

# **ACCELERATING COMMERCIALISATION OF FUEL CELLS IN THE UK: FUEL CELLS UK MANIFESTO FOR THE NEW UK GOVERNMENT**

**The UK fuel cell and hydrogen sector has the potential to become Britain's low carbon energy success story - contributing to the achievement of the UK's environment and energy goals and driving the transition to a low carbon future. At this crucial time for both the UK economy and the global environment, Fuel Cells UK calls on the newly established Government to adopt new measures to support the fuel cell and hydrogen sector in the UK so that it can play its role in delivering low carbon jobs together with a range of other policy benefits.**

Key priorities for the newly established Government include addressing the economic downturn and national debt in the short term while, simultaneously, reducing greenhouse gases emissions and improving Britain's energy security through into the medium to long term. Achieving these require immediate action to stimulate the transition to a low-carbon economy.

Fuel cells and hydrogen energy could revolutionise the energy landscape, bringing high efficiency, low carbon solutions for transport, residential, portable and premium power applications. While the technology has been perceived as a future technology, this is decidedly not the case; fuels cells and hydrogen energy are 'here and now' with commercialisation in early markets well underway and the rate of installation and deployment accelerating rapidly – for example:

- More than 14,000 fuel cells units for the niche transport application have been sold internationally, including materials handling devices such as forklifts
- More than 11,000 small stationary fuel cells units have been deployed globally
- In 2008, the installed capacity of fuel cells in large scale stationary applications reached 170MW<sub>e</sub>

Over recent years, the UK's environmental and energy policy has focused on financial and regulatory support for renewable energy generation; however, meeting the ambitious 80% carbon emissions reduction target by 2050, requires the Government to consider a much wider range of low-carbon solutions – including the environmental and economic benefits offered by widespread deployment of fuel cells. The following illustrate how fuel cells can help deliver key policy objectives:

- Fuel cells produce between 0g (for hydrogen produced from renewable sources) and ~85g (for hydrogen produced from fossil fuels) of CO<sub>2</sub>/km, compared to a gasoline internal combustion engine, which produces approximately ~170g of CO<sub>2</sub>/km
- A mass produced fuel cell vehicle with 350-mile all-electric range is projected to cost less than plug-in hybrid and full battery-electric vehicle
- 6,000 fuel cell CHP units, commercially available today, rated at 400kWe (each sufficient to power a supermarket or school) would deliver the same level of CO<sub>2</sub> reductions as the proposed Severn Barrage, and could be in place in 5 years at more than 3 times lower capital cost

- ...if 5.6 million homes had microCHP installed by 2020, the saved CO<sub>2</sub> emissions would be equivalent to the emissions from eight new 750MW Combined Cycle Gas Turbine power stations

**If the UK is to benefit from growing the fuel cell and hydrogen industry, the Government needs to fast track legislative and fiscal incentives at this pivotal point in the industry's evolution. Fuel Cells UK calls on the newly established Government to support the industry through the following key measures:**

- 1. Extending support for fuel cells as part of the Feed-In Tariff scheme:** Support should be expanded to low-carbon fuel cell electricity generation to 5MW, to fuel cell CHP up to 5MW<sub>e</sub>, and gas-fired microCHP up to 50kW, as enabled by the Energy Act 2008. This will help fuel cells to achieve their potential in delivering key policy objectives, whilst accelerating the development of the UK industry.
- 2. Focusing support for commercial development:** There is a need for focused support for the development of near-commercial fuel cells (including materials, components and manufacturing scale-up techniques). This could play an important role in helping to bridge the gap between research and demonstration, and facilitate longer-term cost reduction through manufacturing volume increases.
- 3. Providing ongoing demonstration support activity:** Demonstration programmes are an essential tool to accelerate the development of emerging energy technologies and solutions and to ensure the UK fuel cell industry plays a leading role in the emerging European market.
- 4. Using Forward Commitment Procurement:** Forward commitment procurement provides the market with the certainty necessary to justify intensive product development effort and "underwrite" significant financial risk.
- 5. Changing existing regulation:** Planning and health and safety 'red tape' which is currently hindering hydrogen and fuel cell projects should be reviewed with a view to facilitating faster, cheaper and easier installation.
- 6. Introducing Enhanced Capital Allowances and tax breaks for the low-carbon industry:** These will help to promote investment in decentralized generation, including fuel cells and hydrogen.

