

Fuel cells : a zero emission alternative for temporary and off-grid power

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Led by GLA – works with wide range of companies on promotion and development of hydrogen fuel cell technologies, applications and markets for transport and stationary applications: securing jobs, investment and environmental benefit

Transport Working Group

- Hydrogen as a platform for elimination of vehicle emissions



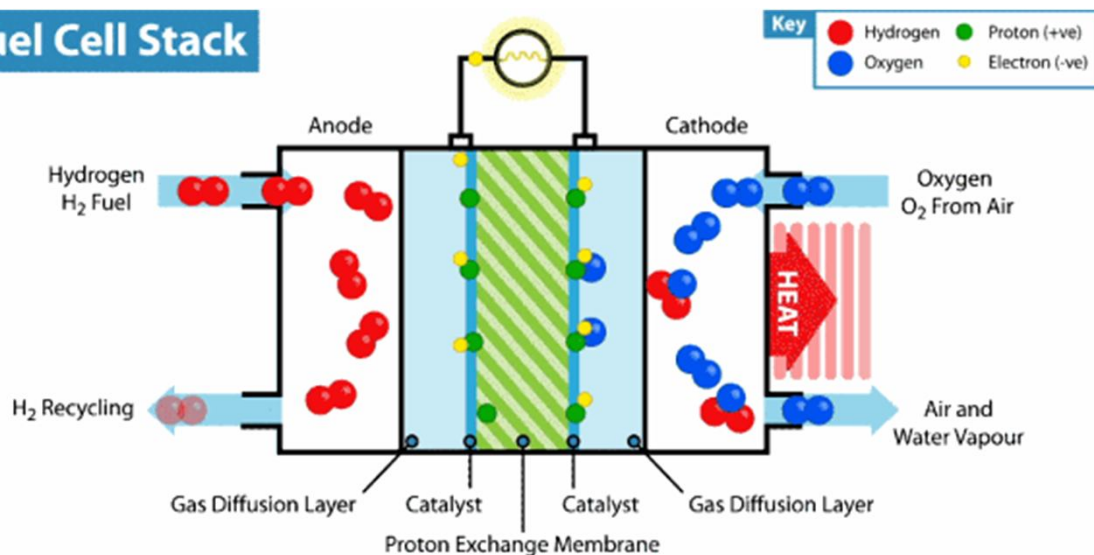
Stationary & Transportable Working Group

- Development of stationary and portable applications, from Watts (cameras) to Megawatts (large-scale CHP)



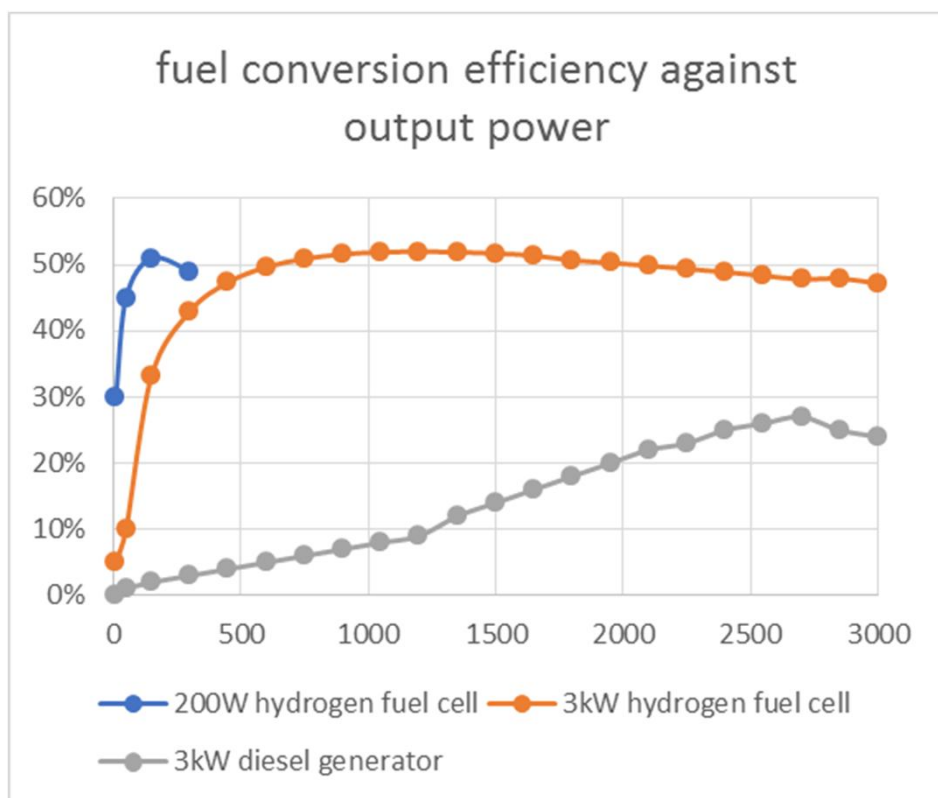
Fuel cells: silent and efficient power generation with almost zero service requirements

