

**Survey for the Fuel Cell Industry Summit for Europe  
29 – 31 October, 2001**

**Grand Hotel Du Parc  
Villars  
Switzerland**

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## Introduction

Following an initial meeting at the Lucerne Fuel Cell Conference, and a series of meetings of the ad-hoc group, it was agreed there was a need to hold an international fuel cell 'Summit' to explore hurdles to commercialisation in Europe and to identify common ground amongst the various fuel cell players. The view was that only the fuel cell industry itself could determine such issues. Hence the conclusion, that potential Summit participants should represent companies that will ultimately be responsible for the success or otherwise of any future fuel cell industry.

One outcome of this process was the idea that companies should be surveyed in order to identify some of the issues to be addressed by the Summit, to facilitate discussion and to execute any subsequent action. Thus, a survey was drawn up requesting interested parties to indicate their areas of activity and to rank eight specific themes in order of importance for the mass-market introduction of fuel cells. A series of follow-up questions was then posed with respect to the eight themes.

The themes in order of their subsequent ranking are as follows:

1. Political and Fiscal Support
2. Codes and Standards
3. Capital Markets
4. Automotive Infrastructure
5. Public Education and Communication Programs (Outreach)
6. An Open Industry Database
7. Stationary Infrastructure
8. Human Resources

Despite the fact that the Summit will concentrate on the commercialisation of fuel cells in Europe, of the 36 companies that returned completed surveys, 10 come from North America and 1 from Japan. The group taken as a whole represents 3 of the 5 hydrogen-air electrolytes and a bewildering array of potential applications.

The respondents included:

- **Eight** 'pure' fuel cell developers
- **Seven** industrials, including well known multinationals active as stack developers and/or component suppliers
- **Ten** component suppliers made up of seven MEA players, including international chemical and precious metals groups and three bipolar plate manufacturers
- **Four** firms involved in fuelling fuel cell plant, comprising two fuel processing developers and two companies directly involved in hydrogen infrastructure.
- **Three** utilities
- **Two** of the world's largest heating appliance manufacturers and
- **Two** of the world's largest auto assemblers

In the next section we draw some tentative conclusions from the surveys. We then move on to the Executive Summary before finally setting out the results of the survey.

## Conclusions

1. The willingness of more than 40 companies involved in the fuel cell industry to commit to take part in an industry-only gathering...

*“... to establish a roadmap for immediate and subsequent joint actions towards commercialising fuel cells in Europe...”* and

*“... to identify areas where the industry needs to collaborate for the good of all its members”*

suggests that the time is indeed opportune for concerted industry action. The fact that 36 of these companies also returned completed questionnaires only serves to support this conclusion.

2. The fuel cell sector appears to be less fragmented than may be expected of an emerging industry, indicating a certain degree of technical maturity.
3. Political and fiscal support in the form of introduction subsidies, tax breaks and support for extensive field trials is resoundingly favoured over research and development grants. This lends support to the impression of an emerging maturity within the fuel cell industry.
4. The call for the government support of extensive field trials, implicit in the survey's results, would demand significant collaboration across a wide range of interested parties. Apart from government agencies, such concerted action could also involve fuel cell developers, systems integrators, corporate and private users, service and maintenance contractors as well as fuel suppliers.
5. While 13 respondents view the establishment of codes and standards as 'Unavoidable' to commercialisation, only 5 consider the urgency of their establishment as being 'Extremely Urgent'. This may well be indicative of the technical and manufacturing hurdles still faced by the industry.
6. The fact that the "... Role Capital Market Will Play in Commercialisation" achieved an overall ranking of third, may reflect a rising appreciation of the massive sums of capital that would be required should fuel cells powered devices go into mass production. This result stands in stark contrast to the fact that to date not a single fuel cell company is quoted in Europe.
7. There is clear support for collective action aimed at communicating with and educating key groups, particularly government agencies, about the industry. This could be seen as reinforcing the view that governments could do more to provide a framework for fuel cell commercialisation.
8. There appears to be strong support for the establishment of an open industry database. Of the 35 companies that responded to this particular question, only 1 said it would not be interested in contributing to such a database.
9. Labour supply problems do not appear to be significant at present. However, it is clear that some companies are beginning to experience difficulties in recruiting suitably qualified staff. Such problems can only be expected to intensify as the industry moves closer to production.

