



FC micro-Cogeneration : Generating Sustainable Heat and Power for your Home

Lessons learnt from field trials

Lisa Ruf, Element Energy

elementenergy

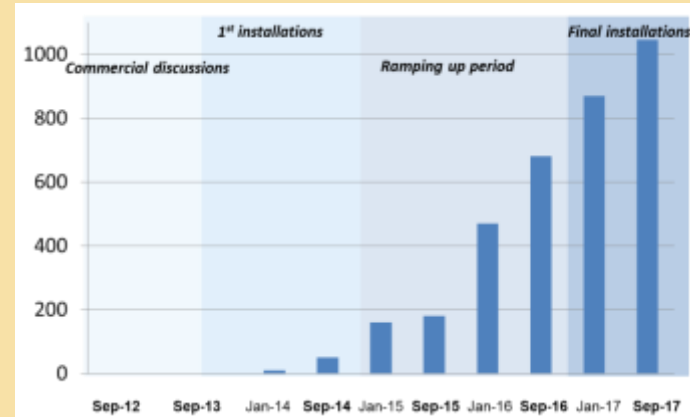
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The research leading to these results has received funding from the European Union's 7th Framework Programme (FP7/2007-2013) for the Fuel Cells and Hydrogen Joint Undertaking Technology Initiative under Grant Agreement Number 303462

- **Over 1000 systems installed** (or ~ 1155 kW of distributed power generation) **in 10 countries across the field trials**
- The 1st phase of the project focussed on developing strategies for field trials and finalising contractual agreements
- **A rapid ramp-up in deployment occurred over 2 years** – the majority of the units were installed over 2015 and 2016
- The project contributed to the development of new markets while developing further the more advanced German market

Ramping up of installations during project



Status installations as of September 2017



Technical characteristics of systems in ene.field

- The systems deployed in ene.field include **a range of fuel cell technology**, system size and operating strategies
- 10 active suppliers** directly involved in the project and in direct interaction with their customers

Elcore 2400	Dachs InnoGen	Cerapower FC10	Logapower FC10	Vitovvalor	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



Mostly one to two-family houses applications (but not limited to)

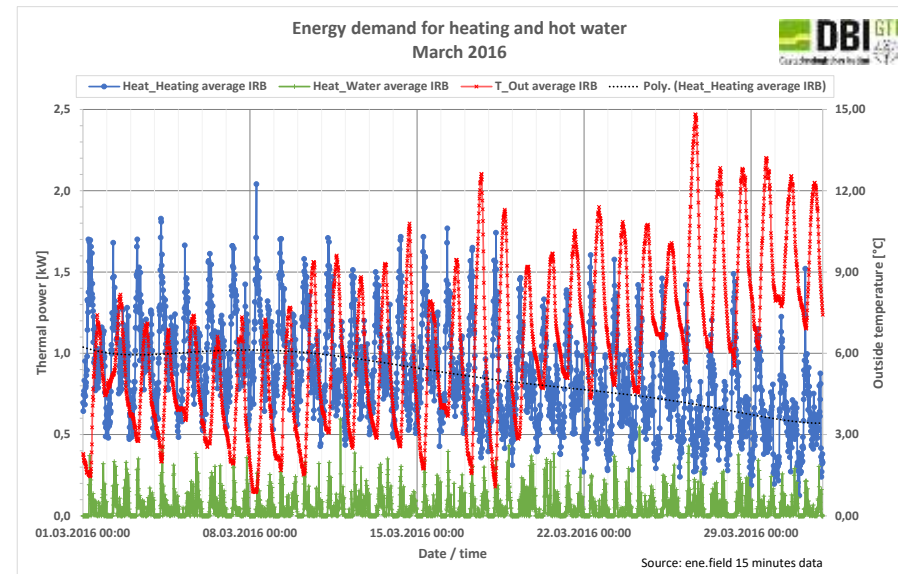


Mostly small and medium commercial buildings, block of flats applications (but not limited to)