Fuel Cell Stack



- An electrochemical device that generates electrical power from reaction of a fuel (hydrogen) with oxygen from the air
- Zero emissions at point of use when used with hydrogen
- Quiet
- Highly efficient – up to 60%
- Highly scalable – efficient from Watts to Megawatts
- Very few moving parts - long operating life with minimal service intervention

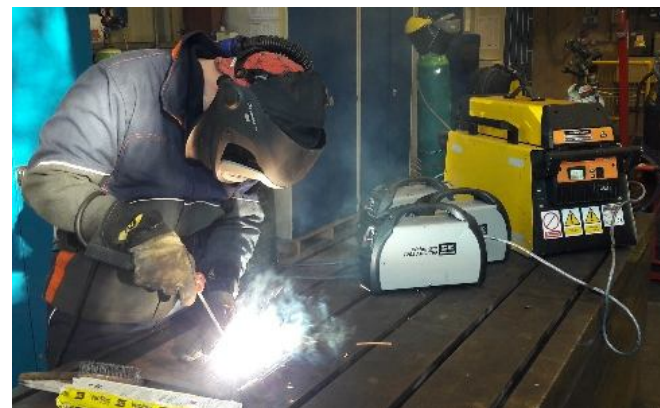
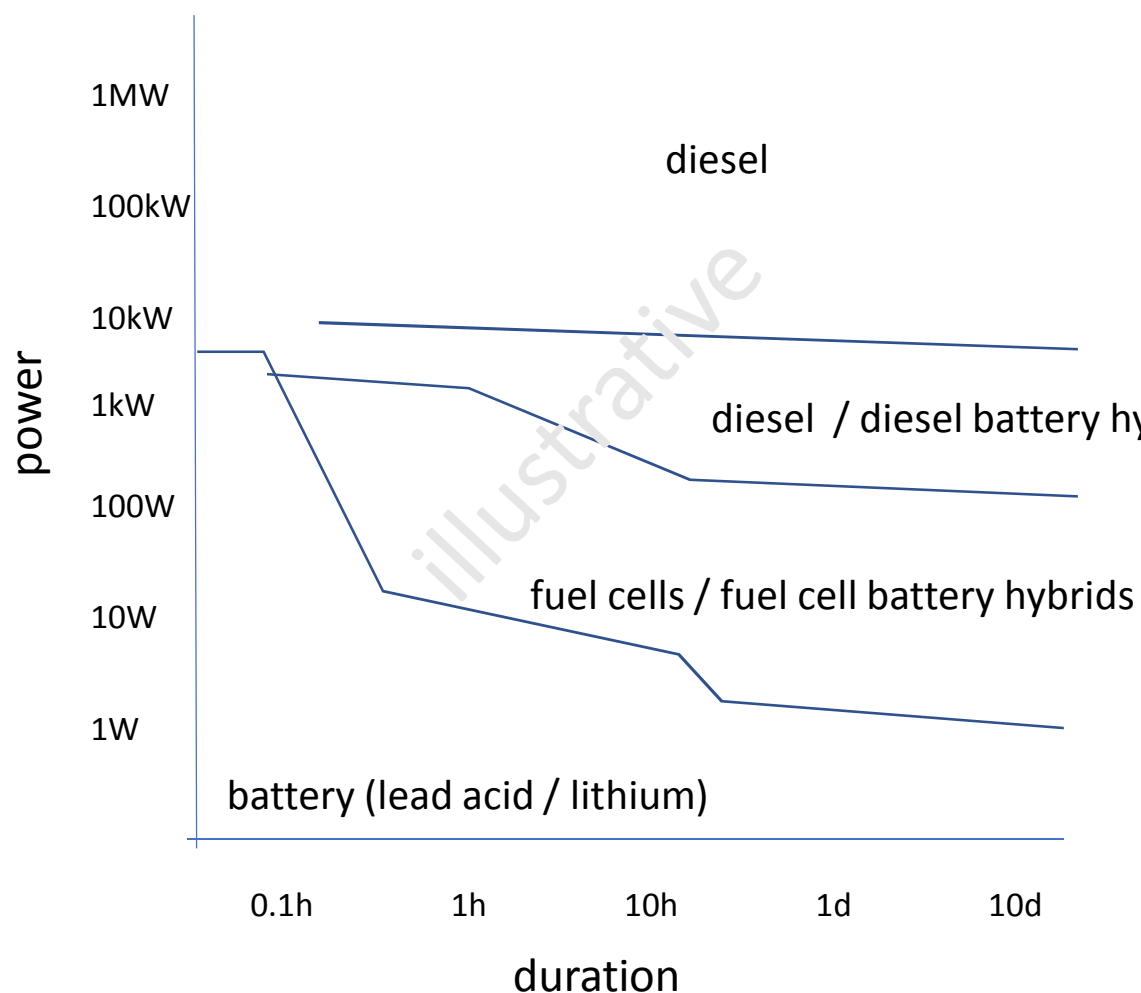
Comparison between small-scale diesel generators and fuel cells



