



# Smart Power

JULY 2006 - Vol 6

CLEAN POWER FOR YOUR HOME

## EWE orders 10 NETGEN™ units

### Further step toward

In June CFCL signed a further contract with EWE, the fifth-largest German multi-service energy company, validating the initial field trials that began in January 2006. Under this agreement, CFCL will supply EWE with ten NetGen™ units for further field trials as part of a collaborative project to develop commercial-ready micro CHP products for the European market. This is CFCL's most significant contract to date, and takes the company within striking distance of its target of selling 12 NetGen™ units by the end of 2006.



This contract follows an initial order of two field trial units by EWE in July 2005 and a Letter of Intent signed by the companies for a commercialisation programme for fuel cell based m-CHP systems for the residential market, using CFCL's core stack and balance of plant technology.

Brendan Dow, Chief Executive Officer, CFCL, commented:

"This order of 10 units is a significant milestone for Ceramic Fuel Cells, validating the field trials and demonstrating EWE's commitment to progress the commercialisation programme in the consumer market by installing fuel cell powered m-CHP units in the home. This order is also further evidence of CFCL's progress towards full commercial roll-out in 2008-09.

"In addition to this order of units, we are continuing to work closely with EWE to develop commercial-ready products. We are also building a pipeline of opportunities with other utilities and appliance partners and will be updating the market on further progress in the coming months."



## Senior Managers join UK office

*In June we welcomed two senior staff members to our office in Chester, UK.*

*Mike Aktinson joined us as Manager - Capital projects, a new senior position reporting to CEO Brendan Dow. Mike will be responsible for managing CFCL's large projects, in particular the powder plant and the fuel cell manufacturing plant. Mike is a senior projects manager with extensive international commercial and engineering experience in managing major capital projects in high technology industries.*

Mike joins CFCL from six years at Johnson Matthey where he was responsible for managing the construction of Johnson Matthey's large dedicated UK manufacturing facility for fuel cell components, from site selection and factory construction, through to equipment procurement and commissioning and factory operations.



Mike Aktinson

Mike holds an honours degree in chemical engineering and is a Chartered Member of the Institution of Chemical Engineers.

We were also joined by **Simon Howard** as **Powder Manufacturing Engineer**. Simon is a specialist ceramics engineer with 17 years' experience in engineering and technologist roles in ceramic manufacturing companies, with a Higher National Diploma in Ceramic Technology.



Simon Howard

Both appointments reflect our increased focus on commercialising our technology and scaling up production, particularly in the European market.

## Broker Briefings

In May CEO Brendan Dow gave briefings to brokers and investors in Melbourne and Sydney, including an update on the Company's commercialisation activities. A copy of the presentation is available on [www.cfcl.com.au](http://www.cfcl.com.au), or by contacting our office.

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**P2 Fuel Cell Development Since 1992...**

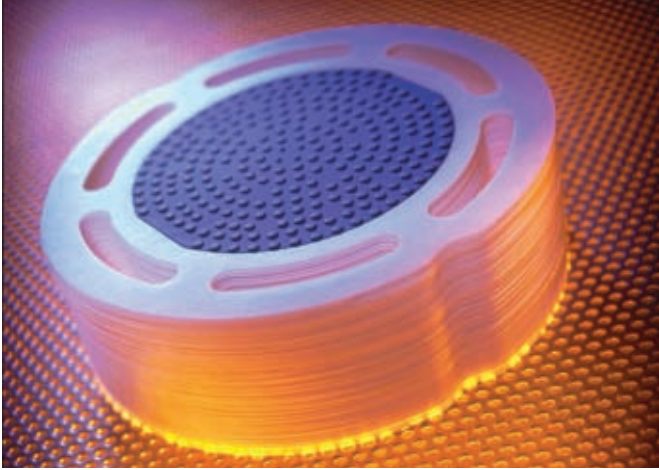
**P3 Rethinking Energy in the UK, Finance, ASX and AIM - FAQs**

