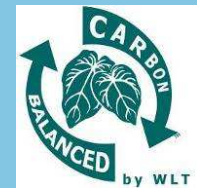


Voller Energy

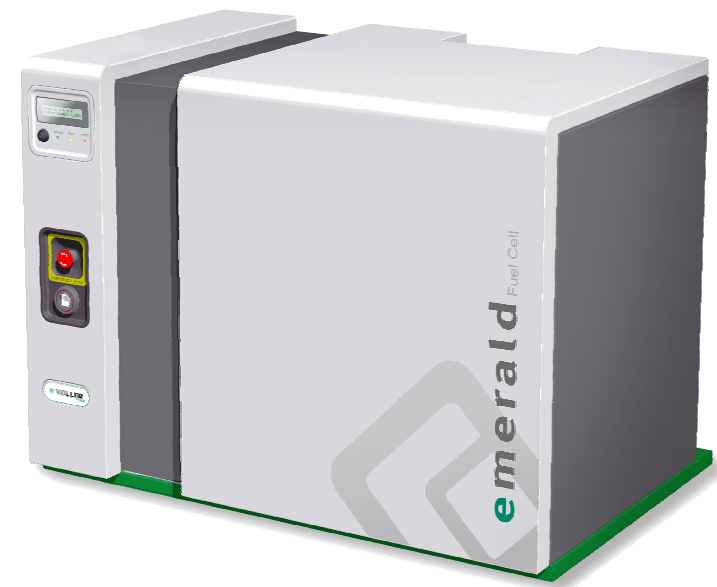
Putting fuel cells to work
Engine Expo 2008



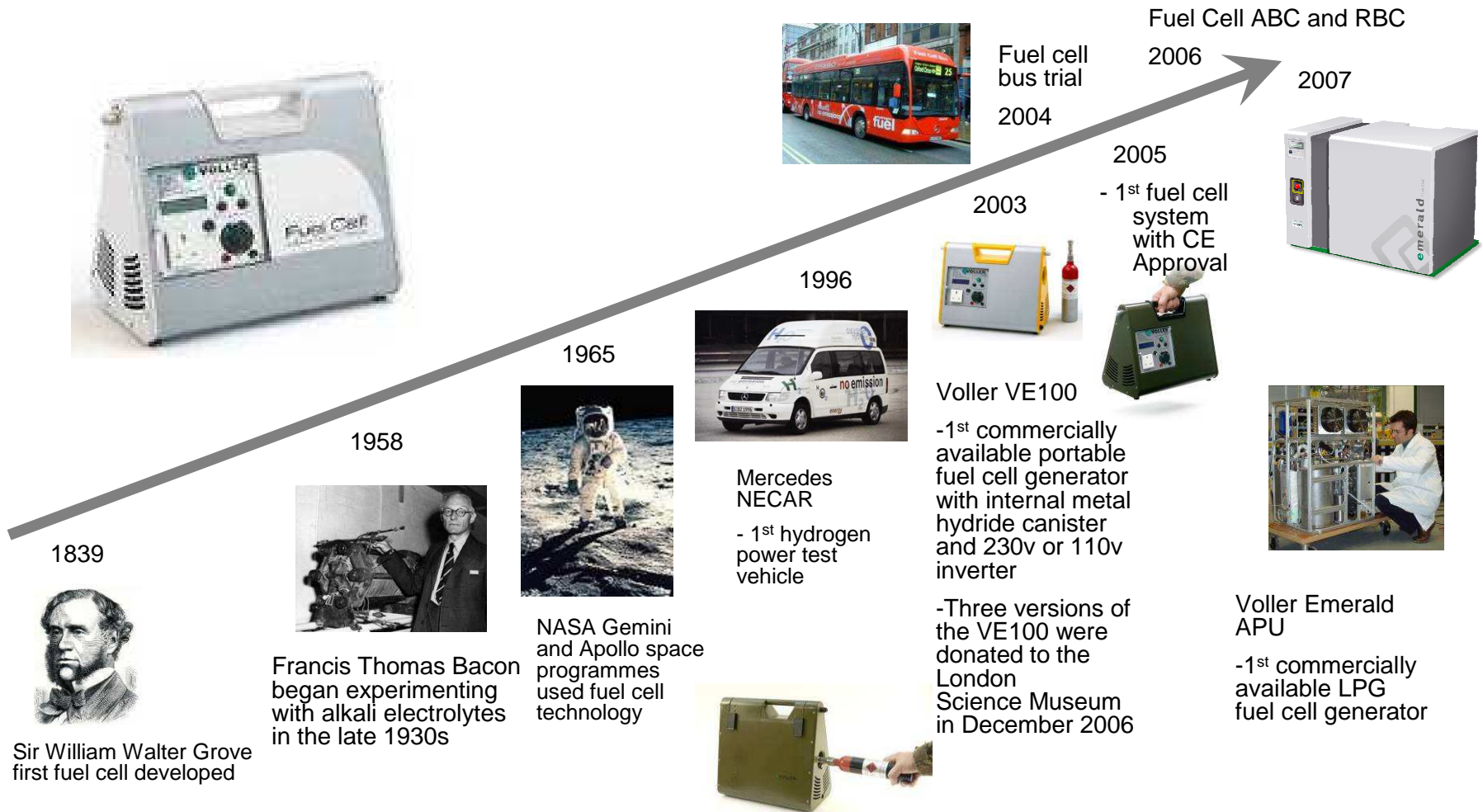
Conserving biodiversity
while offsetting carbon
emissions