	Hydrogen fuel cells	Diesel generators
efficiency	Typical 50%	Max 30% (below 10kW) but typically much lower
zero emissions ?	Zero emission at point of use	Increasing concern over emissions
noise	Almost completely silent	Can be 'silent' but only higher cost systems
service interval	No periodic servicing	250 to 500 hours
service life	6000 to 15000	4000 to 10000
capital cost	High but increasingly affordable, particularly at lower powers	Highly mature technology with very low £/W

Battery and fuel cell technology increasingly viable and attractive alternative to diesel or petrol generators for wide range of applications

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LGP's battery powered welder

- Electrochemical solutions can replace diesel in many applications
- Unlike diesel, they are rapidly getting better and cheaper
- In the context of increasing concerns over safety of diesel

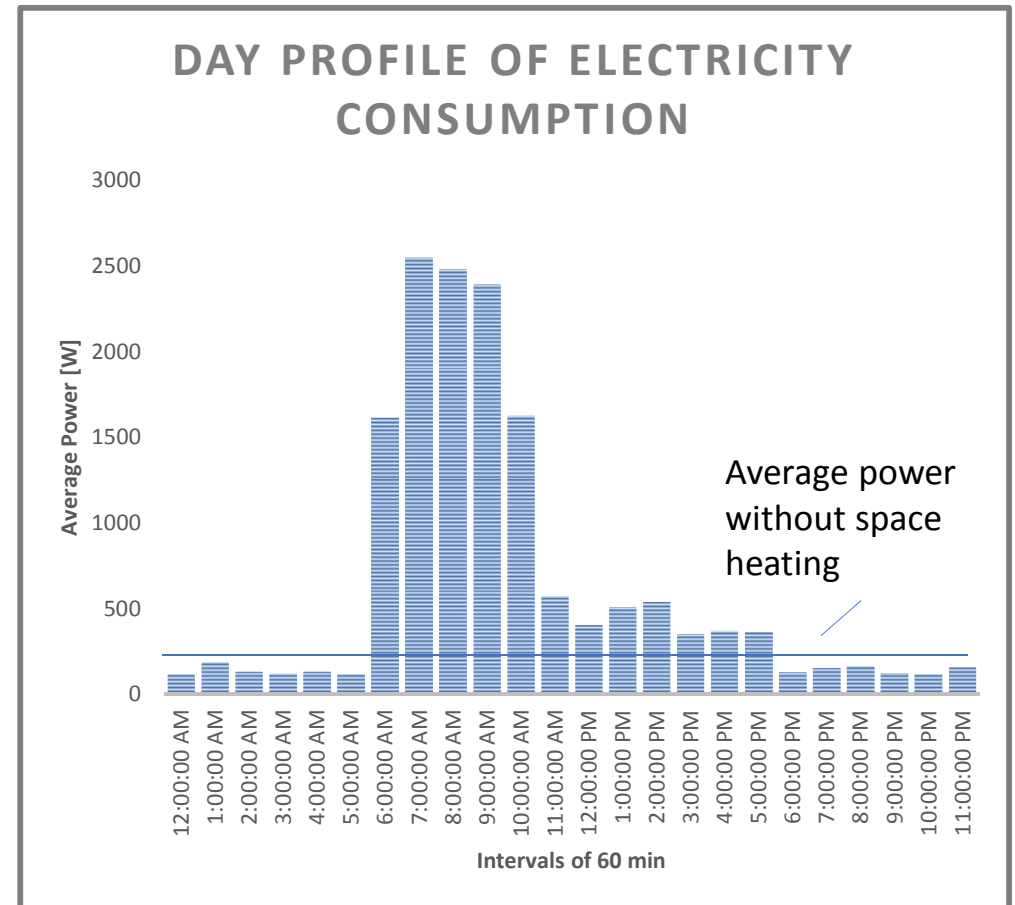


Hydrogen
and Fuel Cell
Solutions

Arcola Energy led project showed viability of fuel cells for temporary offices and welfare cabins

