

HT-PEM system benefits and challenges

...by the worlds most integrated fuel cell company

Carisma 2012 Frank Erne Head of R&D

Outline



- The companies elcomax & elcore
- The elcore2400-system
- System requirments
- Summary

Company Group







Milestones



50 CHP units to be sold to

The group has proven fast execution and has made major technological progress.

field test customers Roll-to-roll MEA First domestic manufacturing **CHP** unit in line operation: **Foundation of** natural gas **Elcore GmbH** steam reforming as HTPEM fuel **Massive cost HTPEM** stack cell systems reduction **Acquisition of** manufacturer through ECPD **HTPEM** assets **Technology** launch of from Sartorius activities 1. July 2007 2007 2008 2009 2010 2011 2012

Overall value chain



Raw material suppliers

Integrated R&D and Manufacturing Strategy

elcomax membrane, catalyst, electrode, MEA

Elcore
stack, reformer,
systems integration
application engineering

Holistic R&D approach to custom develop all key components

→ highest product quality

Perfect interfaces between teams with no conflict of interest

→ fastest development progress

Least overhead and independence from specialized suppliers

→ lowest cost structures

Customers



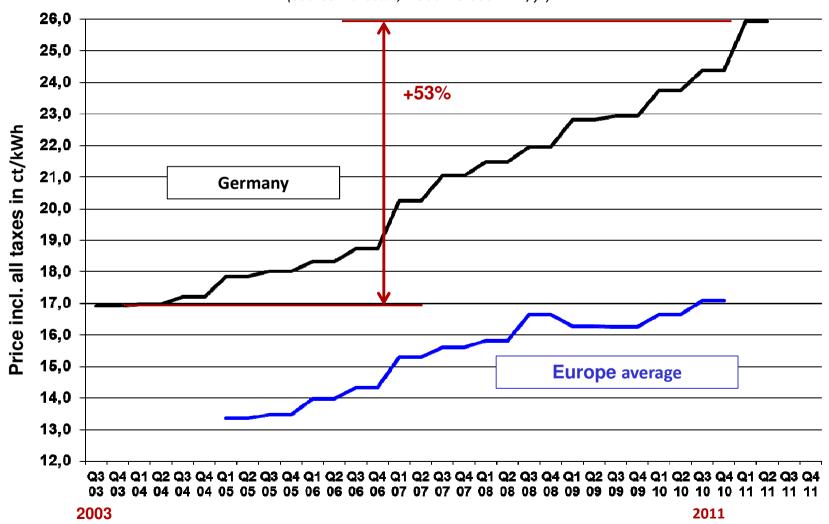
Target Market – Single Homes in Germany

Electricity costs - Comparison



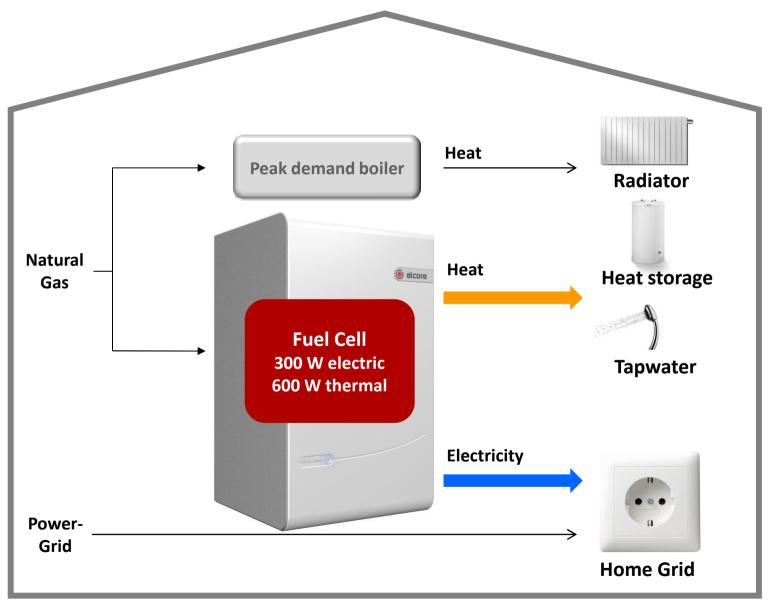
Domestic electricity prices – Germany and Europe

(Source: Eurostat; 2.500 – 5.000 kWh/yr)



