Introducing:

**BlueGEN**

Modular Generator: Power + Heat

Ceramic Fuel Cells Limited

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The Concept

Generating power and heat at the point of use:

- **Europe**
  - Described as micro-Combined Heat & Power (micro-CHP)
    - *Improving energy efficiency, strengthening the grid and CO$_2$ reduction*
    - *Economic incentives to deploy micro-CHP*
  - Germany, UK are market leaders

- **Japan**
  - Described as residential co-generation
    - *Improving energy efficiency and CO$_2$ reduction (to also increase gas sales)*
  - First country in the world to deploy fuel cell demonstration systems in large scale

- **Australia & North America**
  - Increasing interest in co-generation;
    - *Meeting increased electrical demand*
    - *Improving energy efficiency*
    - *CO$_2$ reduction*
    - *Reduce stress on (ageing) power infrastructure*…
Today – Centralised Generation

Large, inefficient electricity generators, a long way from the users

(Average figures – actual numbers vary between markets)
Tomorrow - Distributed Generation

Very efficient, quiet “mini power stations” in homes and other buildings
Natural Gas fuel cell power module (1 – 2 kW) plus hot water
The market for small scale co-generation systems is large; Look at the market potential from three ways:

- Potential sales of co-generation systems to replace boilers/water heaters
- Additional electricity generation required to meet future demand
- Improvements to energy efficiency to meet reduction in CO$_2$
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Sell Appliances
Case study: Japan
Osaka Gas identified 1.1 million individual households suitable for co-generation in the Kansai region. Market can be further expanded by targeting the apartment market.

Potential for other gas utilities...
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Increase Generation Capacity
Case study: Germany
Government target of 140 TWh* of electricity from micro-CHP by 2020
Assume 70 TWh from new capacity:
- 35 TWh from residential co-generation
- 10 MWh output per system per year
Cumulative market potential by 2020
3.5 million systems

Government target in 2050 is:
260 TWh

* 1 Terawatt hour (TWh) = 1,000,000 Megawatt hours (MWh)
  or
  = 1,000,000,000 Kilowatt hours (kWh)
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- Additional electricity generation required to meet future demand

- Improvements to energy efficiency to meet CO₂ reduction targets

**Reduce CO₂**

**Case study: Australia**

Victoria has the world’s highest CO₂ emissions per capita

*If CFCL units replaced just 7% of Victoria's electricity from brown coal, the State would achieve the Federal Government's target of a 5% reduction in CO₂ emissions, well before 2020*
The Technology & The Product
CFCL’s Fuel Cell Technology

CFCL’s solid oxide fuel cell technology is designed for:

High electrical efficiency
- Electricity is the ‘high-value’ product
- High electrical efficiency delivers low CO₂ emissions

Low heat outputs
- Existing burner technologies already produce heat very efficiently
- CFCL’s technology is not intended to compete with existing water heaters

Volume manufacturing
- Using commercially acceptable processes and tolerances
- Designed for low-cost

Mass deployment
- Uses existing natural gas network, can be installed easily into homes
- Does not need hydrogen or other new infrastructure
- In the future, potential to operate on other fuels – LPG, biogas, ethanol
Introducing BlueGEN

Co-generation product concept:
- Use natural gas to make electricity and heat

Electrical output:
Up to 2kW

Peak electrical efficiency:
60% at 1.5 kW

Simple user interface

About the size of a home dishwasher:
660 mm (D)
600 mm (W)
970 mm (H)

Simple connections
Gas cleaning
Air blower
Fuel cell module
Exhaust
Integrated heat recovery (not shown)
Power Management System
Water treatment
Modular Generator

Can be installed as:
- Electric generator system; no heat recovery
  = power only
- Co-generation system; with heat recovery
  = power + heat

Flexible, modular
co-generation system
suitable for many market segments

Installed inside or outside,
at homes and other buildings

Electricity used on-site and
exported back to the grid

Clean Power for Victoria

CFCL’s modelling shows BlueGen can deliver significant benefits in the Victorian market
Each BlueGen unit can produce up to 17,000 kWh of electricity per year

- Enough to power the average Victorian home and export the excess to the grid

BlueGen also makes enough heat to produce 200 litres of hot water per day

- Enough to meet the daily requirements of the average Victorian home
  
  (Australian Standards; Sustainable Energy Authority Victoria, Estimated Household Water Heater Energy Use Report 2005)

Assumes a BlueGen unit operated at 2kW constantly

- 24hr, 7 day, 365 days operation; connected to a hot water tank
More Than Twice as Efficiently as the Grid...

