

Topic 3: Components (oral presentation)

## **Fuel Cells in Photovoltaic Hybrid Systems for Stand-Alone Power Supplies**

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The fluctuating nature of solar radiation means that purely photovoltaic power supplies for off-grid applications must be large and thus expensive, in many regions of the world. To avoid this, it is often economical to combine the solar generator with other electricity generators. If designed appropriately, such photovoltaic hybrid systems generate electricity reliably, with an intrinsic back-up. Components such as photovoltaic generators and batteries can have smaller dimensions, and improved operation management can extend the lifetime of batteries. In most cases today, the electricity is generated with the help of combustion engines, which are fuelled with petrol, diesel, gas or bio-fuels. Small numbers of thermoelectric generators are also in use.

Nevertheless, the motor-driven generators applied up to now have a number of significant disadvantages. Depending on the operating point and the type of technology, the efficiency value is between about 8 and 28 %, the need for maintenance is high (e.g. oil changes), the generators are noisy and they emit exhaust gases continuously. In addition, reasonably reliable motor-driven generators are available only for the power range above about 5 kW, which is much too high for a large number of applications.

Fuel cells offer an alternative. Fundamentally, fuel cells have very good technical properties which make them interesting for stand-alone power supplies: high efficiency values, low maintenance need, low noise level, clean exhaust gases. The disadvantages at present are the costs, which are still high, their low reliability and short lifetime. However, considerable progress can be expected in all of these areas within the next few years, so it is worth analysing the potential for applying fuel cells in stand-alone power supplies in more detail.

The following aspects will be addressed in the paper:

- ◆ Which type of fuel cell technology is best suited for stand-alone power supplies (SOFC, PEM, DMFC, etc.)?
- ◆ How can the fuel be supplied in stand-alone power supplies?
- ◆ What are optimal system configurations with fuel cells? Can advantages be gained with specific component design and operation management?
- ◆ What are the resulting costs and how do they compete with existing solutions?

On the one hand, the paper will show that stand-alone power supplies represent an interesting entry market for fuel cells, and on the other hand, that fuel cells offer considerable technical advantages for stand-alone power supplies. At present, the fuel supply is still a critical point.

Concrete applications from two pilot projects will be presented and initial experience reported.

