

# BOC Hymera - 150W Hydrogen Fuel Cell

## For Universities embarking on Fuel Cell Research



**The first commercially available off-the-shelf portable hydrogen fuel cell generator**  
**Provides an ideal introduction to fuel cell system design and use**

### Why Fuel Cells?

#### Ready to use today

- Small portable fuel cells are commercially viable today
- There are a wide range of applications where fuel cells could be used, but end-user products have yet to be built
- For small systems hydrogen supply is straightforward

#### Benefits of Fuel Cells

- Near silent operation
- Wide variety of sources to produce hydrogen
- A 10kg hydrogen cylinder provides the same useful energy (3kWh) as 100kg of lead acid batteries
- Zero ecologically harmful emissions

#### Why Arcola Energy?

- Arcola Energy is a fuel cell system integrator, active in a wide range of fuel cell application markets including education, portable power, transport and stationary.
- The company has its origins in academia, but is now focused on end-user applications.
- As part of our commitment to hydrogen and fuel cell use we have created a package to support universities in creating teaching resources, lab-based undergraduate projects, MSc projects and early stage research projects.
- We have significant experience in working with universities including Aston, Cambridge, Coventry, Greenwich, Imperial & Oxford.

### Learning areas for fuel cell operation and system design

Understanding overall system layout and function of key components

- Hydrogen system
- Fans
- PEM stack
- Internal battery
- Control circuit
- Output DC/DC controller

Understanding relationship between stack voltage and current

Measurement of hydrogen consumption against stack system power

Principles of efficient design

- How efficient is overall system and what are sources of energy loss?
- What measures could be taken to improve efficiency?

### Possible integration projects & research areas

- Hybrid renewable energy/fuel cell off-grid power source
- Fuel cell powered cart/bicycle
- Design/build hybrid power supply using battery and fuel cell
- Design/build optimised hybrid power supply considering battery size, charge time, output power and hydrogen consumption
- Design/build optimal battery management system to use with fuel cells (variable output voltage/current for different battery chemistries)
- Fuel cell powered 'garden shed'
- Thermal management
- Principles of efficient fuel cell system design
- Power electronics and control for mass-parallelized fuel cells
- Fuel cell system engineering for specific applications – remote cameras, materials handling, remote offices, UPS
- Development of higher efficiency fuel cell balance of plant systems
- Investigation of fuel cell performance and principles
- Integration of renewable energy sources and batteries
- Design of control systems

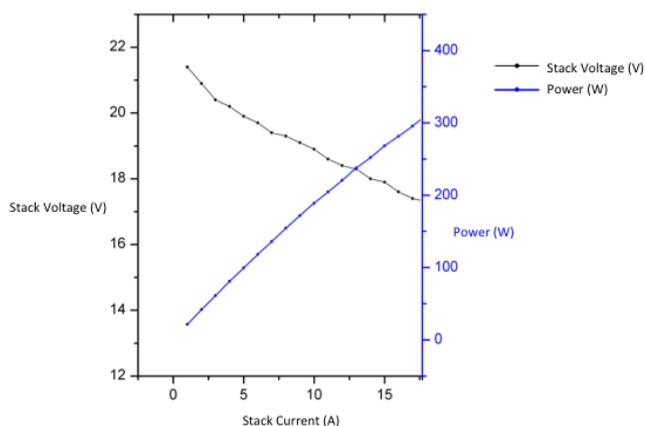
### What is included?

- BOC Hymera 150W fuel cell generator.
- Diagnostic unit to feed data from Hymera in to computer.
- Onsite support from experienced fuel cell engineer to set up system and initiate projects.
- Online user forum with application ideas and ongoing technical support.
- Introduction to larger and more complex systems, for example Eco Marathon lightweight vehicles.

### Technical Specifications

|                               |                           |
|-------------------------------|---------------------------|
| Rated output power continuous | 150W                      |
| Peak output power short term  | 200W                      |
| AC output voltage             | 230Vac / 110Vac           |
| DC output voltage             | 13.3-14.2 V               |
| Maximum DC output current     | 12 A                      |
| Typical gas consumption       | ~1 litre/min @ 100W       |
| Efficiency                    | > 50% @ 100W and above    |
| Operating temperature         | 0-35°C                    |
| Lifetime                      | 1000 Hours-450 Start/Stop |
| Weight                        | 7.38 kg                   |
| Noise Level @ 1m distance     | 60dB max 45dB typical     |

### I/V Curve



### Some power comparisons

#### Hymera

- 14VDC, 14VDC/110VAC and 14VDC/230VAC models
- Cost: £1,500 (at volume)
- Electrical energy produced at 50% hydrogen fuel cell efficiency

| Cylinder Type | K  | GENIE (Lrg) | GENIE (Med) | 54-ZH |
|---------------|----|-------------|-------------|-------|
| Energy (kWh)  | 11 | 7           | 3.5         | 3     |
| Weight (kg)   | 65 | 22          | 16          | 10    |

#### Small diesel generator

- 20% efficient at 1.5kW
- Efficiency reduces with output
- Typical diesel generator 1% efficient at 50W

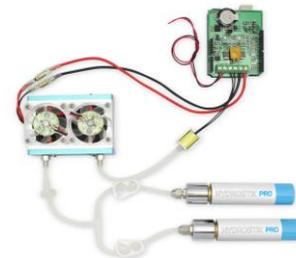
#### Batteries

| Battery Type          | Output | Mass    | Cost  | Charge time |
|-----------------------|--------|---------|-------|-------------|
| AA (non-rechargeable) | ~2.5Wh | 25g     | ~50p  | N/A         |
| Lead-acid             | ~500Wh | 10-12kg | ~£75  | > 8 hours   |
| Lithium Ion           | ~500Wh | 3-4kg   | ~£200 | < 1 hour    |
| Deep Cycle            | ~1kWh  | ~35kg   | ~£225 | > 8 hours   |

### What else is possible?

#### H2MDK

The perfect starting point if you want to create your own fuel cell power system. The kit contains everything you need to build a 1.5-30W fuel cell power source including hydrogen storage, hydrogen supply tubing, fuel cell, valves and electronic controller. Integration with the popular Arduino development board allows easy connection to a computer to monitor performance.



#### Stacks & Lab Systems

Horizon's fuel cell stacks are simple, air-breathing, air-cooled, self-humidified systems requiring minimal peripherals. Provided in kit format complete with air blower, control electronics and hydrogen supply valve. Ranging in size from 10W to 5kW.

A wide range of custom designed lab systems are also available from less than 1W up to 5kW.

All fuel cell stacks and lab systems are available to buy now with a lead-time of 2-4 weeks for stacks and 4-8 weeks for lab systems.



#### Automotive

Arcola Energy has significant experience within the automotive industry having spent the last few years working closely with hydrogen fuelled car developers RiverSimple and Microcab. During this time also developing the AutoPAK range-extender, a turnkey automotive fuel cell solution for high-efficiency lightweight electric vehicles.



#### Feedback

"It was most useful to have a knowledgeable partner to work with in relation to this project, which has now put us in a better position to undertake research projects on fuel cells and I therefore hope to be able to work with Arcola Energy on other interesting projects in the future."

**Dr. Wim J.C. Melis, Senior Lecturer  
Greenwich University School of Engineering**

"Hymera offers a new and practical alternative to conventional fuels. Ideal for high-tech, high efficiency applications that require low power but for a long period of time. Arcola Energy is our integration partner for a wide range of projects."

**Stewart Dow, Packaged Energy Manager, The Linde Group**