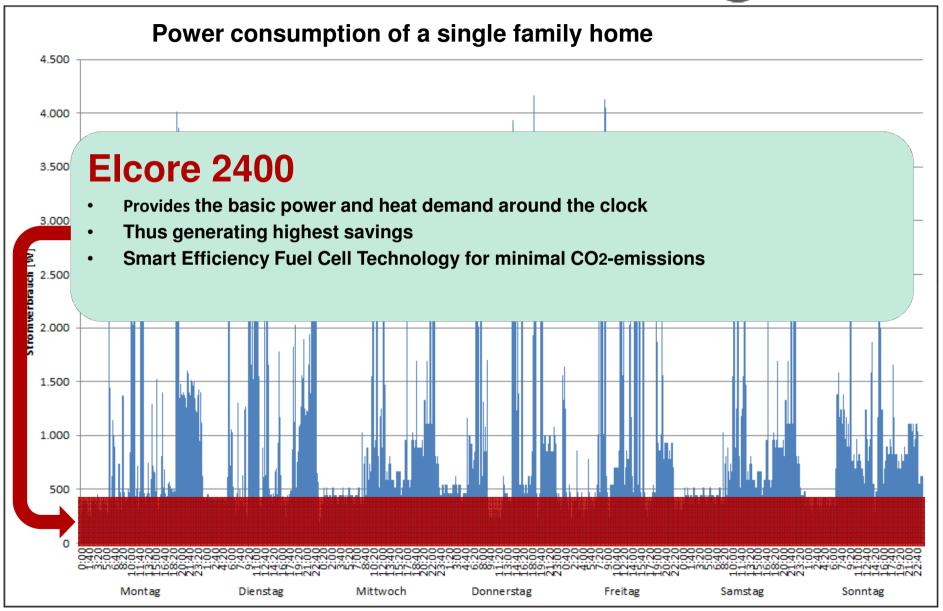
Elcore 2400 – how it works





Up to 50% reduced electricity bill for you





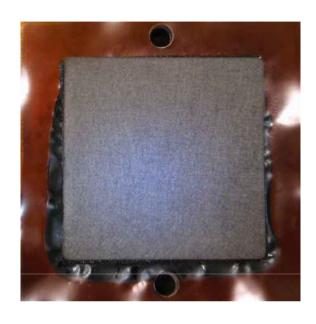
System requirements for pilot products



Requirement	Most critical	Solved by
Maintenance: >32.000h	Lifetime MEA	elcomax
	Stack design, operation conditions	elcore
Gas sealing	Stack	elcore
System cost	MEA cost	elcomax
	Stack & other component costs	elcore
Electrical efficiency	MEA-Performance	elcomax
	Parasitics	elcore

MEA lifetime





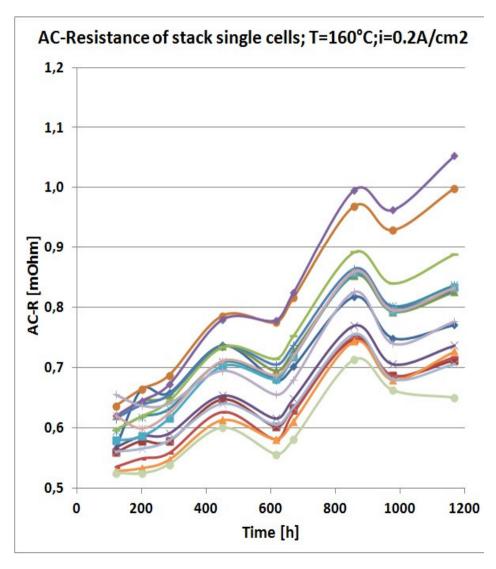


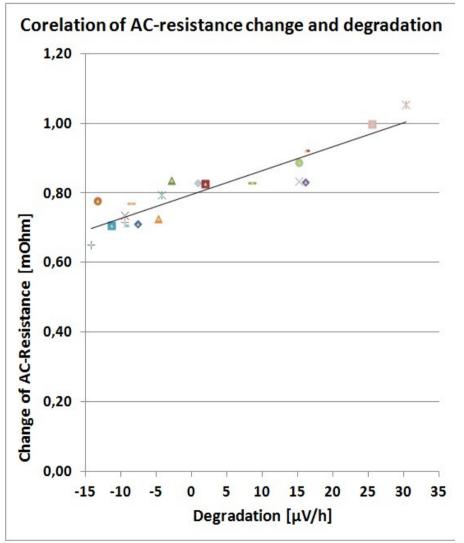
- Good control over H3PO4-content
- H3PO4-loss into frame critical
- Mechanical stability critical

- Significant improvement of lifetime
- Degradation rate of 10μV/h achieved
- H3PO4 loss still important (BPP)

Importance of Acid-handling







MEA cost & reproducability



PBI Polymer



Metal salts



Membran production Capacity: 20.000 sqm/yr



PBI membrane role as basic product



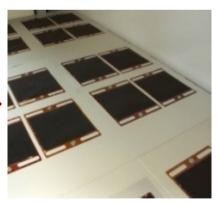


Electrode manufacturing Lamination & gasket Capacity: 20.000 sqm/yr using injection molding

