



Proton Power Systems plc Group

Proton Motor company profile

Proton Motor Fuel Cell GmbH is one of the world's leading specialists in the development and production of industrial fuel cells, stacks and hybrid systems. It was founded in 1998 as a spin-off from Magnet Motor, a company that started to specialise in innovative electrical vehicle drive technology as early as 1980. By 1994, Magnet Motor had already developed highly compact and efficient vehicle drive components and hybrid systems to series production stage.

The company then began to work on fuel cells in 1994 as the "missing link development" for a fully electrical vehicle drive platform. This extensive expertise was adopted in its entirety by Proton Motor Fuel Cell GmbH in 1998.

In order to access the international equity market as a German company, Proton Power Systems plc. was founded as a British holding company and Proton Motor is now a full subsidiary of this company. Proton Power Systems has been listed on the London stock exchange since October 2006 (code: PPS). The management team of Proton Motor comprises Thomas Melczer, Chief Executive Officer, Dr. Christian Meyne, Chief Operating Officer, Achim Loecher, Chief Financial Officer and Dr. Joachim Kroemer, Sales and Marketing Director.

Fuel cells – driving the future

The general ecological and economic framework, especially the increasing scarcity of raw materials derived from fossils and the dramatic price increases for such products, is demanding a fundamental shift in industry. Technologies which make a long-term contribution to ensuring ubiquitous energy supplies are particularly gaining in strategic importance. This security of supply cannot however be ensured by one technology alone; an optimum mix of different approaches is needed.

Hydrogen-based fuel cells in particular will have a key role to play in this area. They rely on what is a virtually unlimited resource, can be used in a multitude of applications and are carbon neutral.

Large market potential

Alongside the automotive industry, it is mainly back-to-base vehicles, data centres, the telecommunications industry, and the manufacturing and processing industry which need to effectively and efficiently use hydrogen-based fuel cells for generating electricity, particularly as a substitute for UPS, diesel- and battery-supplied facilities, and which already have the structural requirements to do so.

The market potential for industrial hydrogen-based fuel cells is therefore virtually unlimited. For example, fuel cells have key benefits to offer in the full range of fixed power generation. They allow much longer operating periods than battery-supplied facilities and, unlike diesel generators, there are no problems associated with exhaust gases, noise and vibrations. The stationary power generation segment alone has an estimated volume of approx. US\$ 20 billion.

Proton Motor – equipped for long-term success

Proton Motor will play a significant role in this market of the future. This assessment is based primarily on five key factors:

1. Proton Motor Fuel Cell GmbH has more than 15 years' experience in this sector – from the development and manufacture of fuel cells, stacks and hybrid systems to the implementation of customised solutions.
2. Under the umbrella of the Proton Power Systems plc. parent company, which is listed on the stock market, the German company has a sustainable shareholder structure and ideal access to the international equity market.
3. Through strategic partnerships, Proton Motor is guaranteeing a continuous innovation pipeline and a powerful production and sales concept.
4. The company's far-reaching application-oriented project experience is the ideal basis for turning project work into product business. For this purpose, Proton Motor will concentrate on the production of standardised modules with flexible scope for use.
5. By concentrating on its key skills and incorporating production in manufacturing partnerships, Proton Motor will be able to manufacture large volumes of modules in the medium term and therefore ensure continuous economies of scale with very high quality standards in order to offer attractive market prices.

Proton Motor therefore has the potential to set the standard for industrial fuel cells and generate cost benefits that extend across all applications.

The product portfolio and product strategy of Proton Motor

The strategic goal of Proton Motor is to change over to a product-driven business model following successful project business. This change is particularly linked to a broader application focus, standardisation of the products, industrialisation of production within the framework of manufacturing partnerships and therefore also to the generation of cost and efficiency benefits. From a technological point of view, the company already has the necessary prerequisites. Its product range comprises three product categories.

1. *PM Basic: industrial fuel cell systems for OEM integration*

Proton Motor offers a flexible range of basic fuel cell systems for OEM integration in various applications. Customers can choose between four different PM Basic systems with an output of 5, 10, 50 and 150 kW respectively. The technology behind PM Basic is based on a complete, integration-ready fuel cell system with Proton Motor fuel cell stacks and dedicated components such as gas, air and water management. The hydrogen-operated and liquid-cooled PEM fuel cell systems (PEM = Proton Exchange Membrane) feature a particularly simple, robust and modular design. This allows them to cover a broad output spectrum. A further core component is an integrated low-energy water management system. This eliminates the need for external humidification and replenishment of de-ionised water. The Proton Motor fuel cells are designed as atmospheric or low-pressure systems. This means they can significantly reduce the energy requirement of the peripheral subsystems and thereby achieve energy efficiency of over 50 percent. The PM Basic systems form the basis for the PM Package and PM Turnkey solutions.