## I) Executive Summary

### Political and Fiscal Support

- The theme of political and fiscal support attracted the highest overall ranking of issues important for the commercialisation of fuel cells. 12 'First' and 9 'Second' votes were cast for this issue from the total of 33 it attracted.
- The quality of support provided by the European Commission requires more detailed work, but on the basis of this survey appears to be regarded at best as equivocal by the fuel cell industry itself.
- At the individual country level, respondents overwhelmingly placed Germany head and shoulders above all other European nations' efforts. Though **it must be noted, nothing can be inferred about the suitability or absolute quality of that support.**
- The situation at the state or Länder level is even more dramatic. The only provinces to get a specific mention were the German states of Bavaria, Baden-Württemberg and North Rhine Westphalia, which all scored 'Positive' or 'Excellent'.
- Policies focusing on government support for field trials, introduction subsidies and tax incentives scored significantly higher than R+D grants or ratification of the Kyoto Protocol

### Codes and Standards

- Codes and standards came a close second to political and fiscal support in order of importance. Specifically, 25 respondents considered the importance of the establishment of codes and standards as either 'Unavoidable' (12) or 'Very Important' (13) for fuel cell commercialisation.
- However, when considering how urgent their establishment is, only 5 respondents considered it to be 'Extremely Urgent', while 3 were of the opinion that their establishment is 'Not Very Urgent'.

### Capital Markets

- Capital markets piped auto infrastructure for third place order of importance reflecting the broad range of respondents interests.
- Out of a total of 27 responses, Capital Markets attracted 11 'First' rankings in terms of importance for the mass-market introduction of fuel cells. This ranking was confirmed by 6 respondents seeing the role financial markets will play in the commercialisation process in Europe as 'Unavoidable' and 13 seeing it as 'Very Important'. This result could be seen as remarkable in the light of the fact that not a single fuel cell company is quoted in Europe.

### Automotive Infrastructure

- The fact that 50% of respondents indicated they were not active in automotive applications in part helps explain why automotive infrastructure *only* ranked fourth in terms of importance. 11 out of a total of the 25 respondents ranked automotive infrastructure 'First' in terms of importance for mass-market introduction. A further 6 ranked auto infrastructure 'Second'.
- The single most important question raised with respect to auto infrastructure was the issue of fuel availability. 15 respondents highlighted this issue independently and unprompted. 7 respondents also raised the problems of hydrogen production and storage.

## **Public Education and Communication Programs (Outreach)**

- The importance of outreach programmes attracted 24 responses, ranking the subject overall 5<sup>th</sup>.
- On the question of key groups to target, 31 out of a total of 35 respondents regarded the task of educating government agencies as either 'Crucial' (10) or 'Very Important' (21). Only 5 respondents considered the targeting of the education system as 'Crucial'. Just one respondent saw targeting the general public as 'Crucial'.
- These results appear to dovetail neatly with the ambiguous regard in which government support seems to be generally held.

## **Database**

- The question of the importance of open databases to the introduction of fuel cells scored an overall rank of 6<sup>th</sup>, attracting a total of 22 responses.
- On the specific question of contributing to a database, only one respondent out of 35 said they were not at all interested in providing information. On the other hand, 29 said they would *probably* contribute to an open industry database while 5 indicated that they would definitely contribute.
- 18 companies made a variety of suggestions regarding the types of data that would be useful. These ranged from applications, cost and performance and field test data, to materials and components directories and information on the availability of funding. One respondent called for information on the state of competing technologies.
- Taken together these responses could be seen to indicate the dearth of publicly available data on the state of the fuel cell industry. More encouraging is the apparent willingness to contribute to an open industry database.

