



Distributed generation products for global energy markets

FUEL CELL MICRO-CHP: THE CLEAN, EFFICIENT HOME ENERGY CENTRE

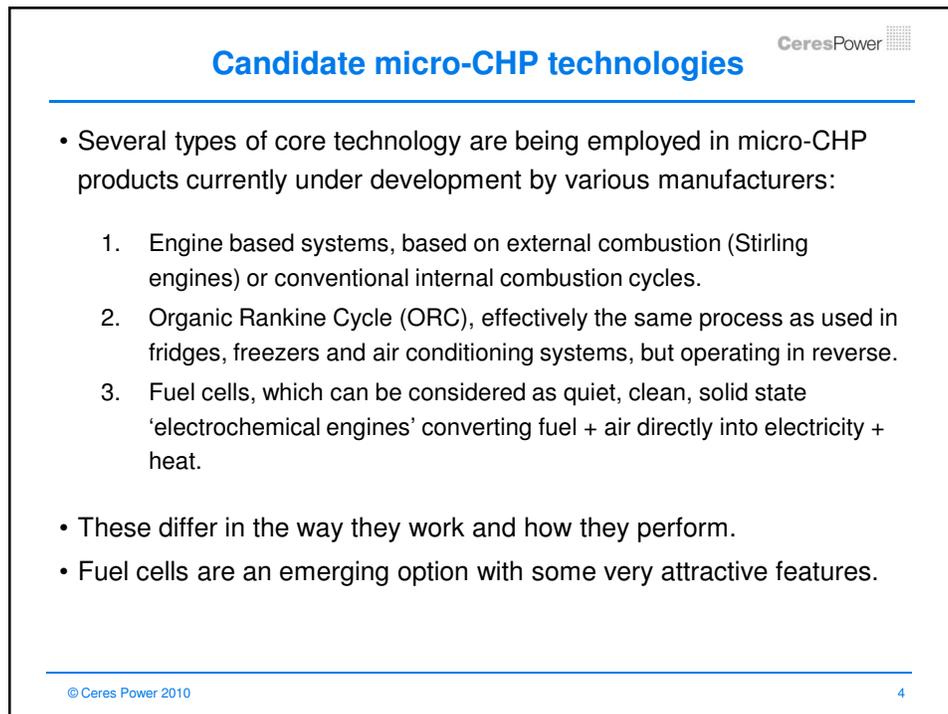
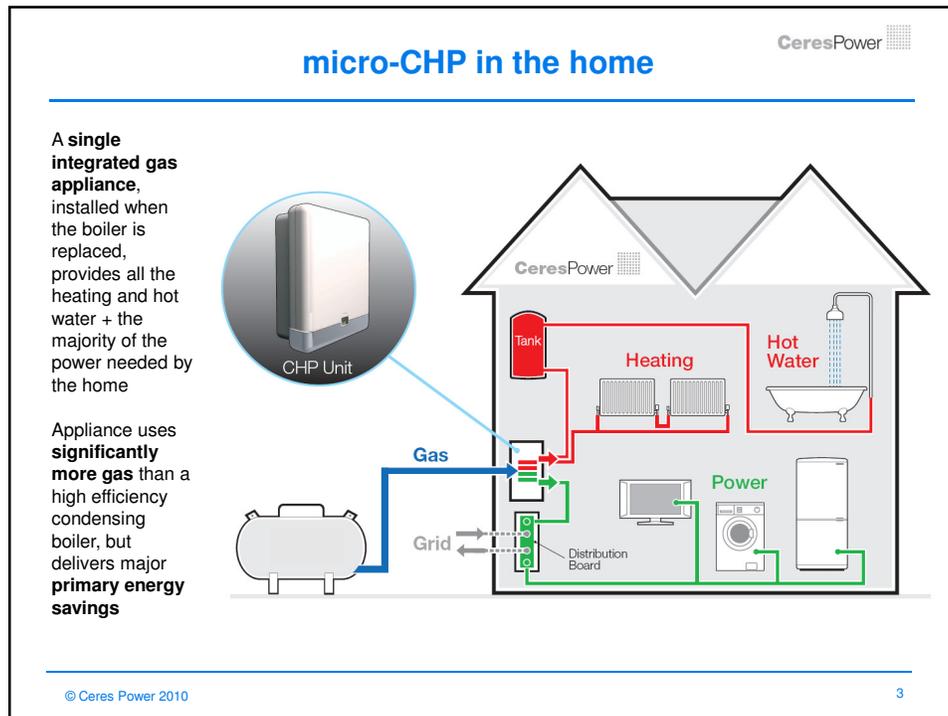
Bob Flint, Commercial Director, Ceres Power