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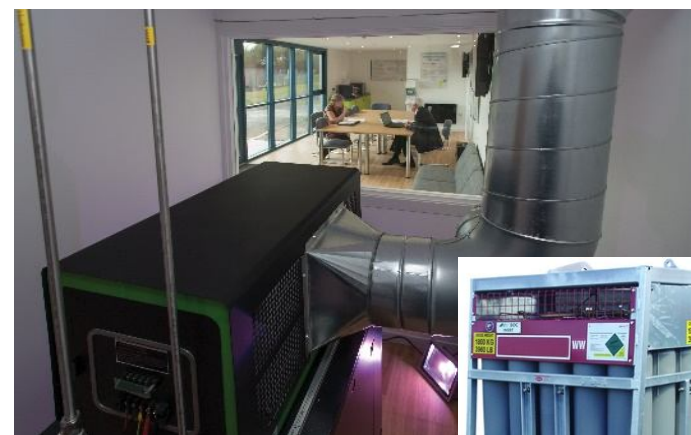
- Arcola Energy is London based fuel cell integrator with nearly a decade of experience in stationary & transport based hydrogen fuel cell systems
- Small site office / classroom - a few hours of peak load at about 3kW but base electrical load only about 140W
- Hybrid diesel would be significantly more efficient than standard diesel but not zero emission
- Site converted to run on small hydrogen fuel cell and Webasto heater for space heating
- Replace circa 50kW site generator consuming more than 50 litres diesel per day with “1 cylinder of hydrogen per week and a few litres diesel per day for heating.”



- Range of power outputs: from 40w upwards (up to 2MW for static installations)
- Multiple fuel types possible: Hydrogen, Methanol, Propane, Biogas, Natural Gas
- The fuelling strategy is important!
- Construction applications available today include:
 - lighting, signage
 - security cameras
 - monitoring stations
 - site cabin power
 - fork lift trucks



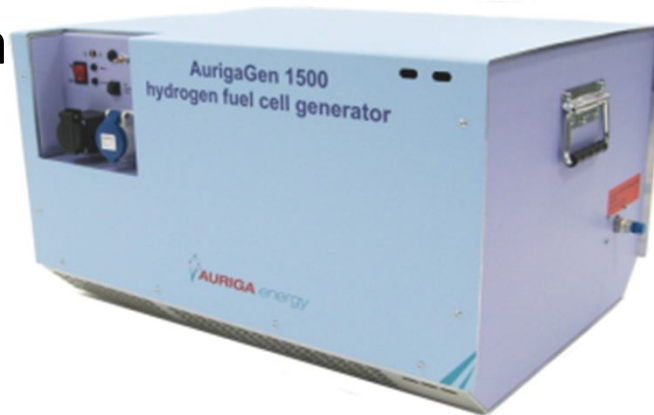
www.fuelcellsystems.co.uk



Delivering tangible emission reductions

- Auriga Energy pioneering fuel cell systems for:

- Ferries/water taxis, yachts, canal boats, barges,ships
- UPS/back-up power
- Transportable generators
 - 1kW - 1.5kW
- Electric fork lifts
- Others to come



BOC's HYMERA hydrogen fuel cell generator and H2 GENIE cylinder



- HYMERA ideal for today's low power/high efficiency loads
- Already widely used throughout UK for Deployable Cameras, temporary lighting and remote monitoring

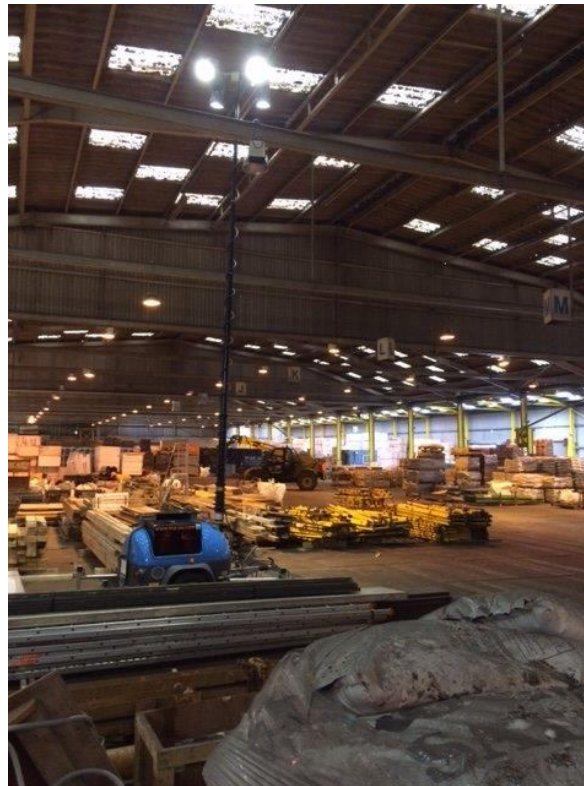
Application	Duration on 1 x GENIE hydrogen cylinder
20W security camera	350 hours / 2 weeks
Full scale lighting tower	30 – 45 hours
Temporary twin task light	100 hours
Lighting, laptop and kettle for small 'guard cabin'	2 weeks
Electrical power for small site office (not including heat)	5 days
Recharger for hand power tool batteries	> 100 charges (50Wh per charge)