## **Stationary Infrastructure**

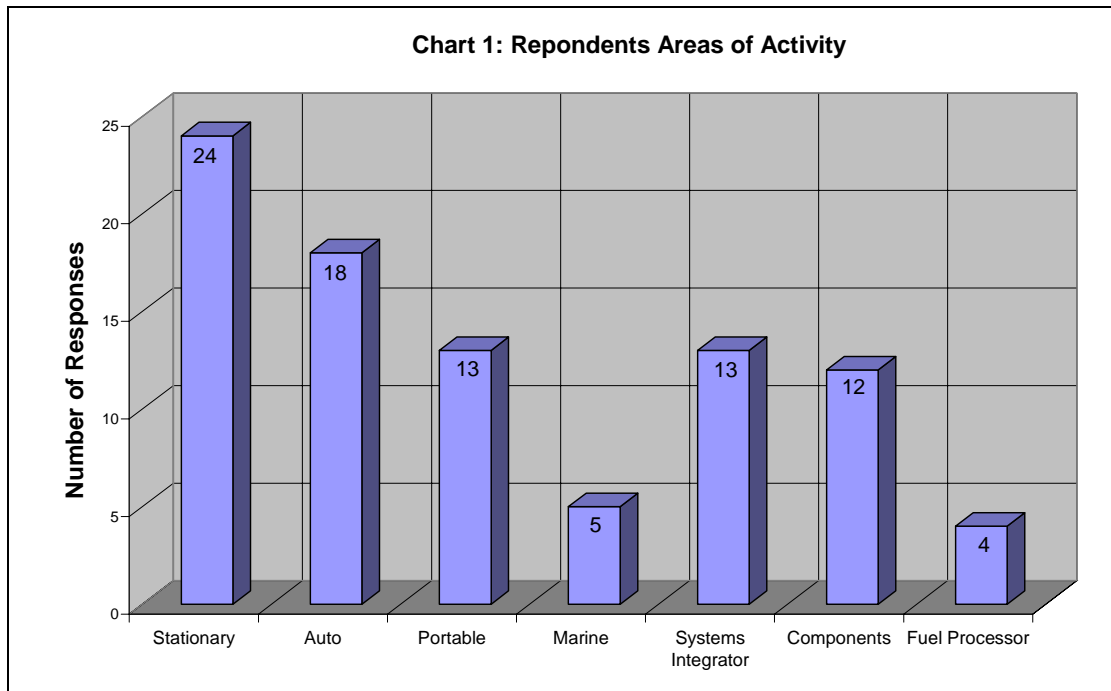
- The importance of stationary infrastructure to mass-market introduction elicited just 21 respondents, three less than the number of companies declaring an interest in this area. Overall this issue was ranked 7<sup>th</sup>.
- While the question of fuel availability was the burning issue for automotive, no single issue was raised in stationary. The range of concerns that were raised included interconnection standards, market liberalisation and issues of service and maintenance, reflecting the radically differing challenges automotive and stationary applications face.

## **Human Resources**

- Human resources -- along with Stationary Infrastructure -- attracted the lowest number of responses (21) to the question of its importance to commercialisation and overall ranked last.
- However, with respect to the specific question of a rising shortage of suitably skilled labour, 13 of 35 respondents said it was a noticeable problem and a further 9 described it as an increasing problem.
- A number of respondents suggested involving the education system in general and universities in particular as a means overcoming expected future skill shortages.

## Respondents Stated Areas of Activity

Chart 1 details the various fuel cell activities as stated by the 36 respondents:



The sum of the activities given by the 36 respondents totals 89, ranging from 24 indicating an interest in stationary applications to 5 in Marine and 13 involved in systems integration to 4 in fuel processing.

The following table matches the number of activities to the number of companies as given by the respondents.