Voller Energy Group PLC (LSE:VLR)

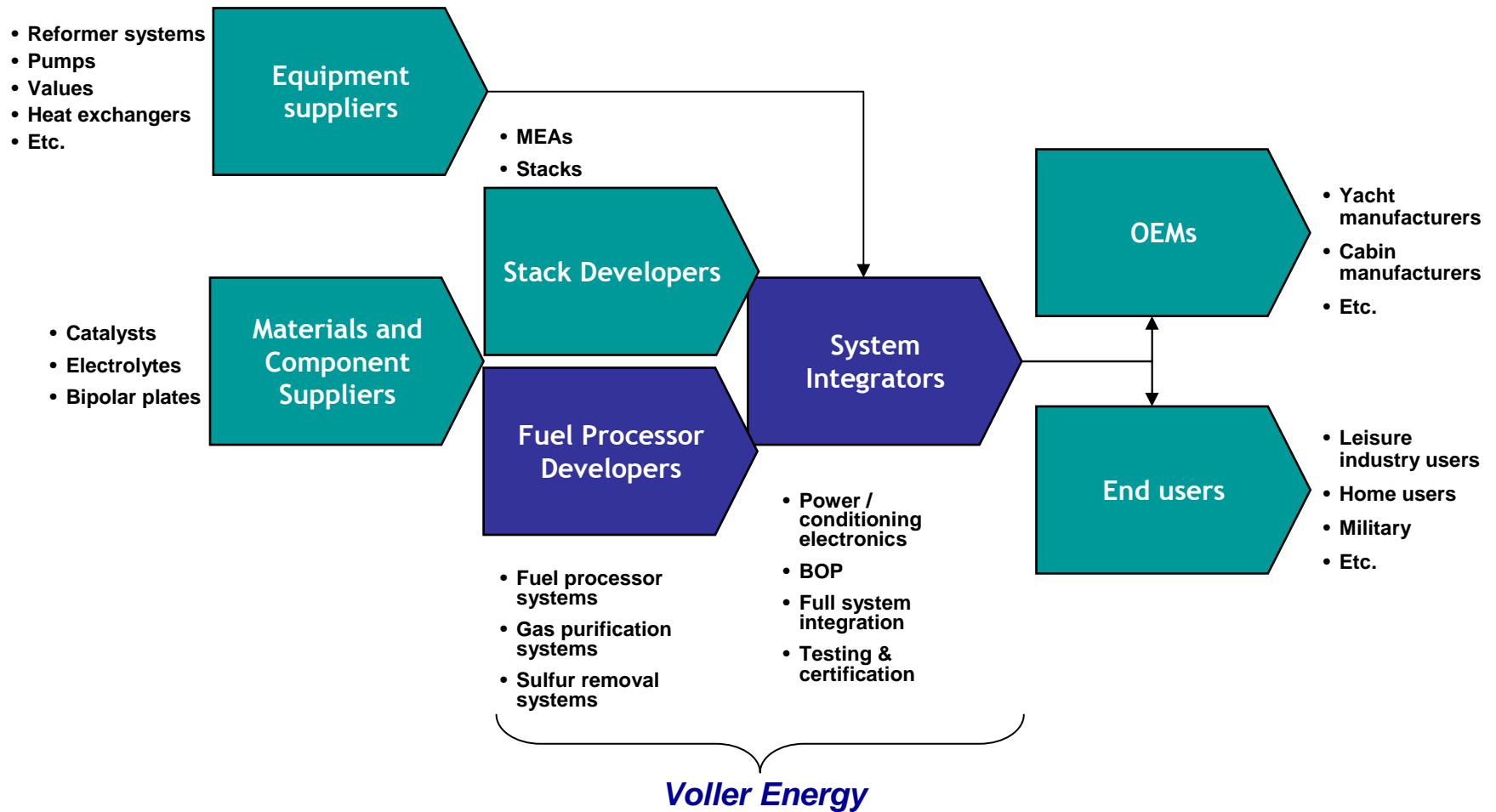
- Founded 2002
- Based in Basingstoke England
- ~ 26 People.
- We develop portable power systems.