Madrid, October 2010

Agenda



- Introduction to micro-CHP
- Fuel cell technology
- Ceres CHP proposition
- Product progress
- Market opportunity & evolution



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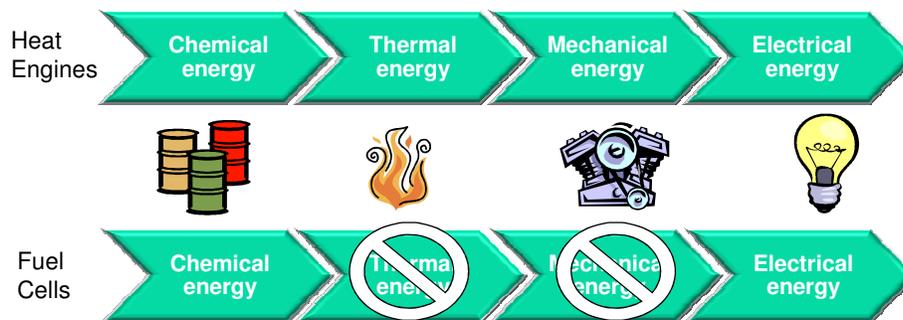
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What are fuel cells?

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Fuel cells are 'electrochemical engines' that generate electricity & heat

- Environmentally friendly technology
- Operate on widely available fuel and air
- Quiet, efficient, solid state reaction
- Near-zero NO_x, SO_x and CO



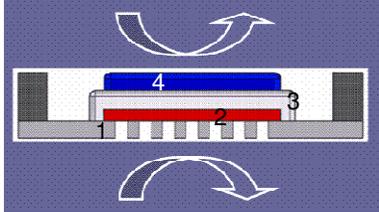
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The Ceres Power fuel cell



- Ceres Power has developed a unique, 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, and allows use of well established manufacturing techniques and product development approaches



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

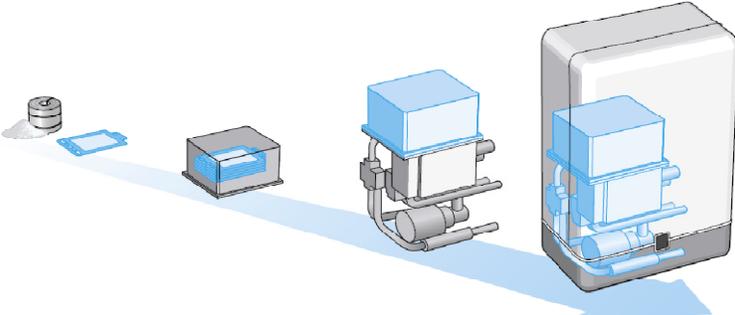


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Inside the micro-CHP Product





Fuel Cell	Fuel Cell Stack	Fuel Cell Module (FCM)	Wall-Mountable CHP Unit
<ul style="list-style-type: none"> • Unique patented technology & design • Materials formulation kept as trade secrets • In-house manufacture • Functional core of stack 	<ul style="list-style-type: none"> • Ceres' own patented design • Well-proven welded stack sealing techniques – durable • In-house manufacture • Functional core of fuel cell module (FCM) 	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • Ceres' own product design • Innovative patented thermal management and system integration • Standard boiler components alongside unique FCM