Adopting these measures will enhance fuel cells' and hydrogen's competitiveness and allow the market to stimulate further low-carbon technology development. We call on the new Government to act promptly to ensure that this 'window of opportunity' for fuel cells and hydrogen is not closed before the benefits for our economy, climate and wider energy market can be realised.

This document is accompanied by two annexes providing further detail on the rationale for Government's support for fuel cells (Annex 1) and detailed description of suggested policy measures (Annex 2).

## **ABOUT FUEL CELLS UK**

Fuel Cells UK is the trade association for the UK fuel cell industry. Our members include the leading fuel cell companies as well as a range of other stakeholders, from energy utilities to component developers, fuel suppliers and others involved both directly and indirectly in the industry.

### **Our aim**

Fuel Cells UK acts on behalf of its members to accelerate the development and commercialisation of fuel cells in the UK.

### **Our members**

Acal Energy Ltd  
Alstom  
Bac2 Ltd  
BOC / Linde Group  
Calor  
Cass Business School, City University  
Cenex  
Ceramic Fuel Cells (Europe) Ltd  
Ceres Power Ltd  
The Centre for Process Innovation (CPI)  
Diverse Energy (UK) Ltd  
East Midlands Development Agency  
E.ON  
Flexitallic  
Intelligent Energy Holdings plc  
ITM-Power  
Johnson Matthey plc  
LOGAN Energy Ltd  
Rolls Royce Fuel Cell Systems Ltd  
UCM Group Ltd  
University of Birmingham  
Valeswood Fuel Cells Ltd

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## **Annex 1**

### **The rationale for UK Government support for fuel cells and hydrogen**

Fuel cells and hydrogen can:

- contribute substantially to a global low carbon economy;
- improve urban air quality and the health of urban populations;
- enhance energy security by allowing a wider choice of fuels;
- contribute to the alleviation of fuel poverty through superior efficiency relative to conventional technologies and ensure that every home is adequately and affordably heated; and
- provide essential intermediate and final components of any future hydrogen economy.

Further details of the greenhouse gas reduction potential as well as benefit to the UK economy that fuel cells and hydrogen can offer are presented below.

#### **1.1 The energy and climate change benefits of fuel cells**

##### **- Greater efficiency in extracting energy embedded in various fuels:**

Fuel cells can operate on the range of different fuels including: natural gas, biogas, hydrogen, methanol and many others. They offer the potential to deliver clean, quiet heat and power at efficiencies in the 80-90% range, with power only generation fuel cell systems provide equally impressive benefits (this compares with an efficiency of 35% for conventional power generation).

The hydrogen needed to power fuel cell vehicles can be produced directly from a wide range of zero carbon sources such as biomass (at a much lower carbon footprint than second generation biodiesel), nuclear or solar (directly from the heat, not via electricity) as well as from conventional fossil fuels and via electrolysis.

##### **- Similar CO<sub>2</sub> savings to those offered by other technologies supported by the Government at lower cost:**

6,000 fuel cell CHP units, commercially available today (range of 250-400kW, rated at 400kWe (sufficient to power a supermarket or school)) would deliver the same level of CO<sub>2</sub> emissions reductions as the proposed Severn Barrage, and could be in place in 5 years at more than 3 times lower capital cost. There are already many examples of working installations (e.g. at the Transport for London Palestra Building in Southwark). Depending on the installation, a 2kW stationary fuel cell unit can save up to 5 tonnes of CO<sub>2</sub> per annum. It has been estimated that, if 5.6 million homes had microCHP installed by 2020, the saved CO<sub>2</sub> emissions would be equivalent to the emissions from eight new 750MW Combined Cycle Gas Turbine power stations. The benefits of fuel cell microgeneration are already being realised worldwide, including in Japan where more than 5,800 units have been installed to date.

