



Fuel cell products for global energy markets

Ceres Power / British Gas programme

FCH JU SGA 2009, 26th October 2009

**EXT –
NON CONFIDENTIAL**

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Background to Ceres Power

microCHP in the UK

British Gas programme

Learning + way ahead

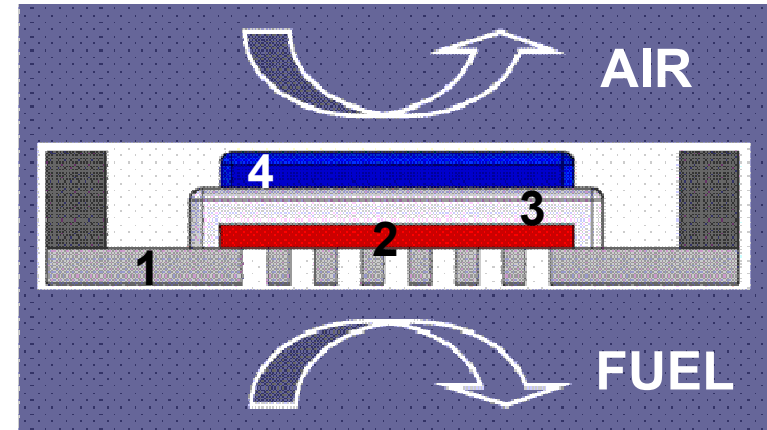
Welcome to Ceres Power

- Commercialising unique fuel cell technology within alternative energy products for global markets
- Company founded in 2001
 - Original IPR transferred from Imperial College, London
 - 2 rounds of private equity, followed by flotation in 2004
 - Key shareholders include Oppenheimer, British Gas, Fidelity
- The organisation is focussed on:
 - Identifying market-led opportunities in volume sectors
 - Value-engineering fuel cell systems to meet market needs
 - Partnering with channel and supply-chain partners
- ~100 staff focussed into product teams, including experienced application development and manufacturing engineers from global product sectors (e.g. automotive, HVAC)



The Ceres Fuel Cell

- Ceres Power has developed a patented Intermediate Temperature Solid Oxide Fuel Cell (IT-SOFC) technology
- Innovative ceramic materials enable operation at 500-600°C, substantially lower than conventional designs
- This permits the use of stainless steel as the cell substrate, opening up fundamental changes in materials choice, manufacturing techniques and product development
- This technology brings benefits in product size, weight and economics along with mechanical robustness, operating mode and manufacturability



1. Support (stainless steel) 2. Anode
3. Electrolyte 4. Cathode



Fit with mCHP Market Opportunity

Technology features

Benefits for Ceres Power CHP products

High efficiency	➤ Greatly reduced lifetime energy costs & carbon footprint
Physically rugged and durable	➤ Needed for normal handling of consumer products
Good dynamic response	➤ Meets load following and power cycling needs
High power density	➤ Complete system in single wall mountable unit
Durable materials	➤ Suitable for consumer appliance lifetimes
Commercial components and processes	➤ Commercially viable products, mass manufacturable, established volume-capable supply chain partners
Fuel flexibility (e.g. natural gas, LPG)	➤ Immediate business case and global usage
Unique and strong IP	➤ Differentiated industry position

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Characteristics of UK Market

- >20 million homes
- ~85% connected to mains natural gas
- Boiler replacement market ~1.5 million units per year
 - ~80% replacement units
- Housing in the UK accounts for ~27% of carbon emissions
- ~80% of the houses we will be living in by 2050 are already built
- 'Easiest' energy efficiency measures starting to saturate (e.g. insulation)
- Retrofit solutions can facilitate large scale carbon reductions