**World leading electrical efficiency**
- BlueGen has achieved 60% electrical efficiency
- Model uses 60% electrical efficiency plus 25% thermal efficiency
  = total system efficiency of 85%

**Average efficiency of Victoria’s current brown coal generators is about 25% at the home**

  *(Australian Government, Generator Efficiency Standards; Loy Yang Power Sustainability Report 2007)*
- So 75% of all the original fuel energy never makes it to the home

**Brown coal power stations currently produce 95% of Victoria’s electricity**

  *(The Climate Institute, January 2009)*
Which Saves Money...

BlueGen forecast to generate electricity at a cost of 11.1 cents per kWh
- Includes the value of the heat and carbon credits
- ~39% cheaper than current Victorian electricity prices (18.1 cents per kW incl GST)

BlueGen forecast to cost around $8,000 per unit – when in mass production
- Forecast payback of seven years, product lifetime of 15 years

This assumes the unit is owned directly by the homeowner:
- Assumes average Victorian home uses 7,000 kWh of electricity per year
- Assumes the home exports 10,000 kWh to the grid for a feed in tariff of 16.5 cents, i.e. equal to the retail price (excl GST)
  (Victorian electricity retailers must offer a fair and reasonable tariff for power exported from a small “renewable” generator. Tariffs will vary between retailers.)
- Assumes the homeowner pays 4.1 ¢/ kWh (incl GST) (1.13 ¢/ MJ) for natural gas
- Homeowner pays for maintenance, including new fuel cell stack every 5 years
And Cuts Greenhouse Gas Emissions...

The facts:

- Victoria’s energy demands forecast to increase by 50% by 2030
  
  *(Sustainability Victoria)*

- Victoria’s greenhouse gas emissions have increased by 6% since 2000
  
  *(The Climate Institute, January 2009)*

The future:

- By 2050, the Victorian Government aims to reduce emissions by 60%
- By 2020, the Federal Government aims to reduce emissions by at least 5%

  *For Victoria, this means a reduction of approx 6 million tonnes of CO₂e from 2000 levels*

The solution:

- When one BlueGen is connected to a gas hot water unit in Victoria:
  - CO₂ emissions are reduced up to 75% (18.6 tonnes per BlueGen per year)

- BlueGen + electric water heater saves even more CO₂ (up to 28 tonnes per year)

- Unlike brown coal, no nitrogen oxide and no sulphur dioxide emissions
Oh... It Also Saves Precious Water!

**Current brown coal generators:**
- Consume about 2.2 litres of water to generate 1kWh of electricity
  
  *(Loy Yang Power Sustainability Report 2007)*

- Water is becoming more scarce and valuable in many markets, including Victoria

**BlueGen cuts this water use by up to 95% - when installed as:**

- Electric generator system; no heat recovery
  
  = *power only*

  0.82 litres of water to generate 1kWh of electricity

- Co-generation system; with heat recovery
  
  = *power + heat*

  0.12 litres of water to generate 1kWh of electricity
Q. What are the target markets for BlueGen?
   A. The earliest markets are Australia, Japan, parts of Europe
      Also looking at opportunities in North America

Q. Who will make the product and when will it be ready for sale?
   A. We will make a small number of demonstration units – we have already made 3 prototype units
      We are talking to potential manufacturing partners about them making the units in larger numbers.
      Plus, we need to obtain safety approvals for the product.
      We hope to deliver units to organisations and institutions from early 2010.

Q. What are the special requirements for installation BlueGen?
   A. BlueGen has been designed like a normal fixed appliance – connection of services (gas, water, 
      ventilation & drainage) needs to be completed by a suitable qualified gas-fitter/plumber.
      In some cases the hot water tank may need to be upgraded.

Q. Can BlueGen operate on LPG and be used for remote power?
   A. At the moment, unfortunately not, BlueGen is a grid parallel system and operates
      on the reticulated Natural Gas network

Q. Where can I find more technical information?
   A. The BlueGen Brochure lists the specifications of the unit
      (performance, consumption inputs & outputs etc)