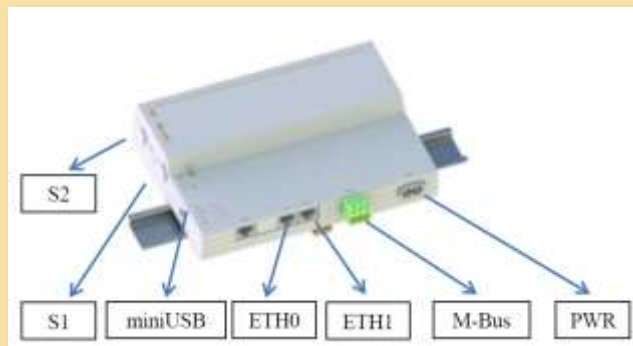
All ene.field units were monitored and 10% at a highly detailed level

- Some form of monitoring for all units.
~ 10% of units undergo detailed technical monitoring
- The monitoring explored
 - performance under real thermal demands
 - interactions with the local electricity and gas supply networks
 - consumer attitudes toward the technology

Database of energy demand profiles



ACOS700 - the "Callux-box" from IDS GmbH

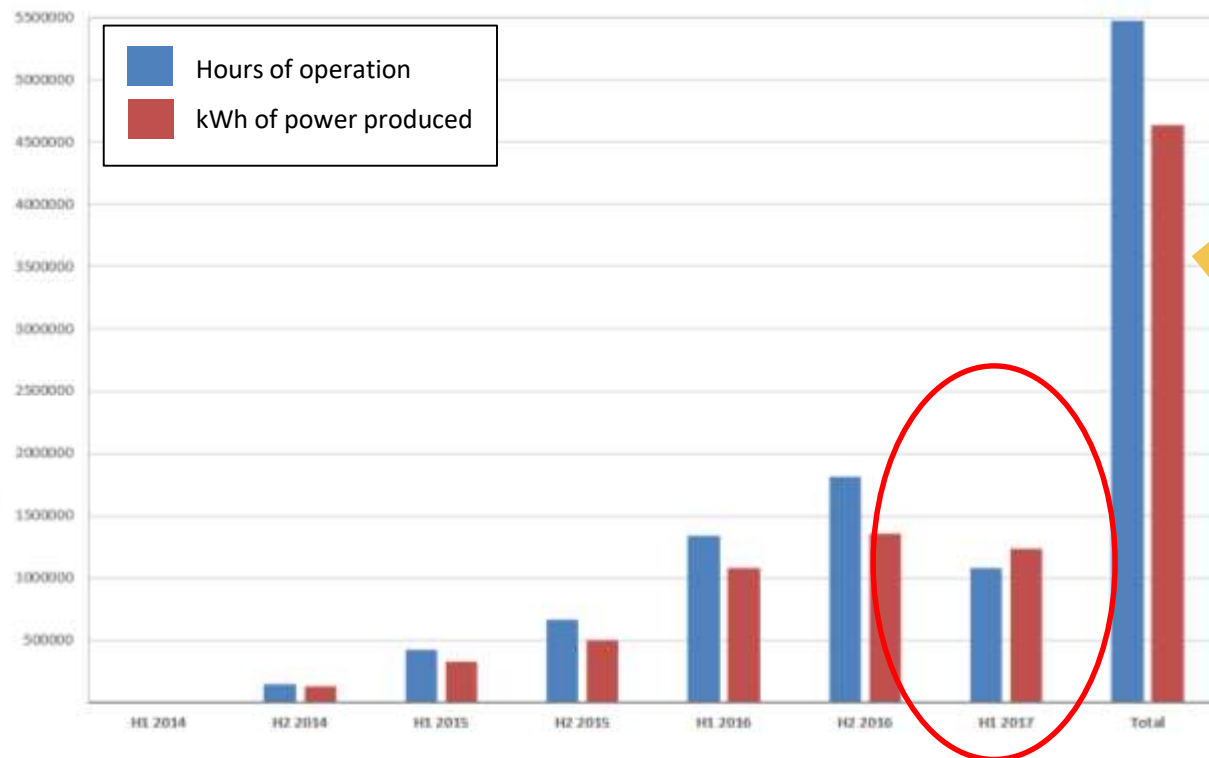


Communication gateway/data logger for collecting and archiving in database servers. It includes:

- 2 Ethernet ports (ETH 0 and ETH1),
- a wireless communication port (M-Bus),
- internal communication networks (S1 and S2),
- a mini-USB service port for direct connection,
- a plug in electrical power connection (PWR).

