FUEL CELL TODAY

Opening doors to fuel cell commercialisation

Fuel Cell Market Development: History and Future

David Jollie, Fuel Cell Today – 02 April 2003

Introduction

Since the discovery of the principle behind the fuel cell over one hundred years ago, this technology has been greatly developed. Today, an increasing number of companies have an interest in the fuel cell area and we have seen a movement of the "industry" from solely academic research to a development phase and on to a pre-commercial stage. The next step, the introduction of commercial products, has already started.

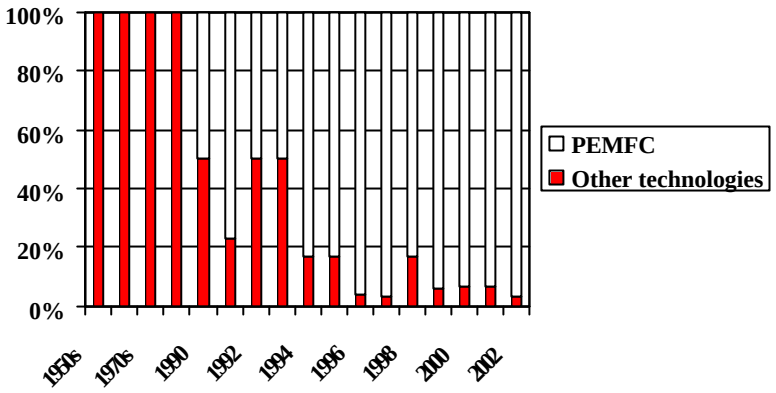
However, the picture is not the same for each of the individual fuel cell technologies. As might be expected, they are not at the same stage of development.

The Technology

The five major types of fuel cell, alkaline, molten carbonate, phosphoric acid, proton exchange membrane and solid oxide all continue to attract commercial attention. Looking back five years, phosphoric acid was the dominant technology and, although it continues to constitute the majority of commercial units "sold", it is clear that the other technologies, in particular PEMFC and SOFC have overtaken it. Direct methanol fuel cells are also beginning to attract attention.

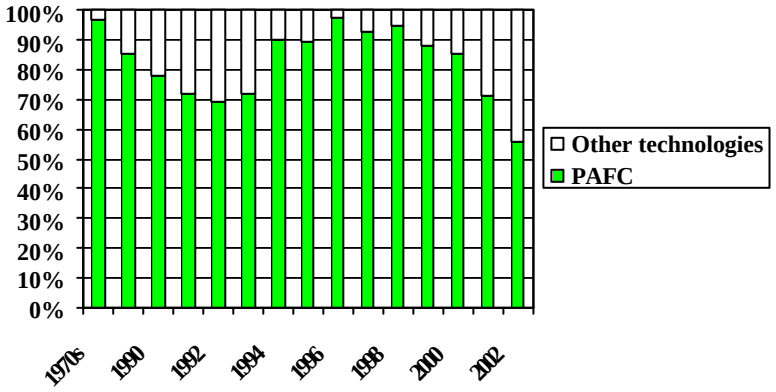
As we move into the commercial phase, it also become increasingly clear that the attributes of each type of fuel cell make them suitable for different applications. The automotive industry does not need to look far beyond the PEM fuel cell, as shown below.

Light Duty Vehicle Fuel Cell Technology



Large scale stationary (>50kW) programmes in PEMFC, on the other hand, appear to be withering as the overall efficiency is not sufficiently high. Here, molten carbonate and solid oxide are increasing in popularity due to the failure of phosphoric acid technology to capitalise on its early entry into commercial or semi-commercial markets.

Large Stationary Fuel Cell Technology



In all other market segments, there is at least a semblance of competition, however. Micro fuel cell developers have generally favoured the direct methanol fuel cell but a rising number are looking at pure hydrogen PEMFC. Intermediate size stationary or residential fuel cells are another battleground where the technical advances in PEMFC, driven in part by the automotive industry, compete against smaller, potentially high efficiency solid oxide units.

Geographical Distribution

A large number of regions, countries and even states are trying to focus fuel cell development, with the aim of building a pre-eminent local industrial network.

Perhaps the highest profile and most successful is Canada, where the commercial advantage of having leading fuel cell companies is being put to good use in building a national fuel cell industry. However, it should be pointed out that Canadian geography does contribute to building local networks simply by the predominant distribution of the population in major cities relatively close to the US border (including Calgary, Montreal, Toronto and Vancouver).

US initiatives are, by comparison, largely on a state-by-state basis and it is debatable whether this can provide the critical mass required to drive this development forward. Initiatives such as Connecticut's Clean Energy Fund and the California Fuel Cell Partnership can work providing they focus clearly enough on specific goals. Connecticut in particular already has a high density of fuel cell companies and may be able to use this. California too has demonstrated a lead in regulating for and implementing fuel cells. Programmes elsewhere, such as in Ohio and Texas will face more challenges. Even Michigan is likely to face stiff competition for the automotive sector with Ontario.

Europe has also started to work on creating a network of fuel cell organisations. However, work is split on a Europe-wide, national and local level. This confusion of resources and duplication of effort has not yet led to development of a real network or cluster of fuel cell know-how, although recent changes will start to improve this slowly.

Most interestingly, though, is the recent Japanese experience. The national government has decided that fuel cells have a high priority and this has been combined with an industry which is keen to involve itself and has a history of technological innovation. We have already seen the first "commercial" cars from Honda and Toyota and Toshiba. National bodies like the Japan Gas Association have also helped by playing key coordination roles.

