



# THE APPLICATIONS

## Fuel Cell Today – Education Kit 3

### Large Stationary

Fuel cells can be used in large stationary applications to provide electricity and heat. Their attractiveness includes their efficiency and low emissions. They are also of use in areas not served by a national power grid or where the national grid is unreliable and backup power is required. With operating temperatures as low as 80°C, fuel cells can be installed in private households and light commercial operations as well as meeting all the energy requirements of large industrial operations.

So far fuel cell manufacturers have focused on non-residential applications. UTC Fuel Cells, for instance, has installed over 250 phosphoric acid fuel cells (PAFC) at a range of sites, including schools, office blocks and banking facilities. In the future, high temperature fuel cells, such as molten carbonate (MCFC) and solid oxide (SOFC), may be adapted for larger industrial applications. With operating temperatures between 600-1100°C these high temperature cells can tolerate a contaminated source of hydrogen and hence can use unreformed natural gas, diesel or gasoline. Furthermore, the heat generated can be used to produce electricity by driving steam turbines.

### Small Stationary

There is significant potential for small stationary units (which we have defined as anything with a power output below 10kW). In this field the heat and power requirements of private households or small businesses could be met by low temperature proton exchange membrane (PEM) or SOFC. Units could power individual

houses or groups of homes and could be designed to meet all of the energy requirements of the inhabitants, or only the base load, with peak demands covered in another way. Initially at least, in most cases natural gas will provide a source of hydrogen fuel. As well as residential applications small stationary fuel cells could also be used to power remote sites, or as premium power supplies. In these areas, the fuel could be hydrogen.

### **Portable**

Fuel cells promise to be an important source of power for mobile electronic devices, offering key advantages over conventional batteries, such as increased operating times, reduced weight and ease of recharging. At present most development has focused on a variation of the low temperature proton exchange membrane (PEM) fuel cell, the direct methanol fuel cell (DMFC). As the name implies these fuel cells run on a methanol-water mix fed directly into the unit without prior reforming. Using methanol, DMFCs offer a great advantage over solid batteries in that recharging will just involve refilling with the liquid fuel.

### **Military**

Military applications are expected to remain a significant niche market for fuel cell technology. Their efficiency, versatility, extended running time and quiet operation make fuel cells extremely well suited for the power needs of military services. In various forms, fuel cells could provide power for the majority of military equipment from portable handheld devices used in the field to land and sea transportation.

### **Transportation**

Fuel cell technology promises to meet the most stringent emissions legislation. However, if fuel cells are to replace the internal combustion engine, the technology must not only meet tightening legislation, but also be able to reach operating temperature rapidly, provide competitive fuel economy and give a responsive

performance. Proton exchange membrane fuel cells (PEMFC) are best placed to meet these requirements. With a low operating temperature (80°C), PEMFC can reach operating temperature quickly.

Able to respond rapidly to varying loads, this type is twice as efficient as internal combustion engines. PEMFC also have the highest power density from the current fuel cell range, a crucial factor when space maximisation is such an important consideration in vehicle designs. Furthermore, the solid polymer electrolyte helps to minimise potential corrosion and safety management problems.

In order to avoid catalyst poisoning at this low operating temperature PEMFC need uncontaminated hydrogen fuel. Most major vehicle manufacturers regard the PEMFC as the successor to the internal combustion engine. Successful tests of buses have already taken place in several cities.