Reliable performance has been demonstrated

Demonstration projects have shown **reliable performance**:
ene.field has demonstrated **5.5 million hours of operation** and **4.5 GWh of power produced**
This contributes to the already **>4 million hours** and **2.5 million kWh of power produced** recorded
under **Callux** project in Germany



Latest data collection exercise indicates **5.5 million hours of operation** and **4.5 GWh of power produced**

Enough electricity to cover the yearly consumption of

900 X



1080 X Heat Pumps

Case study 1 - Logapower FC10 as Buderus Brand

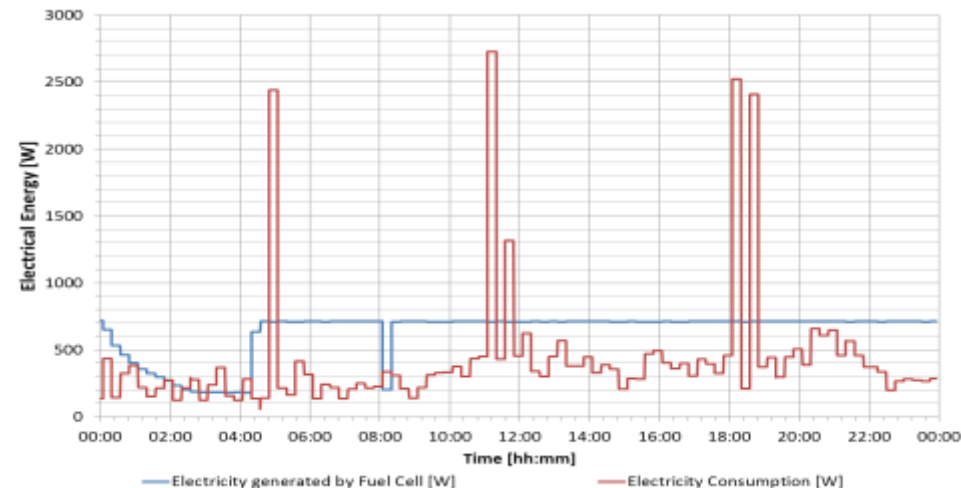
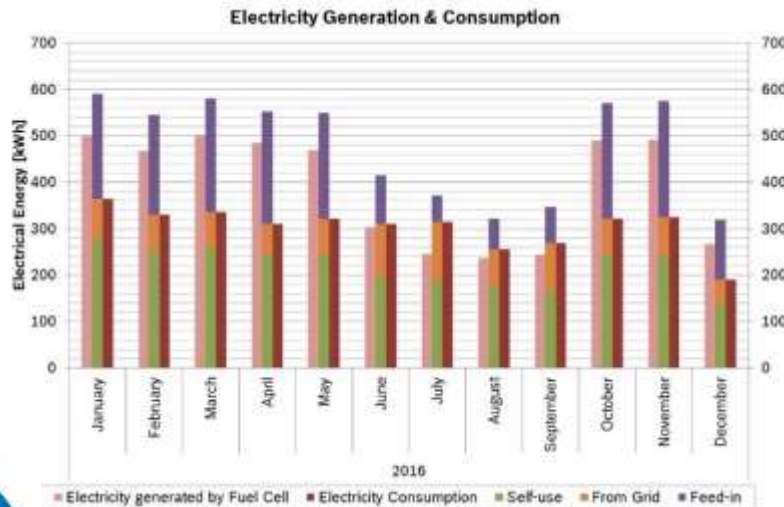
Energy centre	
Thermal output (kW)	15/25
Size W x H x D (mm)	1200 x 1800 x 600
DHW storage tank (l)	75
Buffer storage tank (l)	135
Fuel cell	
Electrical output (W)	700
Thermal output (W)	620
Electrical efficiency (%)	45
Total efficiency (%)	85