The company group possesses the entire value added chain von raw materials to

Key component: HTPEM MEA

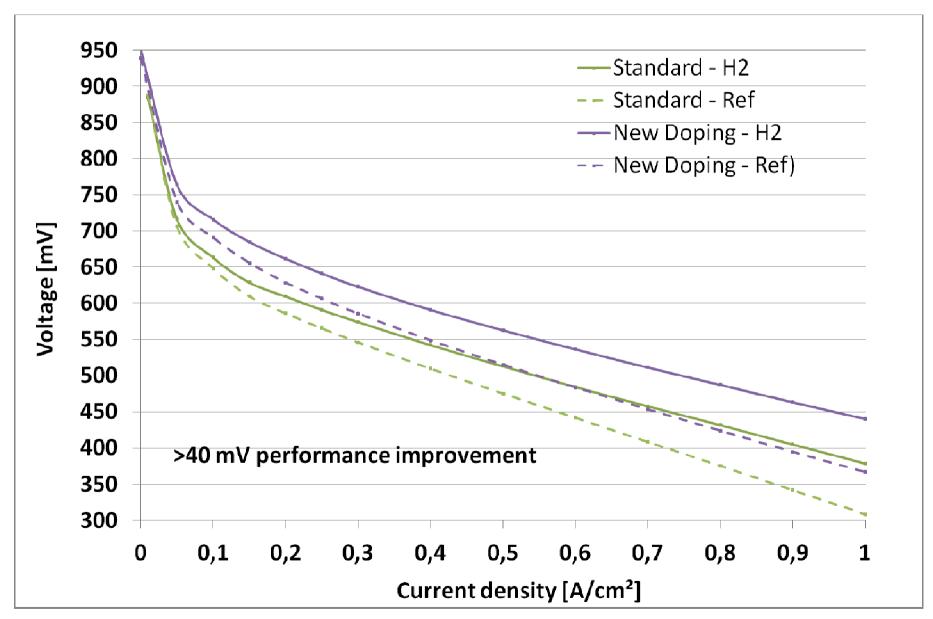
complete systems



Capacity: >1 MW/yr

Improving MEA performance





Stack design



(Nearly) no free space



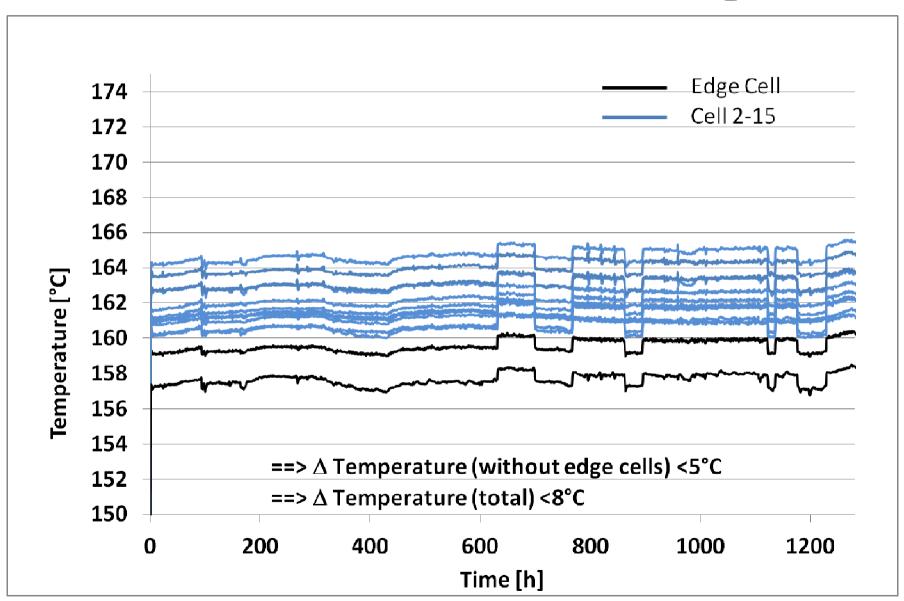


Cost-effective parts

Oil cooling in separate plates

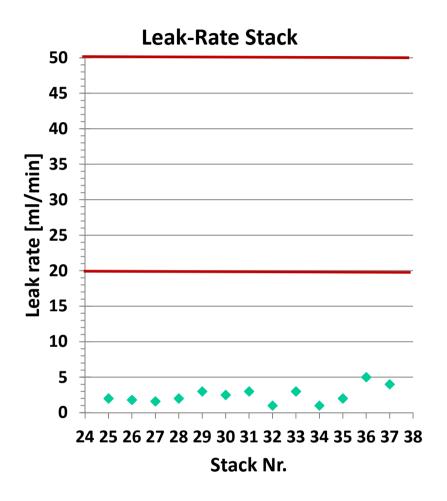
Temperature distribution



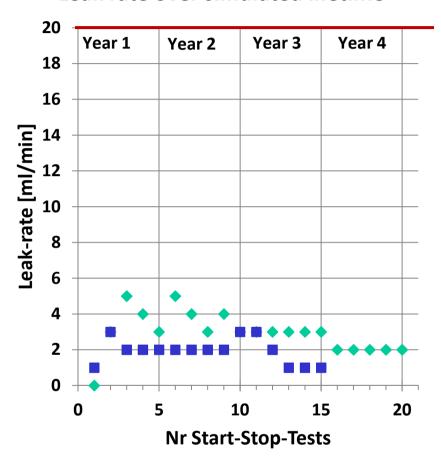


Sealing





Leak rate over simulated lifetime



- Excellent leak rate far below requirements
- Both BOL and over simulated lifetime

Summary



- All system components developed
- Real reformate testing essential
- HT-PEM technology ready for pilot products
- BPP, sealings and MEAs need further optimization in lifetime and cost for series products



Thanks for your attention

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