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For further information on any of these subjects go to CFCL's website: [www.cfcl.com.au](http://www.cfcl.com.au)



# Fuel Cell Development Since 1992...



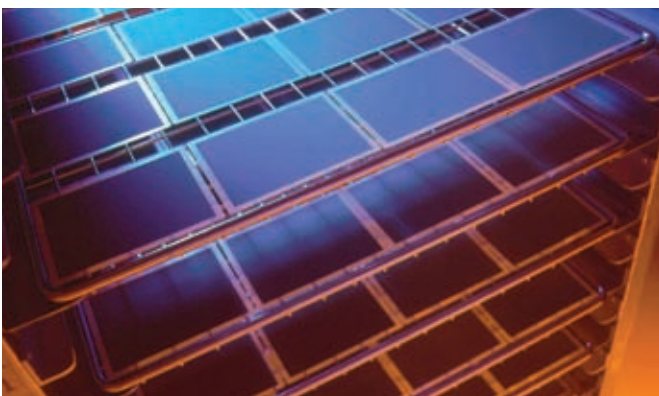
*In this issue of SmartPower we take a step back in time and give shareholders a quick tour of the Company's technology as it has developed over the years and how that knowledge can be important for the Company's future.*

## Early 1990s – Beginnings...

A coordinated R&D effort in solid oxide fuel cell (SOFC) technology was started by Dr Karl Föger and his colleague Dr Sukhvinder Badwal in early 1989 at the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia's leading research institute. In mid 1992 CFCL was founded by a consortium of leading energy and industrial companies, government bodies and the CSIRO.

CFCL developed the first generation of its fuel cells from 1993 to 1995. The first cells were 25cm<sup>2</sup> and 100cm<sup>2</sup>, made of thin (0.1mm) sheets of ceramic (doped zirconium oxide -YSZ), and stacked up on metal interconnect plates to form the Company's first fuel cell 'stacks'. These stacks successfully generated electricity at 930 - 1000°C.

The second generation of cells was made from 1996 to 1997. The major change to Generation 2 was to improve the metal interconnect plates and to reduce 'leaks' in the fuel cell stack. The plates were made from stainless steel, to reduce costs. The cells were similar to those in Generation 1, but with thinner electrolytes, and improved anodes and cathodes. Importantly, the stacks could



'internally reform' gas into its useful parts to ensure that the system is highly efficient.

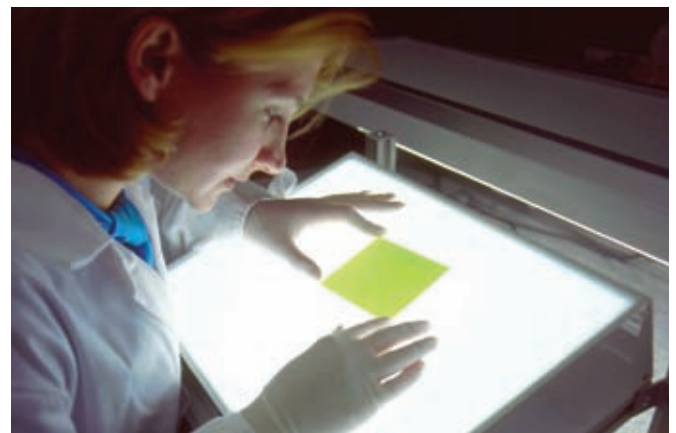
As with Generation 1, CFCL's 1kW and 3.5kW fuel cell stacks successfully produced electricity at about 930°C.

## Late 1990s – Scaling Up

From 1997 to 2000 CFCL scaled up cell production and system development with the design, construction and testing of a 25 kW system. This system incorporated a Generation 3 stack made of multiple thin steel interconnect plates, internally manifolded in 2x2 and 4x4 arrays (window frame arrangements). The cell materials were similar to Generation 2 with thin ceramic (YSZ) electrolytes of 90mm x 110mm and anodes that were capable of internal methane reforming.