Y	Electrical Efficiency * [%]	Thermal Efficiency* [%]
'14	43%	35%
'15	41%	35%
'16	43%	33%
'17	45%	36%

*) based on Lower Heating Value
= 10.725 kWh/m³

- The Logapower FC10 replaced the former oil-fired boiler in this 1953' building
- The electricity produced is consumed by the residents who can feed excess electricity into the grid and receive a government guaranteed price for it cutting their energy costs by an 800€ to 1300€ p.a. (estimations)
- 47 % estimated reduction in building CO2 compared to a German coal power plant



Case study 2 - SenerTec's Dachs InnoGen

Dachs InnoGen at the Dilgers' family home, already an efficient low-energy house



Annual	Consumption [kWh]	Production [kWh]	Self produced / self-consumption [%]
Overall gas consumption [kWh]	23,162	-	-
Overall electricity production / consumption [kWh]	4,927	4,155	73% in building (3,033) or 62% of demand



Typical installations profile

- Single/Two family homes. Continuous operation according to electricity time schedule or heat led with power dependent on heat demand. Most of the electricity produced can be used internally
- Integrated system with a gas condensing boiler (5– 22kW), a fresh domestic hot water station (hydraulic module) and a 300 l buffer tank controlled by an energy manager
- Energy cost saving of ~ 900 € p.a. compared to a gas condensing boiler (estimation)

Customers key interest

- “The opportunity to be less dependent on rising energy costs and be among the first to demonstrate the possibilities of the new technology has confirmed our decision to opt for a high-efficiency cogeneration unit like the Dachs”
- Ease of operation: touch screen, up-to-date information about the operating status, easy adjustment of settings to suit individual heating and power requirement

Demo projects such as Callux and ene.field show reliable performance and advances in products quality

- **Show reliable performances and advances in products quality** (reduction in appliances dimension and weight, system are now better fit for quick installations, reduction in maintenance requirements)

Best practices and streamlining of sales and installation activities but, some remaining challenges:

- **Administrative preparation for the site was burdensome.** In some cases, this has allowed for initial discussions with regulatory bodies to start
- Further work is required in **raising visibility and improving understanding of the technology** at all level of the product value chain
- **System capital costs are the major challenge** (running costs are competitive with incumbents). **Increased manufacturing volumes are required**, which require a stable policy framework and high level political commitment to ensure investor confidence
- **Governmental supports and long term contracts** (e.g 10 years) contribute to **increase confidence of customers in the products**

Qualifications of new route to market and business models

- FC mCHP have provided a practical **solutions in a number of cases where alternative or incumbent technologies were not able to fulfil all requirements** for the building
- New business models and partnerships

New business models and partnerships – Two illustrative cases

Elcore Technology as 360° Energy Turn-Key Solution Package offer from Efficiency



- Development, manufacturing and sales
- In-house production (proprietary technology)

Efficiency



- Full-Service Energy Service Company (ESCO)
- Fixed monthly fee, incl. gas and power supply, planning and installation, financing, full service and maintenance – with 10 and 15 yr contract options

E.ON



- Energy supplier with a focus on renewables and innovative customer solutions
- Promotion platform for Efficiency package

*SOLIDpower sales of 550 BlueGEN appliances via contract with Elugie in Belgium**



SOLIDpower



- Development, manufacturing and sales
- In-house production (proprietary technology)

Elugie



- Belgium announced its withdrawal from nuclear energy in 2003. **CHP is today the 2nd largest source of energy (20%)**
- Elugie sees considerable potential for growth with energy requirement of > 10,000 kWh – likely to increase

Thank you for your attention!



www.enefield.eu



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