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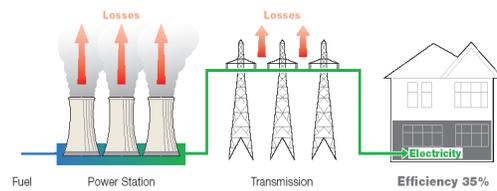
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The distributed generation (DG) proposition

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- Distributed Generation (DG): generate power at point of use, in the home
- Use a highly efficient process to reduce generating, transmission and distribution losses
- Capture heat output to drive further savings
- Package into a consumer appliance
- Converts gas into electricity
- Uses more gas than a high efficiency condensing boiler

Centralised Generation



Distributed Generation



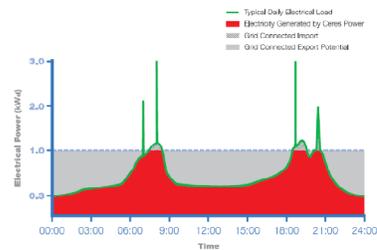
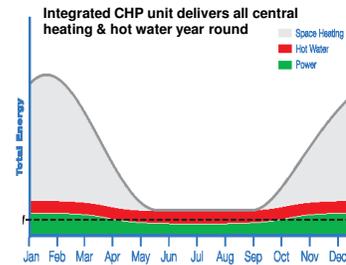
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Unique technology delivers maximum energy savings

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- **Low heat to power ratio:**
 - Enables all year round operation
 - Minimum heat output matched to summer hot water requirement
 - Maximum heat capture (electrically-led thermally capped)
- **Load following & cycling enables 'smart grid':**
 - Delivery of high value electricity during peak demand
 - Compatibility with existing and future grid infrastructure
 - Can be turned up & down, on & off as required
 - Controllable on-site generation asset for demand management



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Consumer proposition

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- The fuel cell micro-CHP system can address 80-90% of the home's electricity needs, providing the following benefits
- Lower energy costs through
 - Avoided electricity import
 - Sales of excess electricity back to the 'grid'
 - Feed in tariff ('FiT') income
- Reduced emissions (cleaner, greener energy)
- Expedient installation + maintenance
- No need to change 'energy lifestyle'
- Improved energy continuity
 - Heating and hot water continue in case of mains electricity outages

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Carbon benefits

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- Annual CO₂ savings of 1 to 1.5 tonnes p.a. up to 2020
 - Relative to high efficiency condensing boiler and grid electricity
 - Based on actual power plants displaced in the merit order
 - Verified by Oxera
 - Carbon savings are higher if fuel source moved (e.g. from oil to LPG)
- Highly cost effective CO₂ reduction for a difficult sector
 - Retrofit of existing homes
- A major impact on CO₂ reduction by 2020
 - Can be quickly deployed
 - Compatible with majority of UK homes
- Persistent CO₂ savings even as the electricity grid decarbonises
 - Displaces peaking / mid-merit fossil plant
 - Can utilise de-carbonised gas (e.g. biogas)



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Trialling and testing

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- Sheltered field trials enable
 - Learnings from operation in houses to be captured
 - Optimisation of control systems under 'real-life' operating conditions
 - Validation of logistics chain + customer support model including installation, service and maintenance

Ongoing testing in

Ceres test facilities:

- Accelerated lifetime testing of CHP products
- Durability testing of CHP products, FCMs & cells
- Reliability testing of sub-systems & components