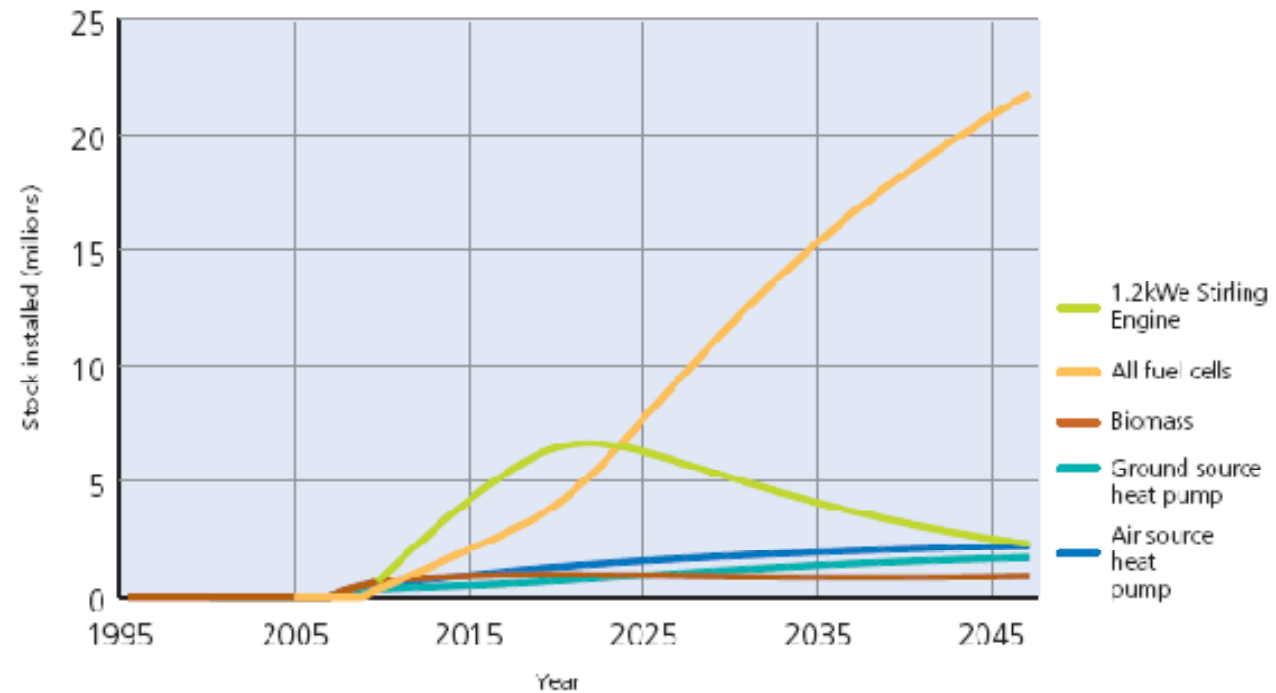
Potential Impact of Fuel Cell mCHP

- Annual predicted total energy bill cost savings of ~ 25%
 - Relative to high efficiency condensing boiler and grid electricity
 - Based on measured real home occupancy, actual energy demands, and usage patterns for mass market homes with 2-3 occupants
- Annual carbon savings of 1 to 1.5 tonnes p.a. up to 2020
 - Relative to high efficiency condensing boiler and grid electricity
 - Based on actual UK power plants displaced in the merit order
- Potential for significant additional benefits to UK energy system
 - Reduces peak demand and generation investment requirements
 - Reduces capex requirements for grid network

UK Mass Market Potential

Fuel Cell CHP optimises electricity savings and CO₂ emissions savings due to :

- All year round operation
- Load following capability



Source: Energy Saving Trust 2007 (study sponsored by UK Government)

“Over 6 million fuel cell CHP units installed by 2020 (30% of the market...)”

2008 Element Energy Report for UK Government

Opportunity for Energy Companies

- Fuel cell mCHP offers potential benefits to energy suppliers
 - Differentiated energy efficiency proposition
 - New / enhanced revenue streams from Services (inc. installation, service, maintenance, finance)
 - Enhanced customer loyalty / lower churn
 - Innovative, green branding ('part of the solution', not 'part of the problem')
 - Improved government relations
 - Enabling shift of business model (e.g. 'energy services')