Results from a full lifecycle analysis, comparing CO<sub>2</sub> emissions from a traditional petrol internal combustion engine, with CO<sub>2</sub> emissions from a hydrogen powered fuel cell vehicle, show that the internal combustion engine accounts for 167g/km, while the fuel cell system produces from 0g/km (when fuelled by renewably generated hydrogen) to 85g/km (when fuelled by hydrogen generated using fossil fuels).

## *- Improved air quality*

By excluding combustion from the process of electricity generation, fuel cells improve general air quality by eliminating nitrogen oxides, sulphur oxides and particulate matter from exhausts.

## **1.2 Grid balancing: additional benefits of deployment of fuel cells and hydrogen**

### *- Energy Storage*

Fuel cells in partnership with electrolyzers and hydrogen storage systems can help to address situations when electricity production from renewables exceeds demand. Excess electricity can be used to produce hydrogen, which can be stored and then used in a fuel cell to meet demand for either stationary power or motive power for a fuel cell powered vehicle.

### *- Managing intermittency of renewables*

Storage, in combination with fuel cells, can also be used to assist with peak shaving when demand is high and renewable electricity production is insufficient to meet demand. In addition to increasing the reliability of supply, this negates the need for traditional spinning or standing reserve, which tend to be either open gas turbine generators, or fossil fuel power plants that are used as back-up to provide emergency power at peak times. This traditional approach has negative implications both in terms of carbon emissions and the renewable energy challenge.

### *- Systems already operating in the UK*

An example of a working fuel cell installation in this type of application is the PURE Project on Unst in the Shetland Islands. The system consists of two 15kW wind turbines, a high pressure hydrogen electrolyser, high pressure hydrogen storage device, a fuel cell and an inverter. The output provides power and heating for five businesses on the island, with the stored hydrogen being also used to power fuel cell / battery hybrid vehicles.

## **1.3 The Economic Case**

### *- Value of the global and UK fuel cell market*

Recent estimations suggest that the global fuel cell market could be worth over \$26bn in 2020 and over \$180bn in 2050. The UK share of this market could be \$1bn in 2020 rising to \$19bn in 2050. In recent year the fuel cell sector has continued to grow, despite the global economic downturn; experiencing a 41% increase in shipments in 2009 relative to 2008.

### *- Creation of the new 'green collar' jobs*

Recent reports indicate that global fuel cell industry could create as many as 700,000 jobs in the manufacturing sector by 2019, rising to over one million if installation, service and maintenance jobs are included.

### *- Growth of intellectual property within the UK:* Strong research and development activity means that the UK is the second most successful country in the EU (behind Germany) at securing new fuel cell related patents.

### *- Improved competitiveness on the emerging energy markets globally:* The UK represents one of the strongest global markets for fuel cell investment. In 2008, there were 10 times as many companies listed on the AIM market as the NASDAQ. These developments

ensure that the UK is able to compete globally and continue attracting investors and creating wealth.

## Annex 2

### Detailed description of suggested policy measures

#### *2.1 Extending support for fuel cells as part of the Feed-In Tariff scheme.*

Fuel Cells UK would like to see expansion of the existing feed-in tariff scheme in line with the Energy Act 2008, which includes electricity generated by fuel cells in the list of sources that are eligible for FIT support.

Fuel Cells UK strongly advocates that:

- a. The limit for fuel cell power generating installations (whether powered with fossil or renewable fuels) is set at 5MW to encompass the larger systems which are commercially available today. This would allow larger scale decentralised low carbon generation to benefit from the scheme, contributing to carbon reduction objectives (through greatest efficiencies in extracting energy from fuels when compared to conventional generation) and accelerating progress in reducing the costs of fuel cell installations.
- b. Fossil fuelled (as well as biogas and anaerobic digester gas fuelled) fuel cell CHP installations up to the limit set in the Energy Act 2008 (i.e. 5MW<sub>e</sub>) are included in the FIT during the first revision of the mechanism. This would allow the UK to use all available approaches to achieving the Government's carbon reduction budgets and the long term target of 80% carbon emissions reductions by 2050, and would be complementary to the development of strong renewable energy capacity to meet the 2020 renewables target.
- c. Fuel cell microCHP is fully incorporated in the scheme following the trial period. It would fall under the category of natural gas-fired CHP under 50kW, as stated in the Energy Act 2008.