The History of Fuel Cells



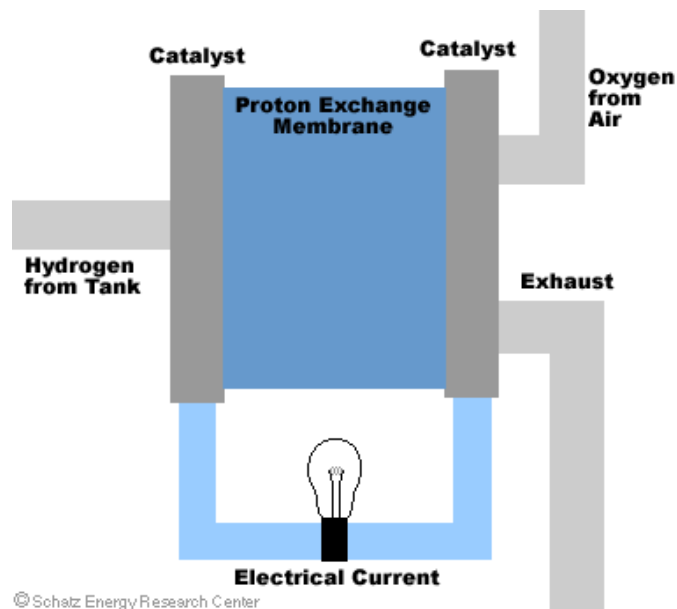
Value Chain



Basic Fuel Cell Knowledge

The Fuel Cell Stack

- Hydrogen plus Oxygen = Energy and Water
- $H_2 + \frac{1}{2}O_2 \rightarrow H_2O + \text{Energy}$