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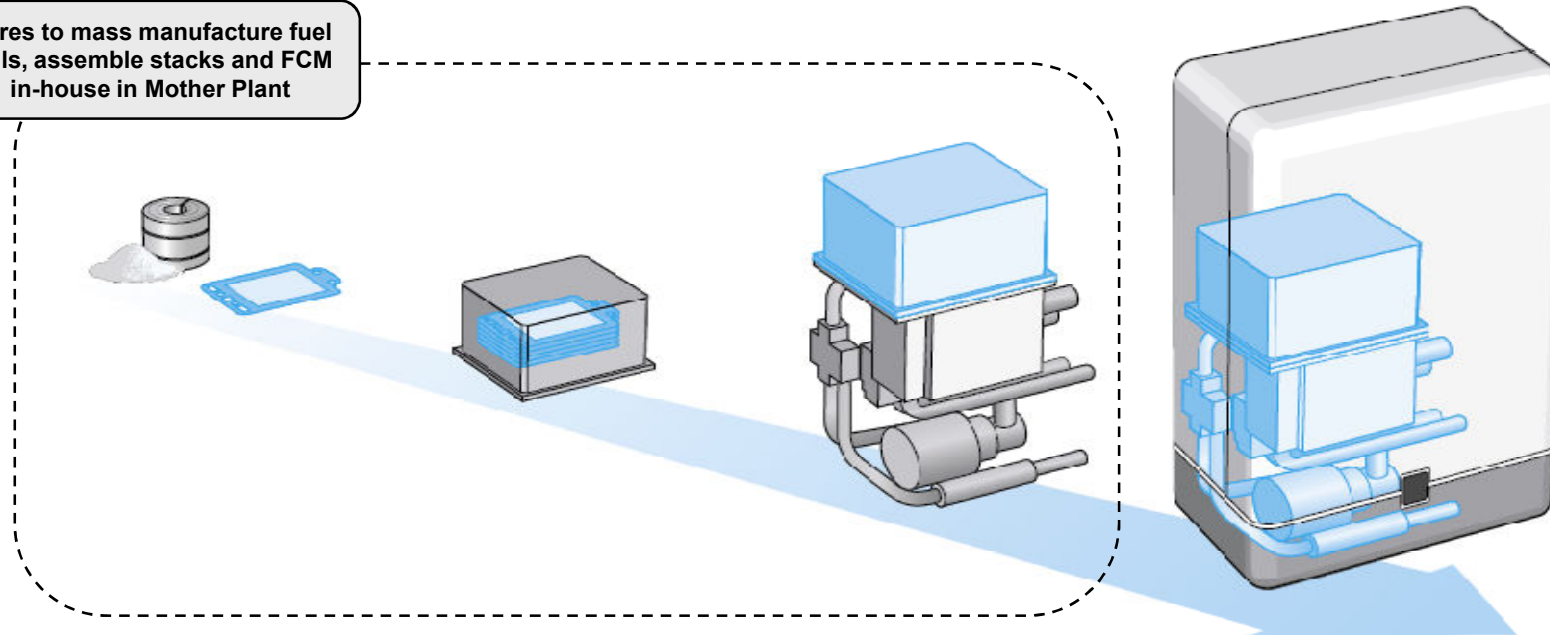
Background

- British Gas is UK's largest residential energy supplier
 - 16 million customer accounts
 - Largest heating installation & maintenance force (>9,000 engineers)
 - Install >100,000 boilers per annum
- Ceres and British Gas started developing their relationship at an early stage in the product lifecycle
 - Collaborative R&D project, sponsored by UK Government
 - Developed a technology demonstrator for a residential fuel cell mCHP system in summer 2007
- Following this, Ceres and British Gas entered into a commercial development, supply and distribution agreement in early 2008
 - Objective: bring complete fuel cell mCHP product to market in volume

- mCHP programme with British Gas
 - Funded development & trialling programme (£5 million)
 - Significant operational resources committed by British Gas for mCHP trialling & product launch (e.g. marketing, logistics, procurement, service, maintenance)
 - Volume forward order (37,500 units minimum over first 4 years)
 - Equity investment (~£20 million cash by Centrica for ~10% of Ceres)
- Route to market for volume uptake of fuel cell mCHP established
 - Strong market channel partnership for UK mCHP
 - Agreement covers residential market in England, Scotland, Wales

CHP Product

Ceres to mass manufacture fuel cells, assemble stacks and FCM in-house in Mother Plant



Fuel Cell

- Unique patented technology & design
- Materials formulation kept as trade secrets
- In-house manufacture
- Functional core of stack

Fuel Cell Stack

- Ceres' own patented design
- Well-proven welded stack sealing techniques – durable
- In-house manufacture
- Functional core of fuel cell module (FCM)