#### *2.2 Focusing support for commercial development*

In any innovative product development process, the final phase (taking a prototype from the laboratory and turning it into a cost-competitive, engineered and quality assured product) is typically the most costly point on the curve. In established businesses this phase is usually funded internally via retained profits from other products. Given the new-to-world status of many fuel cell and hydrogen energy technologies these internal sources are not available at the levels required to achieve timely product development. External assistance is required to accelerate this phase and to avoid UK companies losing their competitive advantage or relocating to more supportive countries, particularly Germany.

Assistance of this sort (at a materials and components as well as at a system level) would play a key role in bridging the gap between research and demonstration, and facilitate longer-term cost reduction through manufacturing volume increases. Making such support available not only through cooperative / consortium programmes but also to single companies to efficiently pursue their development would also accelerate this process and can be achieved through a long term commitment (at least 5 years).

Whilst the Technology Strategy Board and the Carbon Trust provide established mechanisms to support research and technology development, we believe that there is a growing need for focused support (e.g. in the form of grants and / or rolled up tax breaks) for fuel cell product development as well. Grant programmes can be very successful in stimulating technologies in their very early stages of commercialisation, as has been proved by the Low Carbon Building Programme and Clear Skies list (now the Microgeneration Certification Scheme).

There is also a need for funded work on safety, codes and standards and education in support of hydrogen production, storage and consumption.

Fuel Cells UK recommends that:

- a. Total funding of £75 - £100 million over 5 years is allocated for commercial fuel cell products development. This will create certainty in the market, and work in harmony with European funding strategy, such as the Joint Technology Undertaking (JTU), maximising the ability of such support to accelerate the development process.
- b. The Government should commit to the extension of capital grants in order to help the deployment of fuel cells and hydrogen in the energy market at a faster rate than would otherwise be the case
- c. The level of grant available for a particular technology, whether it be fuel cells or other low carbon technology, should reflect the potential contribution of that technology to the realisation of policy objectives such as the reduction of CO<sub>2</sub>, as well as other environmental and social objectives, such as the alleviation of fuel poverty, improved energy security and minimisation of other pollutants. This will help to ensure that technologies that offer considerable energy and carbon saving potential, but which, due to low production volumes at present, are less commercially developed and consequently more expensive, receive the necessary support to bring them to market.
- d. Support should be analogous to that previously adopted under the Low Carbon Buildings Programme. For instance, a purchaser of a fuel cell system could receive a capital grant of £1,000 for each kW of electrical capacity installed. Such a scheme was initiated by the US Department of Defence under their Climate Change Rebate Project, which provides \$1,000/kW installed capacity. This support also applies to US operations outside of the USA (such as in Woking, Surrey, where the first stationary fuel cell was installed in the UK). Support under this scheme must not exceed one third of the overall project costs.
- e. Fuel cells and hydrogen are eligible for credits under the emissions trading scheme.
- f. Research to facilitate the development of codes and standard for hydrogen production, storage and use be supported.

## **2.3 Providing ongoing demonstration support activity:**

Demonstration programmes are a vital element in bringing high value, high cost new energy systems to market. Unlike in the USA, there is extremely limited late-stage venture capital funding available for demonstration and product development in the UK; consequently, most fuel cell companies are reliant upon State support to assist with this element of the innovation chain.

Fuel Cells UK believes that:

- a. There is a clear need for a firm commitment from the Government for ongoing demonstration support programme in fuel cells and hydrogen, to build investor confidence and ensure that the UK industry continues to expand.
- b. Whilst Fuel Cells UK welcomed the earlier demonstration programmes as first steps in supporting demonstration in the UK, there is a need for an ongoing strategy of support. In order for the UK to compete effectively, we believe a minimum figure of £100–£150 million over five years from 2011 is required.
- d. Demonstration programmes are a key support tool in the funding landscape along with forward commitment and regulatory support. It is vital that they are well designed and tailored to the needs of the industry, and that different support mechanisms dovetail to provide access to funds at all stages of development, ensuring that the risks of investment are rewarded.
- e. The Government should learn from successful programmes and strategies adopted overseas, e.g. Japan, USA and Germany, where there are currently major development programmes.