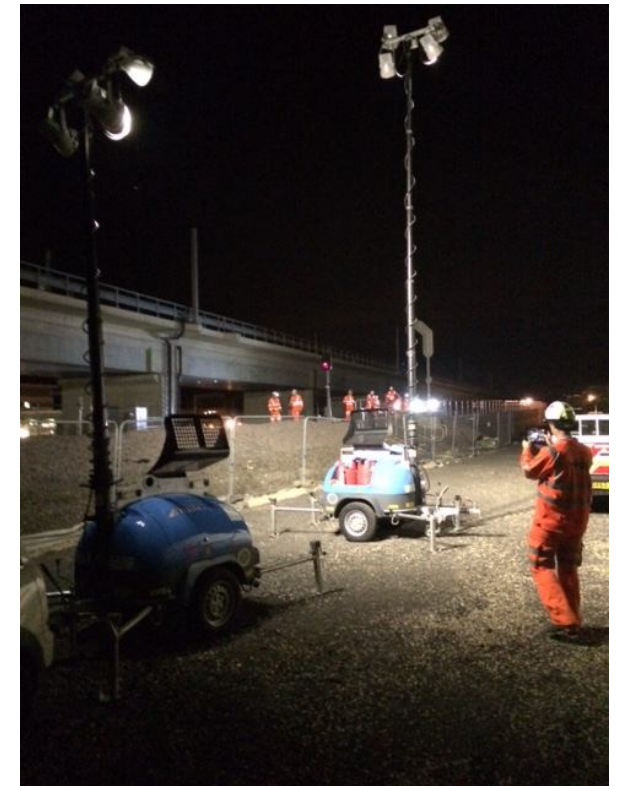
TCP's Ecolite-TH2 – worlds first commercial hydrogen powered lighting tower already widely used in London

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- TCP's Ecolite-TH2 full-scale light tower already deployed throughout UK
- Silent and zero emission alternative to diesel powered lights
 - ZERO CO2 site emissions
 - ZERO Noise Pollution
 - ZERO Particulate Pollution
 - ZERO Servicing
 - ZERO Possibility for fuel or earth contamination
 - Fully autonomous run-time between 30 and 120 hours



TCP Ecolite-TH2 at Ford, Dagenham



TCP Ecolite-TH2 on Network Rail site

Hydrogen safety – addressing concerns and answering myths

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- Hydrogen is a hazardous gas : highly flammable and mixes readily with air to form flammable atmosphere – this is true also of LPG, natural gas, petrol etc
- Hydrogen has a good safety record and when used correctly in properly designed equipment is as safe as other fuels and has some clear safety advantages
- Much lighter than air ...so any leaks very quickly dissipate
- Hydrogen cylinders can be transported easily and can be stored with other gases (apart from LPG) and no specialist permitting required other than normal safety training
- Hydrogen bombs are thermonuclear devices...



‘La Gordon Bennett’ annual hydrogen balloon race

Fuel cells in combination with batteries already viable as zero emission solution for wide range of applications within construction industry



Application	Current Status
rapid deployable security cameras	Already widely used - fuel cells have much lower operating cost than any other technology
temporary lighting	TCP's Ecolite-TH2 is a silent and zero emission and economic alternative to diesel powered lighting towers – already in use throughout London
welfare cabins	Fuel cells viable for up to 5-10 people (particularly if space heating requirement can be addressed by other means e.g LPG, Webasto heater)
power tools	Increasing use of battery based systems even for welding – fuel cells ideal for distributed battery charging
general 'site power'	Viable today for smaller sites (up to 1kW average / 5kW peak) and with potential to go to 5kW average / 25kW peak within 3-5 years
small excavators, lifts	Potential within 3-5 years based on fuel cell battery hybrid technology
large scale compressors, breakers, earth movers etc	Likely to be diesel / liquid fuel based for foreseeable future