Between 1997 and 2000 a number of kW size stacks were operated successfully on natural gas and propane at about 850°C.

One of the challenges of using metal plates in between ceramic cells is the different **Coefficient of Thermal Expansion** or CTE. This can cause the fuel cell stacks to crack, and has been a problem for many SOFC developers. In late 2000 CFCL began designing an all-ceramic stack to overcome this problem.



## 2000s – Focus on Product

From 2001 to 2004 CFCL developed an all-ceramic Generation 4 stack. This ceramic cell (electrolyte, anode, cathode) was similar to previous cells, but this time the cells were stacked between very thin ceramic plates and seals, not metal ones. This stack operates at slightly lower temperatures (800-850°C), but like previous cells, still internally reforms the input gas. This 'all-ceramic' fuel cell stack overcame the 'CTE' problem of ceramic/metal stacks.

In mid 2003 CFCL began to focus on a 'product' for its SOFC technology, namely micro-CHP systems in the 1-5kW size range.

In 2004, CFCL began a commercialisation phase with the evolution of the 'all-ceramic' Generation 4 design, leading to a higher power per layer and lower cost product. It was designed from a product specification approach, where the cell properties were matched to the desired stack requirements, which in turn were built into early CHP units.

These 1kW stacks are integrated into the CHP field trial units that have been deployed since mid 2005.

# Smart Power

## 2004-06+ – Power Improvement

CFCL has continued to work on improving the Generation 4 cells, particularly to generate more power from each cell, to make the fuel cell stacks easier and cheaper to manufacture and to make them last longer. These improvements will help to make fuel cells cost-competitive with existing energy technologies.

In parallel, CFCL has also solved a problem with earlier metal / ceramic stacks, namely the cathode being 'poisoned' by volatile chromium emissions from the metal plates, by developing and patenting low cost coatings for standard stainless steels and other metals.

## So what does all this mean?

CFCL has a wealth of experience with many SOFC designs and materials, having successfully designed, built and operated both 'all-ceramic' and 'metal supported' kW size fuel cell stacks. This broad expertise is reflected in CFCL's intellectual property portfolio, including 28 patent families around its principal inventions.

This is important as it gives the Company a wide range of expertise and background knowledge to continually improve the Company's cells. The Company looks forward to announcing further technical improvements over the coming months.

## "Jargon Buster"

**CHP** – combined heat and power. Domestic CHP systems produce electricity and heat for the home, and will be the first application powered by CFCL's fuel cells.

**CTE (Coefficient of Thermal Expansion)** – the rate at which a material heats up or cools down. A problem for fuel cell developers is when different materials used in a stack, such as metals and ceramics, expand at different rates. If these materials are "sealed" together but are moving apart at different rates, the seals can break leading to a faulty stack.

**Electrolyte** – a substance that carries electrical current by the migration of ions. Together with the external connections of a fuel cell, this allows the creation of an electrical circuit.

**Reforming** – the process of converting hydrocarbon fuels (such as natural gas, LPG, diesel and biogas) to a hydrogen-rich gas stream for use in a fuel cell. CFCL's fuel cells operate at sufficiently high temperatures to be able to convert fuel to hydrogen within the fuel cell stack itself - this is known as internal reforming. This means CFCL's systems do not need expensive external reformers.

**SOFC** – a type of fuel cell made with a solid oxide as the electrolyte.

**Stack** – fuel cells combined one on top of the other to form a fuel cell stack which provides higher voltage and higher power than a single cell.

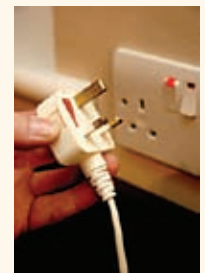
**Thermal Cycling** – the ability of a fuel cell stack to change from room temperature to operating temperature and back to room temperature (ie be turned on and off repeatedly).