2. *PM Package: pre-configured "plug & drive" fuel cell hybrid systems*

PM Packages are standardised fuel cell hybrid systems for use in forklifts and city buses. They offer a combination of fuel cells and electrical energy storage systems (batteries and ultracaps which store the braking energy of the vehicles). The Package systems are supplied ready for immediate use and their dimensions are coordinated to fit the vehicle. They supply power in the voltage that the application requires. Further perfectly adapted components such as power management systems, electrical converters, hydrogen tanks and cooling systems round off the PM Package. For applications with high peak loads and energy recovery systems such as city-based vehicles, Proton Motor has developed triple hybrid technology. The combination of fuel cells with special batteries and temporary storage systems

called ultracaps boosts efficiency while reducing costs. The PM Package contains all the components the operator needs to replace conventional batteries or diesel generators with an emission-free, efficient fuel cell solution. The effectiveness of the fuel cell hybrid systems becomes particularly apparent when used in city traffic. In typical applications, it requires 50 percent less fuel than a bus with a conventional diesel engine.

3. *PM Turnkey: tailor-made fuel cell hybrid systems*

PM Turnkey provides OEM manufacturers with turnkey fuel cell hybrid systems with an output of between 5 and 200 kW for their products and applications. PM Turnkey systems are particularly well suited to "back-to-base" vehicles such as regional buses, ferries or municipal supply vehicles. They can be used in any area where a hybrid system specially adapted to the application offers the most benefits and where no standardised solution tailored to this application as yet exists. As a basic rule of thumb, the more the vehicle stops-starts, the greater the potential savings from the PM Turnkey hybrid drive. Compared to conventional diesel drives, users can save up to 50 percent on fuel costs.

Application examples

1. *Alster ferry in Hamburg*

Proton Motor supplied the innovative hybrid drive for the world's first fuel-cell-driven passenger ship, ZemShip (Zero Emission Ship). In this customised PM Turnkey complete system, the required output is supplied by two 50 kW PM Basic A 50 fuel cell systems. The ship has been carrying up to 100 passengers per tour completely emission-free on the Alster and in the port area of Hamburg since summer 2008. Proton Motor has broken new ground in the fuel-cell ship propulsion sector with this project supported by the European Union and has confirmed its status as a frontrunner in Cleantec and zero-emissions solutions.

2. *Triple Hybrid City Bus*

In cooperation with Skoda Electric, the Czech experts for trolley busses and electric rail vehicles based in Pilsen, Proton Motor has built the first triple hybrid fuel cell bus. This bus fully utilizes the advantages of electric gear and allows energy savings of more than 50 per cent compared to conventional busses. Core of the bus is the 50 kW PM Basic A 50 fuel cell system, used also in the Alster ferry ZemShip in Hamburg. The basic vehicle is a 12 meter long standard city bus, as it

is used thousandfold in local traffic worldwide. The first triple hybrid bus will be used in Prague and surrounding area starting in spring.

3. Commercial vehicles with fuel cells

Proton Motor develops and produces the fuel cell hybrid system and the complete energy management of the EcoCarrier HY3, a light-duty commercial vehicle of EcoCraft Automotive. The Wilhelm Karmann GmbH, experts for the development and production of complete vehicles, integrates the fuel cell hybrid system into the fourwheeled basic vehicle EcoCarrier. Target groups of the EcoCarrier HY3 are first of all municipalities and companies with a regional application area. These vehicles benefit from the advantages of the fuel cell gear, because they have to return to their base regularly and so can be fueled with liquid hydrogen without any problems. Thanks to its high efficiency factor they typically need less than 50 per cent of energy, compared with conventional internal combustion engines. In comparison to battery-operated vehicles, long charging times or complex battery changes are not being generated. Because of the combination of fuel cells and electric energy storage the EcoCarrier has a cruising range of more than 250 km. Compared with battery-operated vehicles it is 200 kg lighter, that improves the loading capacity.

4. Uninterruptible power supply (UPS) with fuel cells

Uninterruptible power supply systems with a performance of 5 to more than 100 kW are more and more difficult to realize by batteries, because time periods, that have to be bridged, extend. Batteries need a lot of space, they are very heavy and have a proportionally high amount of maintenance. Proton Motor and its UPS industry partners can offer much more attractive solutions based on fuel cell systems of the PM Basic line. Thanks to the easily scalable supply of hydrogen, that can be changed even during operation, even long bridging periods can be realized and the required space is low. Proton Motor and its partners focus on fields of application like data centres, telecommunication and the healthcare sector.

Proton Motor Fuel Cell GmbH

Proton Motor is an expert in industrial fuel cells, fuel cell and hybrid systems with over 15 years of experience in this sector. The company, whose headquarters are in Puchheim near Munich, is a one-stop shop for complete fuel cell and hybrid systems, covering everything from the development and manufacture to implementation of tailored solutions. The fuel cell experts focus their work on back-to-base applications, for example for fork lift trucks or city buses as well as stationary solutions. Their product range consists of basic fuel cell systems *PM Basic*, standard complete systems *PM Package* e.g. as substitutes for batteries and tailored systems *PM Turnkey*. Proton Motor is a wholly owned subsidiary of Proton Power Systems plc. The company has been listed on the London Stock Market (Code: PPS) since October 2006.

More information available from www.proton-motor.de or:

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