x 48 = Fuel Cell Stack

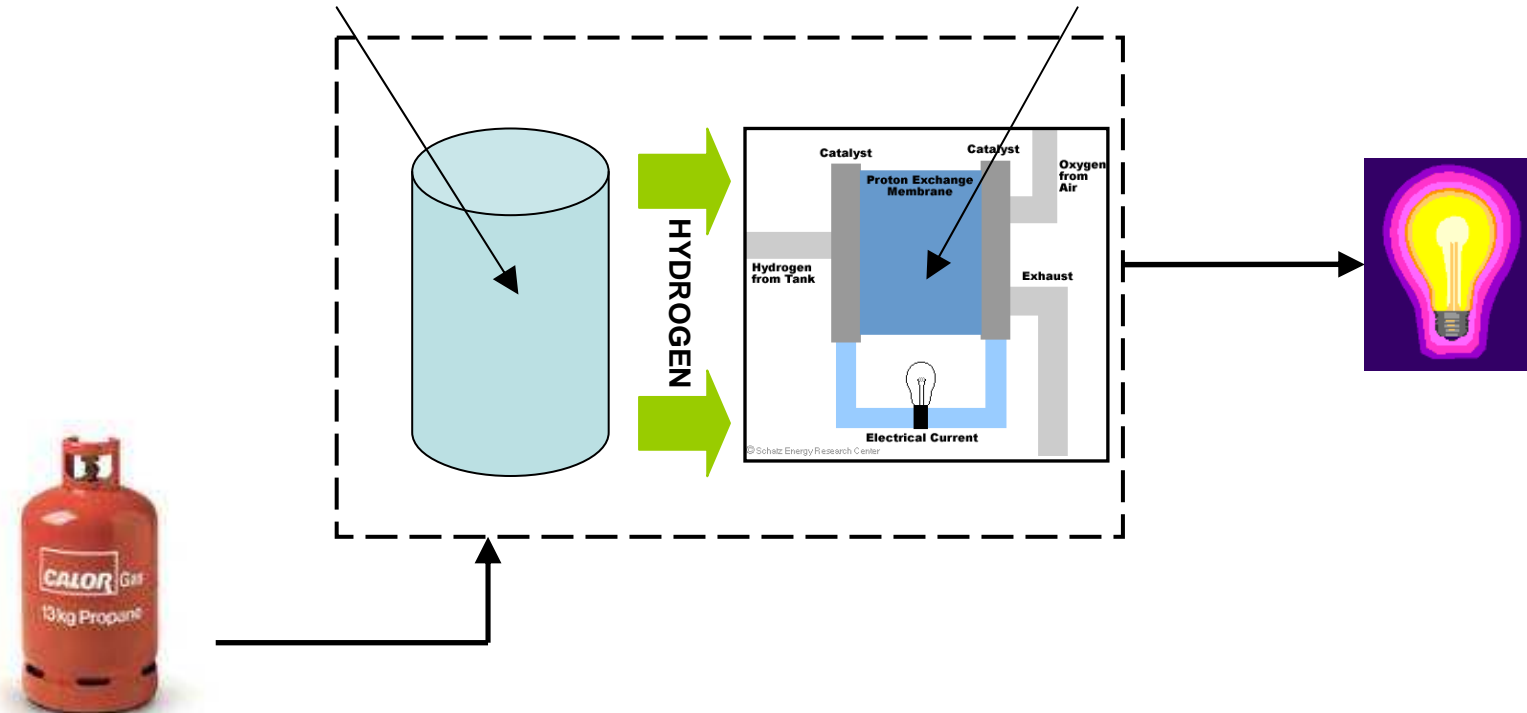
Basic Fuel Cell Knowledge

The Emerald

The Emerald system is therefore comprised of two halves

Propane Reformer

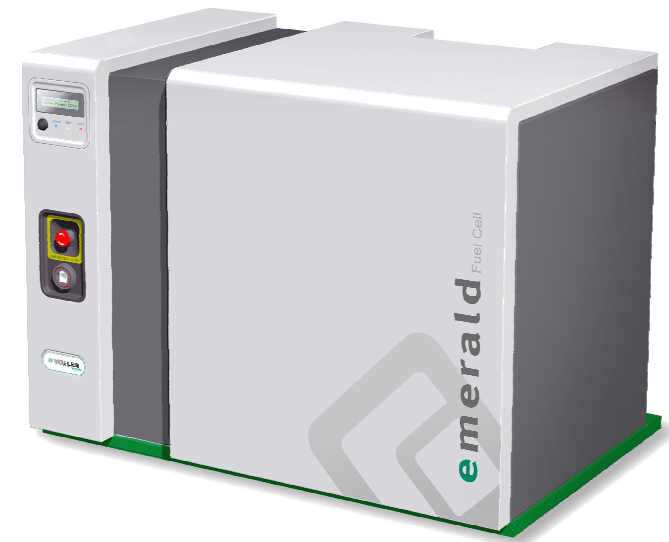
Hydrogen PEM Fuel Cell Module



Putting Fuel Cells to Work: The Difference

- Firstly may I say that fuel cells will not replace generators in the next 10 to 20 years, they will work along side them.
- Fuel cells and generators fulfil a similar role but not in the same way.
- Generators are usually specified to meet the peak load required.
- Fuel cells should be specified to meet the base load requirements.

