

# Public Fleet Report
# Operating Data (07/2008 – 06/2010)



# Public Fleet Report
# Failure Categories (07/2008 – 06/2010)



# Conclusions

- Large-scale pre-market field test projects are an important measure to bridge the gap between laboratory developments and market launch
- Coordinated design and execution of regionally clustered demonstration projects allows for bundling forces and reducing transaction costs
- Practical experience from real-world operation reveals the need for further improvement; fuel cell heating systems are not yet market-ready, esp. with regard to balance-of-plant issues
- Progress can be expected from next Callux project steps
- Socio-economic studies are an important enlargement of technically oriented field test work

# Thank you.

EnBW
BAXI INNOTECH
e·on Ruhrgas
HEXIS
EWE
Vaillant
MVV Energie
ZSW
Verbundnetz Gas AG