**Table 1: Match of Companies to Stated Number of Fuel Cell Activities**

| Number of Activities | Five | Four | Three | Two | One | Total Responses |
|----------------------|------|------|-------|-----|-----|-----------------|
| Number of Companies  | 4    | 6    | 5     | 9   | 12  | 36              |

As can be seen above, 12 companies, or 33% of the sample, indicate interest in only one area with the balance declaring an interest in 2 to 5 different areas.

One conclusion that may be drawn from the above is that the fuel cell industry may be less fragmented than could be expected from such a nascent industry. This in turn may support the view that the time is ripe for this emerging industry to consider collaboration and co-ordination of individual efforts to ensure the successful commercialisation of the technology.

No attempt was made to determine to what extent, if any consolidation of the various electrolytes has taken place.

## Ranked Themes

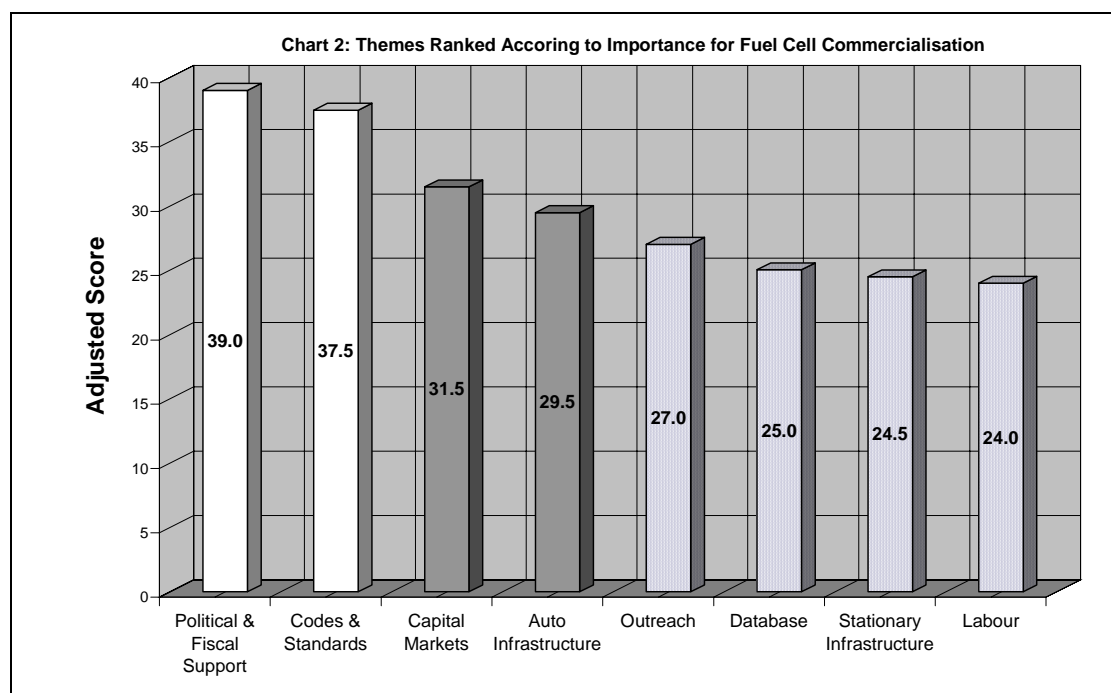
Respondents were asked to rank 8 themes in terms of importance for the mass-market introduction of fuel cells. While all 36 companies responded to this question, the number of companies ranking the individual themes ranged from 33, for Political and Fiscal Support, to just 21 for Stationary Infrastructure and Human Resources. The ordered responses are shown in Table 2 below:

**Table 2. Themes Ranked In Order Of Importance for Fuel Cell Commercialisation**

| Theme                      | Total Responses | 1 <sup>st</sup> | 2 <sup>nd</sup> | 3 <sup>rd</sup> | 4 <sup>th</sup> | 5 <sup>th</sup> | 6 <sup>th</sup> | 7 <sup>th</sup> | 8 <sup>th</sup> | Adjusted Score | Overall Rank |
|----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|--------------|
| Political & Fiscal Support | 33              | 12              | 9               | 7               | 2               | 2               | 0               | 1               | 0               | 39.0           | 1            |
| Codes & Standards          | 32              | 9               | 12              | 4               | 3               | 3               | 0               | 0               | 1               | 37.5           | 2            |
| Capital Markets            | 27              | 11              | 4               | 3               | 3               | 3               | 2               | 0               | 1               | 31.5           | 3            |
| Auto Infrastructure        | 25              | 11              | 6               | 4               | 1               | 0               | 2               | 1               | 0               | 29.5           | 4            |
| Education & Communication* | 24              | 1               | 4               | 6               | 1               | 3               | 4               | 3               | 2               | 27.0           | 5            |
| Database                   | 22              | 2               | 3               | 7               | 3               | 1               | 3               | 2               | 1               | 25             | 6            |
| Stationary Infrastructure  | 21              | 5               | 9               | 2               | 2               | 2               | 1               | 0               | 0               | 24.5           | 7            |
| Human Resources            | 21              | 2               | 2               | 7               | 3               | 1               | 2               | 3               | 1               | 24.0           | 8            |

\* Public education and communication programmes often abbreviated to 'Outreach'.

As can be seen in the 'Total Responses' column,, no theme received the maximum 36 responses. The following eight columns show the distribution of responses between the themes in decreasing order of importance. These responses were subsequently weighted<sup>1</sup> in order to impute an overall rank to each theme. The penultimate column shows the adjusted or weighted average score each of the themes achieved while the final column shows the rank. The adjusted scores are shown in the following graph:



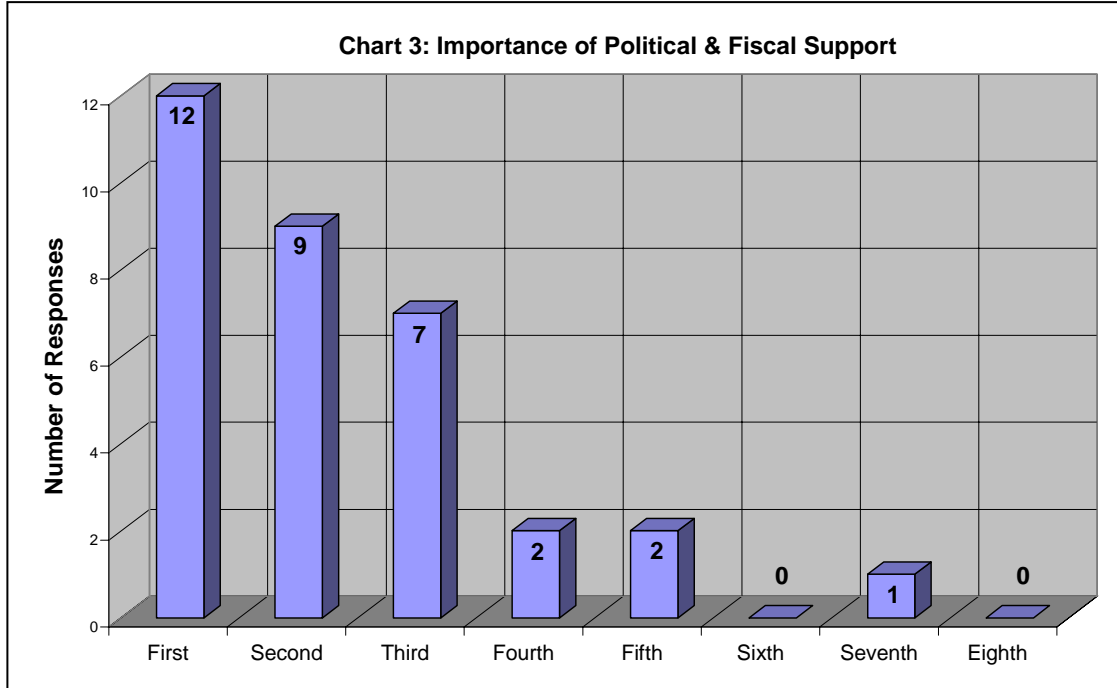
It should be pointed out that given the scores are ordinals, it is not possible to say anything quantitative about the rankings. Nevertheless, the results can be regarded as falling into three distinct clusters or levels of importance. The first, 'Political and Fiscal Support' and 'Codes and Standards' are clearly seen as the most substantial issues for fuel cell commercialisation. The second cluster incorporates 'Capital Markets' and 'Auto Infrastructure'. The final cluster groups the remaining four issues, namely Outreach, Stationary Infrastructure, Industry Databases and Human Resources.