**Yttria-stabilized zirconia (YSZ)** – is a dense white powder of high chemical purity which CFCL uses to make its electrolytes and separator plates. It is a compound of zirconium dioxide and yttria ( $ZrO_2 + Y_2O_3$ ). Stabilized zirconia is used in fuel cells (and oxygen sensors) because it has a unique ability to allow oxygen ions to move freely through the crystal structure, particularly at high temperatures.

## Rethinking Energy – Distributed Generation in the UK

On 11 July 2006 the UK Government released *The Energy Challenge*, a significant review of the UK's energy future. The report looks at how the UK can deliver secure, clean energy at affordable prices, whilst tackling climate change by reducing carbon dioxide emissions.

The report places a welcome emphasis on using our existing energy sources much more efficiently. A whole chapter is devoted to Distributed Generation – where electricity is generated close to where it is used, not in large centralised power stations. 'Micro CHP' units, powered by fuel cells, are a form of distributed generation.



The report notes that "a 'distributed' system could fundamentally change the way we meet our energy needs, contributing to emissions reduction, the reliability of our energy supplies and potentially to more competitive energy markets."

This report continues the moves by the UK Government, which we profiled in our last newsletter, to encourage



microgeneration and invest in new energy technologies. It is clear that UK policy makers are creating a receptive environment for domestic CHP units powered by CFCL's fuel cells.

## Finance

In early June the last of the convertible notes, issued in August 2005, were converted into CFCL shares. All of the notes, issued to raise A\$8.2M, were converted to shares, rather than being paid back by the Company. This represents a significant cash saving to the Company.

## ASX and AIM - FAQs

In our last edition we answered some Frequently Asked Questions to help shareholders understand CFCL's dual listing on ASX and the London AIM market – including how to trade shares on each market. If you would like a copy, please download the last newsletter from our website, or contact us and we will email you a copy.

## Patent portfolio extended

*In May CFCL was granted two new Australian patents relating to its fuel cell technology and has applications in respect of the technologies pending in Europe, USA, Japan, China, Canada, India, and Norway.*

The first new patent relates to ceramic powders, which are a key material used in the production of solid oxide fuel cells. The patent protects a continuous reactor process which produces chemical products of exceptionally uniform quality at high production rates. CFCL developed the process to produce consistently high quality powders for its fuel cells, and the Company believes there is significant potential for the technology to be applied outside the fuel cell industry.

The second new patent is for a process of producing electricity using fuel cells operating with a fuel supply that includes hydrocarbons higher than methane, for instance LPG and ethanol. CFCL's fuel cells can already use natural gas, syngas and hydrogen to generate electricity. CFCL believes this innovation can create additional product and market opportunities by cost effectively expanding the range of fuels suitable for CFCL's fuel cell based power generators.

## Shareholder Open Day

*We are again inviting shareholders to visit our head office and factory in Noble Park.*

Our next Open Day will be on **Wednesday 30 August 2006**, 10 – 11.30 am.

Attendance is limited to two adults per shareholding and pre-booking is essential. Both previous Open Days have been booked out, so get in early!

If you would like to attend please email [reception@cfcl.com.au](mailto:reception@cfcl.com.au) or call **+61 3 9554 2300** during Melbourne office hours. Be sure to provide your full name, shareholder HIN or SRN, email address and daytime phone number and we will notify you to confirm your place.

## Research Note

UK research firm Equity Development has completed a research note on CFCL, which is available at [www.equitydevelopment.co.uk](http://www.equitydevelopment.co.uk)

The full report may be downloaded by registered users (registration is free). Alternatively, contact our office to obtain a copy.

## More information...

### About your CFCL shareholding on ASX:

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## Spreading the word

*CFCL is continuing to raise its profile by participating and presenting at key industry events:*

Fuel Cells for a Sustainable World, Lucerne, 5 July 2006  
Synnogy New Energy Consortium, UK, 6 June 2006

Copies of CFCL's presentations are available at [www.cfcl.com.au](http://www.cfcl.com.au), or by contacting our office.



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