How does this work?



Putting Fuel Cells to Work: The Diesel Generator

- Taking the case of the 6kW diesel Generator. The unit is versatile, it can generate up to 6kW and down to a few hundred Watts.
- Making the engine economical over this range is difficult and is costly, so the unit is generally configured to operate on a fixed RPM (optimised for the 50% to 100% power range) economy and emissions become an issue at <50% power take off.
- Car engines are becoming very efficient and are getting more environmentally friendly.
- Is it possible to use the same technology on a portable genset and still sell at today's prices?

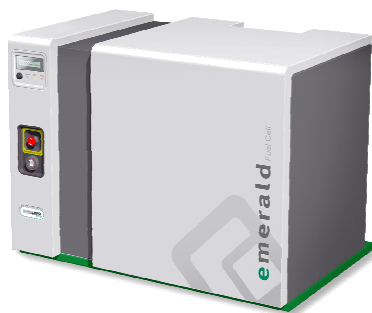
Generators run best at full power, fuel cells also run best at full power.



Putting Fuel Cells to Work: The Fuel Cell System

- Fuel cells are sized to cope with the total power required in a 24hr period.
- The fuel cell creates the power, the batteries store the power and the inverter supplies it.
- Fuel cells operate at full power while charging the batteries then stop when they are full. The customer uses the power from the batteries as their supply when they need it.

An ideal portable fuel cell application is a load of <50% of its total output capability (24hr).



fuel cell

+



batteries

+



inverter

Putting Fuel Cells to Work: Voller Energy “Emerald” – APU

Fully integrated LPG reformer and fuel cell system - *LPG in, power out*

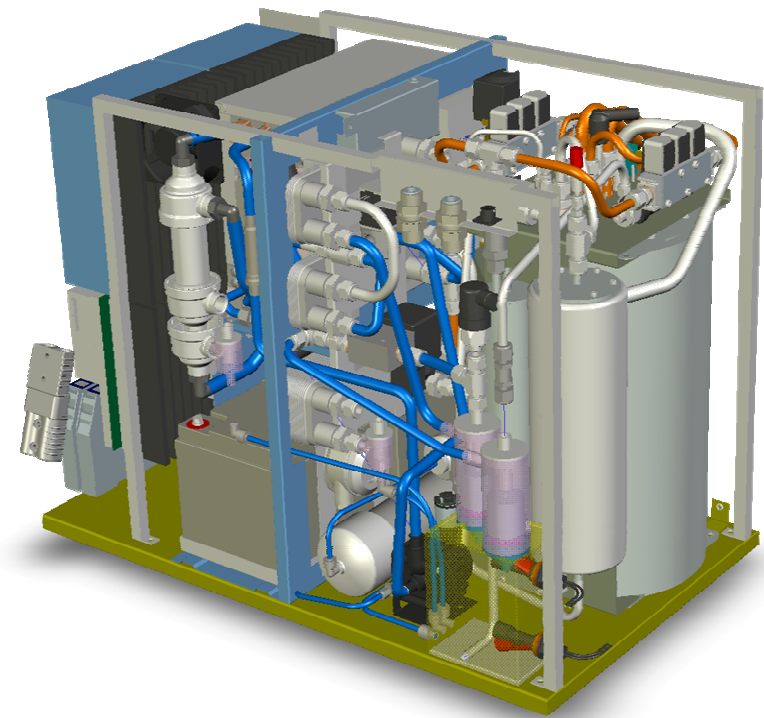
Designed as “fit & forget” automatic battery charger system

Continuous electrical output 0.8 – 1 kW possible

AC and 2-5 kW peak power provision via battery bank and inverter

~1.5 kW of thermal energy available for space and water heating

Remote diagnostics and data capture
Quiet, clean, efficient



Putting Fuel Cells to Work: RV's and Yachts

The Drivers:

- Quiet
- Low vibration
- Low emissions

- Longer maintenance intervals
- More fuel efficient
- Uses propane or LPG



Putting Fuel Cells to Work: The Construction Markets

Why are the markets interested?