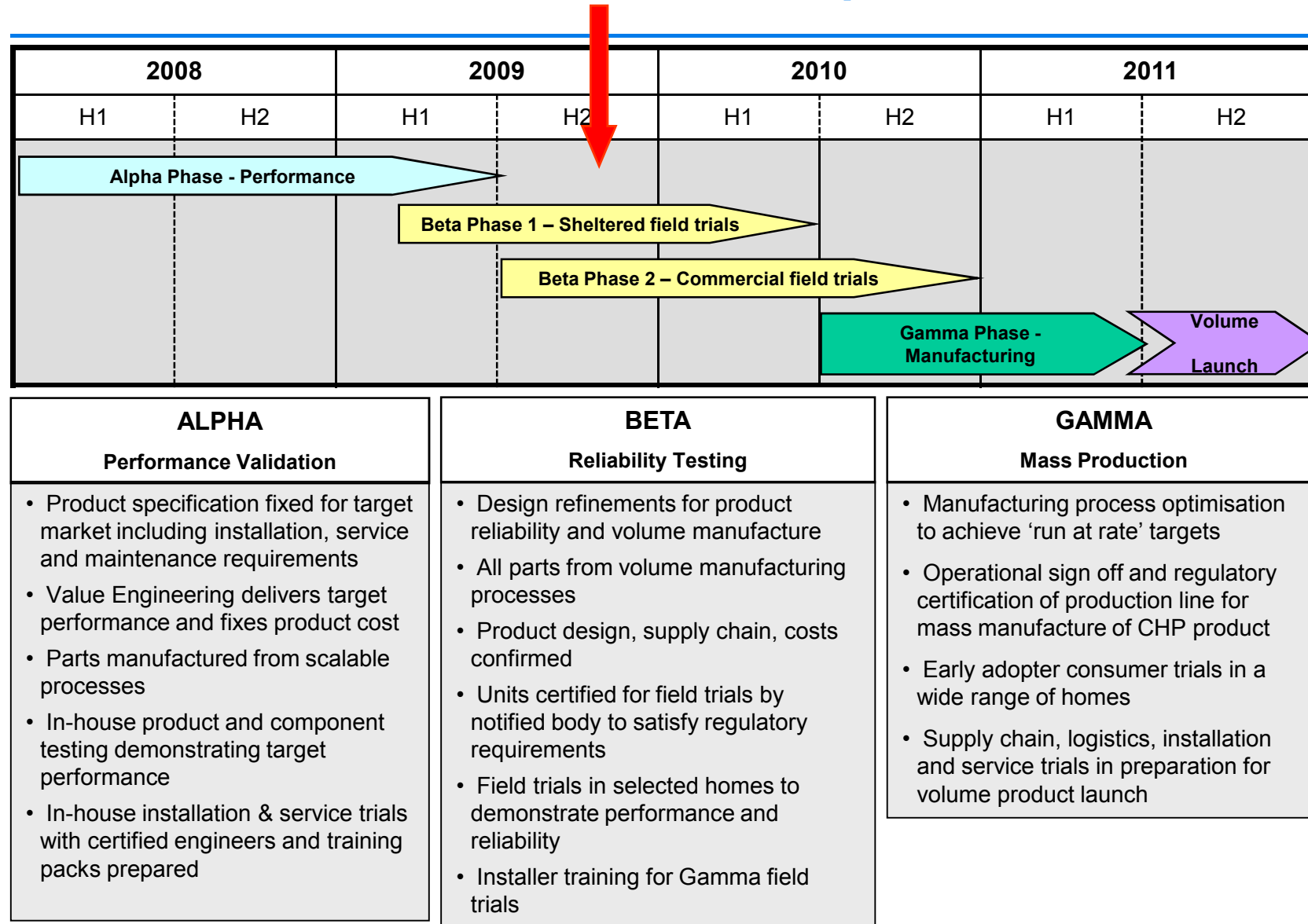
Fuel Cell Module

- Electro-chemical engine, source of heat & power
- Unique low cost, compact, patented design capable of volume manufacture
- BOP sourced from established volume suppliers
- Common product platform

Wall-Mountable CHP Unit

- Ceres' own product design
- Innovative patented thermal management and system integration
- Standard boiler components connected to unique FCM
- Partnership for volume assembly

CHP Roadmap





1kW Alpha CHP products on test:

- ✓ Running on mains natural gas
- ✓ Exporting/importing power to/from the grid
- ✓ Delivering representative residential heating and hot water outputs
- ✓ Automated start-up and operation
- ✓ Compact & wall-mountable
- ✓ Alpha phase signed-off by British Gas & independent gas appliance testing company
- ✓ Successful completion of Alpha phase validated by AEA