## **2.4 Using Forward Commitment Procurement**

Forward Commitment Procurement (FCP) is a valuable tool for underwriting the investment required in scaling up production, and in placing the risks of new technology introduction with those parties best placed to manage them (technology risk with the supplier and market risk with the purchaser). An FCP process helps to set clear objectives for the technology and create the market confidence that is required to attract further investment and development, despite requiring no additional funding.

Forward orders under forward procurement deals have a proven track record of stimulating growth and development. Recent FCP examples include deals for tens of thousands of products between fuel cell CHP companies and utilities – including two leading fuel cell companies, Ceramic Fuel Cells and Ceres Power that entered agreements with EWE and Centrica respectively.

Internationally, a number of governments have used FCP to stimulate commercialization of new technologies. One example is a Swedish procurement competition for heat pumps in 1990s that led to significant reduction in ground source heat pump costs and expansion of sales. Other Swedish procurement competitions resulted in similarly impressive results for energy efficient ventilation systems as well as small scale solar heating and household water appliances.

Fuel Cells UK:

- a. Strongly supports the principles of Forward Commitment to Buy (FCB) as an economic tool within the business to business sector, to drive investment and innovation.
- b. Strongly supports the previous Government's commitment, set out in its Sustainable Procurement Action Plan, to Forward Commitment Procurement (FCP) in the public sector, to promote socially and environmentally beneficial technologies and as a tool for realising policy objectives.
- c. Believes that the Government should design a framework for managing and evaluating FCP projects to ensure that costs and specifications are appropriately set and that the needs of the market have been adequately taken into account in the design of any programme.
- d. Recommends that the Government facilitates the development of a suite of Forward Commitment Programmes to support the use of fuel cells and hydrogen energy in a range of applications, thus helping to accelerate commercialisation of fuel cells and development of hydrogen infrastructure, in turn bringing forward the associated policy benefits. These could be applied at central, regional or local level, with economies of scale being achievable where several regions / locations collaborate on the procurement.

## **2.5 Ensuring appropriate regulation**

In order to deliver policy objectives, the Government should, over time, introduce legislative requirements to purchase fuel cells and use hydrogen as a low carbon fuel. The introduction of a microgeneration obligation into building regulations is one of the most effective ways of supporting uptake of modern microgeneration technologies including fuel cells. In the UK, an example of how such regulations can work effectively is the requirement to install high efficiency boilers. At the same time, the planning barriers to the use of hydrogen and fuel cells must be removed, and local / regional governments should be provided with hydrogen and fuel cell projects implementation training from central Government.

Fuel Cells UK would like to see the Government:

- a. Introducing a requirement that a certain level of fuel cell capability should be installed in new buildings. This will help bring this technology forward and will be similar to the one already existing for high efficiency boilers.
- b. Minimise planning and other constraints associated with the implementation of fuel cell and hydrogen projects through appropriate regulations, and provide training to local and regional governments.

## **2.6 Introducing Enhanced Capital Allowances and Tax Breaks for the low carbon industry**

Enhanced Capital Allowances (ECAs) are a mechanism which allows businesses to write off the whole of the capital cost of their investment in eligible technologies

against their taxable profits of the period during which they make the investment. They are a strong incentive for utilities in the context of installed capacity. Under current rules, whereas 1GW centralised capacity would qualify for ECAs, 1GW decentralised capacity would not.

Fuel Cells UK advises that:

a. There is a need for a level playing field to address this inconsistency. The introduction of such an incentive would effectively be cost neutral for the Government and go a long way to incentivising the development of a sustainable, low carbon energy network.

b. In addition, the Government should consider supporting product development through the existing corporation tax system. This could include measures such as an extension of the current R&D tax credit system to enable claims to be made against a wider range of expenditure and against part-funded development programmes, or additional tax credits against product development expenditure payable in cash rather than offset against future taxable profits.

**Fuel Cells UK will be delighted to work with all parts of the newly established Government to help ensure that fuel cells deliver their potential to help grow the UK economy and address energy and environmental policy goals.**