- The mobile construction cabin market (UK) is interested in reducing the maintenance costs.
- Fuel cells require next to no 'on-site' maintenance.
- Data from the systems can be accessed over the web or modem.



Putting Fuel Cells to Work: The Road Sign Markets

Road signs (mobile and static)

- The interest is in quiet, 'clean' systems for environmentally sensitive areas.
- Cleaner fuel, longer run times, less maintenance.
- Access to data over the web or modem.



Putting Fuel Cells to Work: The System Data

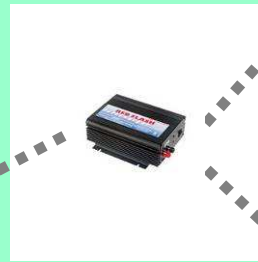
Core Product

LCD control panel – option to position on appliance or remotely via ethernet connector and cable

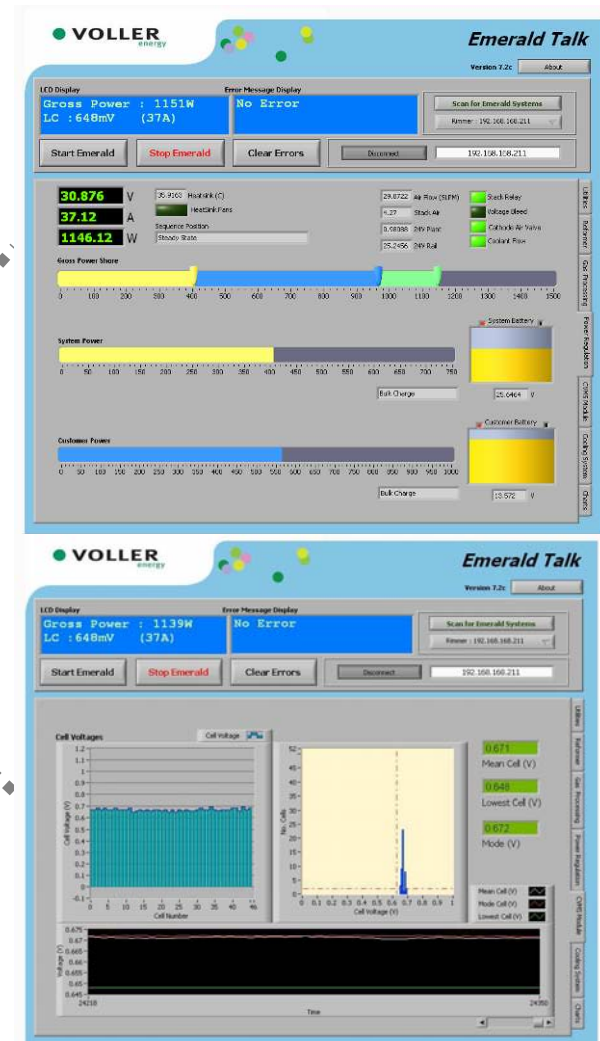


Ancillary Product (Optional Extra)





External processor device for running enhanced GUI software and web browser



modem



Putting Fuel Cells to Work: Higher power, choice of fuels

| | | | |
|---|---|-----------------------|---|
|  | 1 kW | 3-5kW |  |
| <p>Gas fuels : Propane, LPG (Calor Gas), Natural Gas</p> | <p>2008 → 2009/10</p> <p>2008 → 2010/11</p> | | |
| <p>Liquid fuels : Diesel, bio-diesel, JP-8, kerosene</p> | <p>2010/11 → 2010/11</p> | | <p>Collaboration with University of Cambridge, plus internal program, plus other collaborations</p> |
|  | Some Air Conditioning | Full Air Conditioning |  |

* N.B. Target dates for commercial launch. Prototype systems generally a year earlier.