Technical Issues

One of the major obstacles in the way of development of any fuel cell market is the state of the technology. Realistically, alkaline and phosphoric acid fuel cells appear to have the most significant problems and will require large amount so effort to overcome these. Solid oxide and molten carbonate systems appear to work relatively successfully but there are materials problems associated with frequent start-ups and durability is an issue. Proton exchange membrane cells have come the furthest but still need to demonstrate extended durability and the capability of low cost manufacture.

For most of these technologies, these technical issues should not be fatal flaws but they all have the potential to delay the acquisition of significant market share. In the worst case scenario, repeated failure of fuel cells, once commercially introduced, could irreparably damage their reputation.

Legislative Developments

Again, legislation is being developed at a number of levels, for instance, in the US, at federal and state level. To date, national and supranational legislation has generally been funding-focussed and has had relatively few concrete targets. Freedom Car and Freedom Fuel in the US are perhaps the most important of these but there are examples in all other regions.

However, local legislation is more interesting in terms of providing a platform for the development of a fuel cell market or industry. Subsidies for manufacture of products in a specific location are often exclusively local rather than national. However, perhaps the most interesting examples come from the automotive sector.

In Europe, there are already a number of schemes to limit personal usage of cars, in Athens, Gothenburg and other cities, but most interestingly in London. Government subsidy for cleaner vehicles combined with an exemption in congestion charging have led to an explosion in demand for hybrids and clean fuel vehicles. Fuel cell automobiles, being commercially unavailable, have not benefited from this so far but have the potential to do so from similar measures.

In Japan, there has been public antipathy towards the use of diesel as a fuel. Legal action against the government and the vehicle manufacturers may succeed in limiting the use of diesel cars. As a precedent, this could drive the introduction of much stricter local emissions legislation. There is already an awareness of these issues enshrined in the California Air Resources Board's mandate.

Outside the transport market, legislation is equally important. Unfortunately, developments are slow. There are considerable challenges to be faced in all regions in connecting fuel cells to the grid system. The general absence of net metering also reduces the attractiveness of fuel cell technology.

Fuel Trends

For once, the fuel cell market appears to have reached a consensus - for the time being. First generation cars and buses will carry hydrogen on-board. Residential and larger scale power generation will employ liquefied petroleum gas or natural gas initially.

In the longer term, fuel choice for transport could widen to include methanol. Gasoline has largely fallen from favour as an onboard fuel. Stationary fuel cells should start to choose from a broader palette of fuels. In particular, biogas may become an important alternative fuel. In the longer term, integration of fuel cells with renewable energy, such as biogas, will increase the environmental and commercial benefits.

Key Developments to watch for

So, if the fuel cell industry is moving forward, if it is to meet some of the market predictions, where are the key points?

Firstly, one of the largest confirmed orders for fuel cells should be delivered this year and next. The timing of the delivery of the thirty DaimlerChrysler buses will be interesting. Reports suggest that most will reach the operators towards the end of 2003. Any delay in this would be negative, showing either technical difficulties or a decreasing desire to sell products into the market.

The number of prototype fuel cell cars will also be important to watch. In 2002, almost all of the major manufacturers exhibited either a concept or a prototype. Some may not do so this year as they now have "production versions" (i.e. DaimlerChrysler, Honda and Toyota). It will be intriguing to see how Ford and General Motors in particular proceed. But, what will be more illuminating is the depth of commitment by BMW, Hyundai, Nissan and Renault, Peugeot-Citroen and others. A healthy fuel cell automobile market will require a reasonable number of manufacturers.

As mentioned above, changes in the regulatory environment are occurring. We should see the first fruits of the Japanese and US national programmes. If these and other programmes (e.g. the London Hydrogen Partnership or Stuttgart's Fuel Cell Initiative) set targets for the implementation of fuel cells, it will finally be possible to measure the progress of the industry.

Finally, there is intense speculation that the portable fuel cell market could flower this year, with the first products being truly commercially available. Already, Ballard is selling portable power products. If two or three more companies join them, as we expect, this will be perhaps the most positive sign of all, providing proof that fuel cells can be sold commercially, giving visibility of this technology to the general public and boosting research and development into the topic.

Conclusion

The fuel cell market is moving forward with a total of 1,500 units produced and placed in 2002, compared with almost 1,000 the year before and 435 in 2000. PEMFC technology is certainly the market leader but direct methanol and solid oxide, in particular, may compete in some areas.

Concrete forecasts on market size are hard to find. Legislation and technology development remain important. Nonetheless, with an increasing number of public announcements from government and industry, fuel cells are moving from a research and development phase into a demonstration mode, the precursor to real commercial sales. Targets for sales and installed generation capacity are being made public and, for the first time, will allow an objective monitoring of the progress being made over the next few years.

Acknowledgment

I would like to acknowledge the other people involved in the work for this presentation, principally Mark Cropper and Stefan Geiger.

About the author

David Jollie is working for Fuel Cell Today, the global Internet portal for companies and individuals with an interest in the commercialisation of fuel cells. It is your single free source for comprehensive and authoritative fuel cell news, commentary, resources and business opportunities. To contact the author, please send an email to: davidjollie@fuelcelltoday.com, Tel: +44 (0)20 7269 8284.