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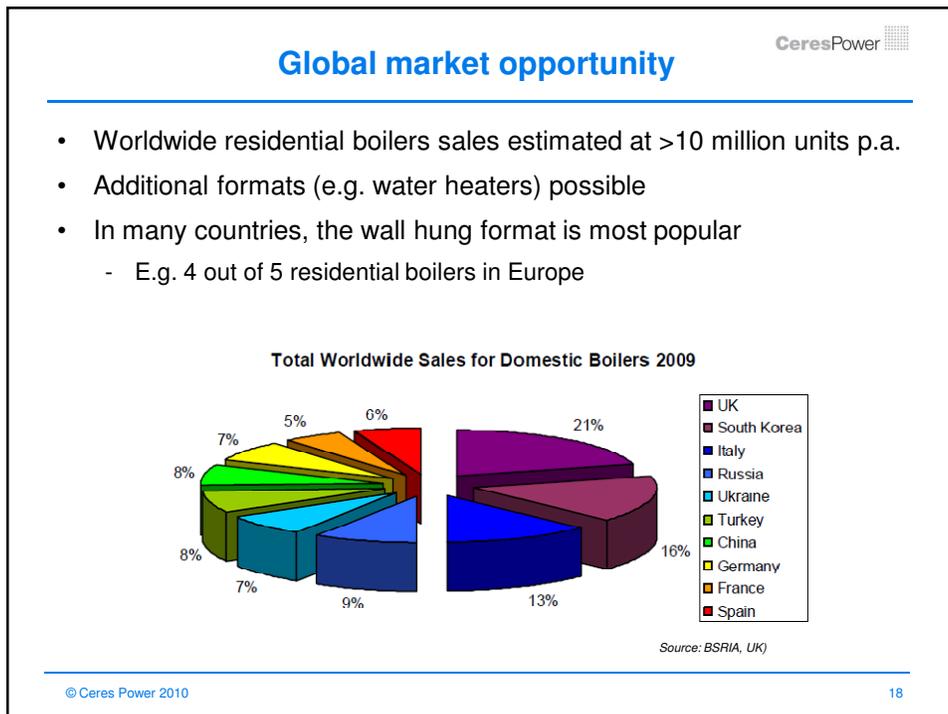
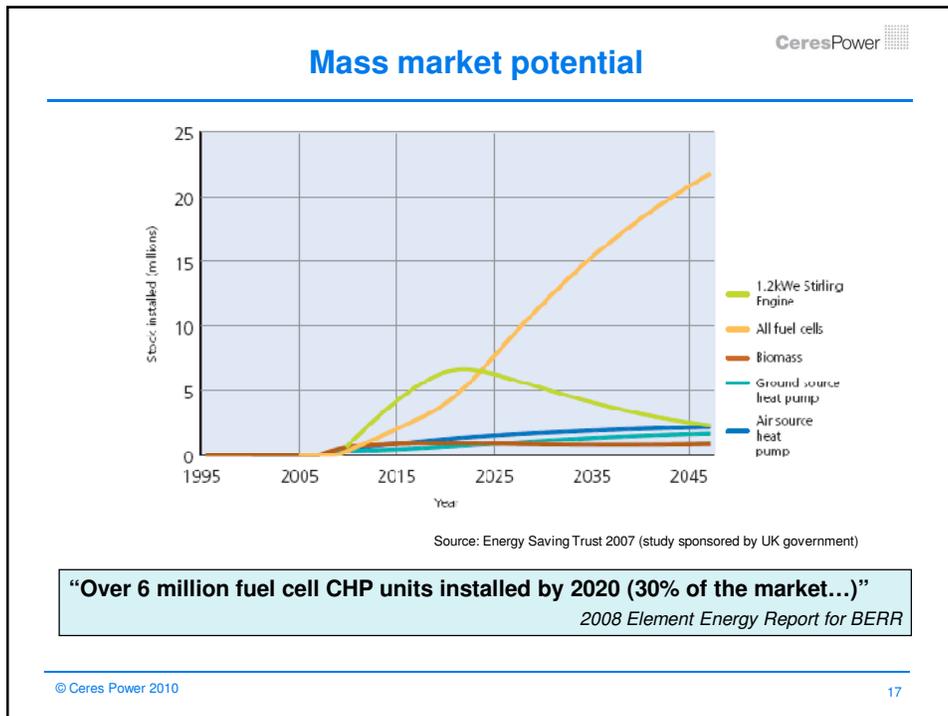
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