	Go to market specification	Alpha CHP Units
Electrical rating	~1kW	> 0.8 kW
Thermal rating	Up to 28kW	7kW – 29kW
CHP Product efficiency	80 - 90%	87%
SEDBUK (Boiler efficient heat-only)	'A' rating	'A' rating
Fuel Type	Natural Gas	UK Mains Natural Gas
CHP Product width	<600mm	600 – 603mm
Fuel Cell Module weight	<25kg	22kg
Installation	Wall-mountable	Wall-mountable
Water, gas and electricity connections	Similar to condensing boiler	✓
Flue type	Balanced	✓
Certification	CE, GAD, LVD, G83	Compliance with relevant standards
Service & maintenance	CORGI / Gas Safe	✓

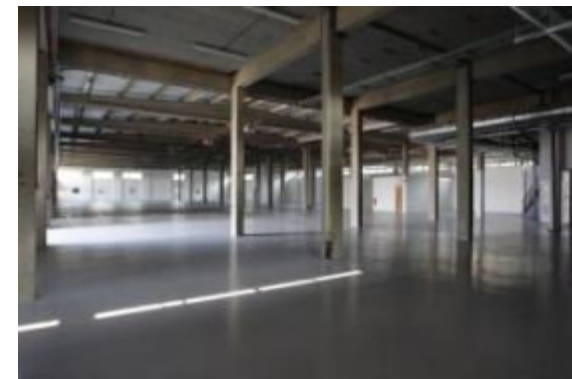
CHP Unit in Home-like Environment



Ceres Manufacturing Operations

Mother plant

- 50,000 sq. ft (5,000 m²) manufacturing facility secured
- Located within 15km of existing Ceres' facilities - ease of technology transfer
- Volume manufacturing & assembly of fuel cell module & CHP product testing



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Key Learning to Date

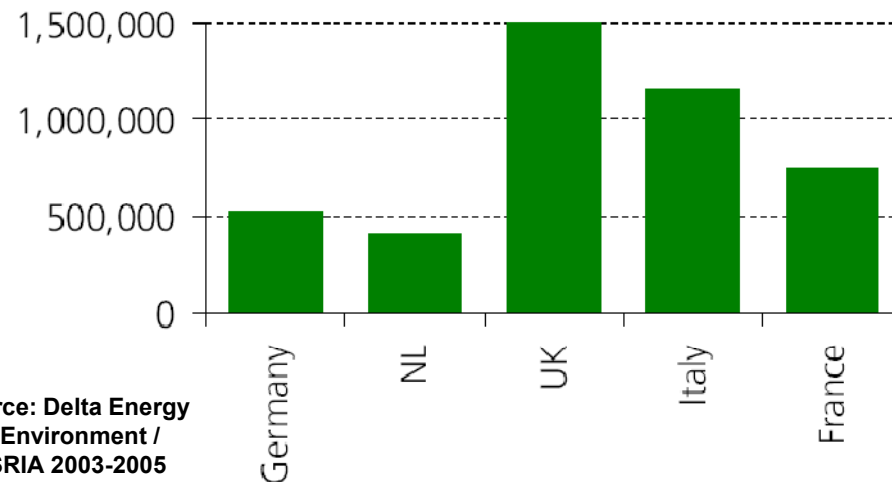
- Articulate a clear vision of future potential
 - Global market opportunity, strong value capture, differentiated product
 - Provide metrics of success to investors, partners & employees
- Invest in the 'critical success factors'
 - People, equipment, partners...
- Create the right culture
 - Entrepreneurial, commercially-focussed, delivery-oriented, fun but driven
- Technological strength is necessary, but not sufficient
 - Grow IPR portfolio at component, sub-system and system levels
 - Translate into innovative product(s)
 - Requires capital (commercial, investor, collaborative R&D...)

Approach to Preparing the Market

- Start early! i.e. several years before product launch...
- Form strong 'win-win' partnerships with significant corporate energy players
 - Trusted brands help reduce entry barriers around new technology
 - Embed market insights into product development process (e.g. design-for-manufacture, design-for-installation, regulatory compliance)
- Become involved with government and standards activities
 - 'Top table' positions can be influential (e.g. ETI, ERP...)
 - Influence government, commercial partners, NGOs
- Seek endorsement of the proposition
 - Confirm technical and commercial progress
 - UK Prime Minister, Government agencies, energy industry execs...

International Opportunity

Annual boiler sales in selected European countries



- Boiler sales across the top 5 European markets alone, are over 4.5 million per annum

- An integrated wall mountable product is a pre-requisite for mass market adoption across European markets

Country	Wall Hung as % of Boiler Sales
UK	85%
Netherlands	96%
Germany	58%
France	75%
Italy	84%

Source:
Frost &
Sullivan,
2003



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