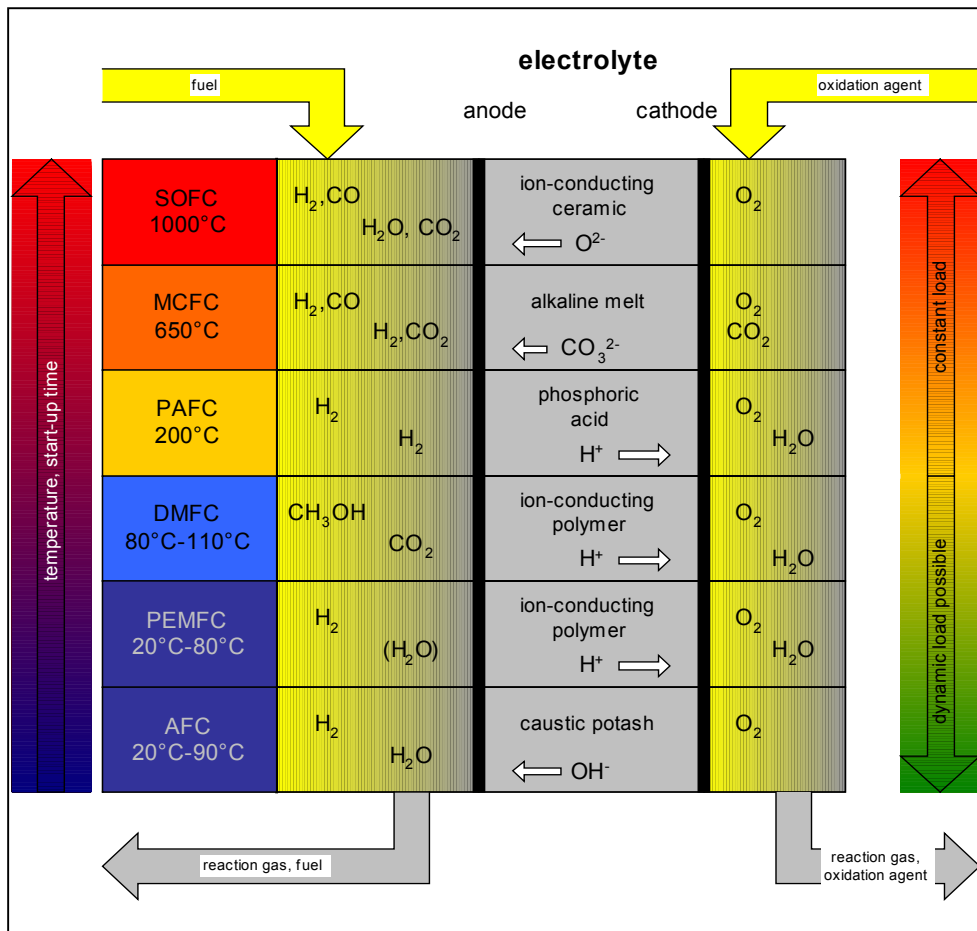


Fig. 1: Overview of the various types of fuel cell technology. The performance and the pros and cons of the various technologies will be discussed with respect to autonomous power supply systems.

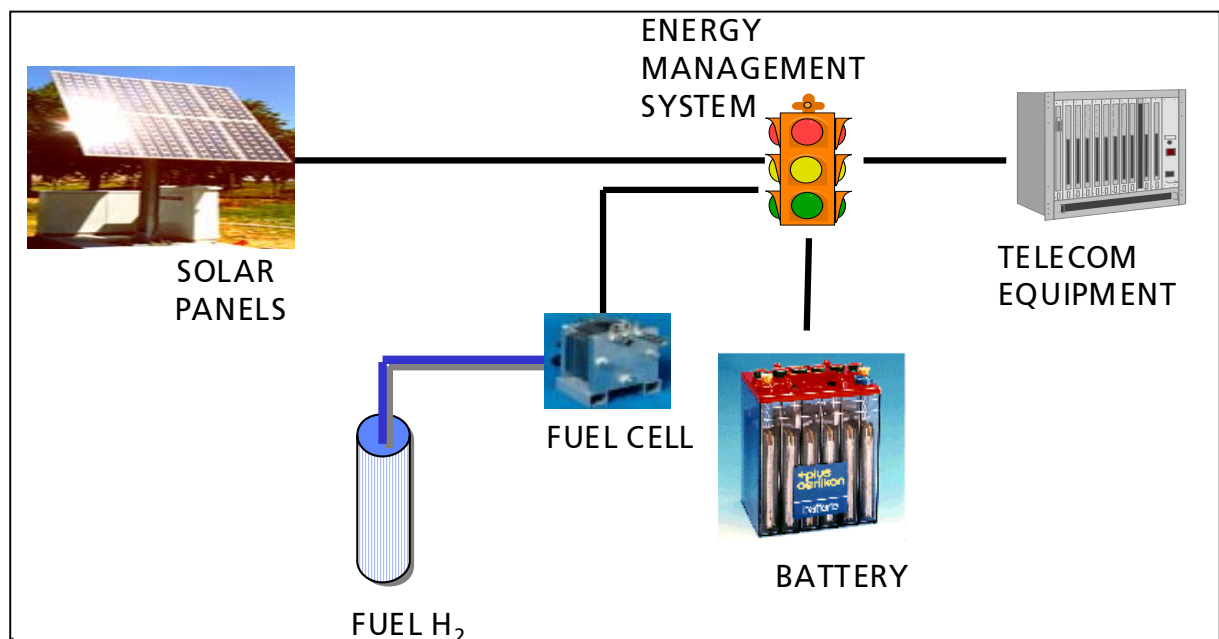


Fig. 2: Stand-alone power supply for telecommunications systems with a photovoltaic/fuel-cell hybrid system. Realisation of system within the EC project FIRST with 7 partners. System in operation in the field since January 2003.



Fig. 3: First solar powered inn - the »Rappenecker Hof«. A PEM fuel cell will be added to supplement and – in the long range – to replace the diesel generator in the this hybrid system. Planning is ongoing, begin of operation of revised system design including the fuel cell is 3<sup>rd</sup> quarter of 2003.