<sup>1</sup> Each vote is accorded a base weight of 104.5%, with rank 8<sup>th</sup> rated lowest with the base weight. Given it is not possible to know how important the respondents ascribed to each issue the remaining weights are distributed to the succeeding 7 rankings in increments of 2.3% such that 7<sup>th</sup> has a 106.8% weight and 1<sup>st</sup> a 120.5% weight. No adjustment was made for the differing number of responses to each issue on the basis that a no vote implied less or no interest and that this information should not be lost.



## Theme: Political & Fiscal Support

As noted above this issue was ranked first in order of importance for the mass-market introduction of fuel cells. Chart 3 below details how the votes 33 cast for Political and Fiscal Support were distributed:



In order to shed some light on the quality of the political support on offer within Europe respondents were asked to grade the support provided by the European Commission, the individual European countries and the states within those countries as 'Poor', 'Good' or 'Excellent'. The results, detailed below are less than encouraging:

**Table 3:**

| Quality of Political Support | European Commission | Individual Countries | States / Provinces |
|------------------------------|---------------------|----------------------|--------------------|
| Poor                         | 9                   | 6                    | 5                  |
| Good                         | 13                  | 21                   | 11                 |
| Excellent                    | 1                   | 1                    | 5                  |
| <b>Total Responses</b>       | <b>23</b>           | <b>28</b>            | <b>21</b>          |

When considering the results it should be borne in mind that it is not possible to determine the nature of the support the various political entities are providing. Further, 'Good' should not be read as implying that support is appropriate or optimal given we can say nothing about its absolute quality. One need only consider the confusion, to say nothing of the deep dissatisfaction surrounding proposed government policy on subsidising fuel cell CHP plant in Germany, the country which stands head and shoulders above all others.

Support from the Commission could be described as ambiguous, particularly considering the fact that 36% of the sample (13) did not register any response to the Commission's support. 13 of the 23 that did respond rated the Commission's support as 'Good' while 9 consider EC support as 'Poor'.

At first glance support from individual countries appears to be viewed somewhat more positively. 21 respondents see country support as 'Good' and only 6 as 'Poor'. But these numbers mask the huge impact Germany has on the overall result.

When indicating the quality of country support some respondents associated that support with specific countries. For example the one 'Excellent' response was awarded to Germany. Twelve of the 21 'Good' responses were associated with specific countries: 8 for Germany, 2 for the U.K and 1 each for France

and Switzerland. Five of the six 'Poor' responses were also associated with specific countries, 2 each for the U.K. and Italy and just one for Germany. On the basis of these results it would appear that the federal authorities in Germany are at least a relatively 'Good' source of support.

The situation within the individual states or Länder is even more pronounced with only Germany's provinces being specifically mentioned. The German Länder of Bavaria, Baden-Württemberg and North Rhine Westphalia accounted for all 5 'Excellent' (14%) and 11 'Good' (31%) state-specific responses. The five 'Poor' responses (14%) were not associated with any particular state.

The UK Chartered Insurance Institute in a recent research reported noted that, "The renewables opportunity is worth trillions of dollars – the biggest market in history". Given the versatility and breath of fuel cell applications fuel cells can be expected to claim a significant portion of that market. However, the above analysis bodes badly for any future European fuel cell industry and its employment prospects.

When asked to specify whom best to lobby for political support in Europe, 9 respondents pointed to the European Commission while only two suggested lobbying individual countries. Surprisingly no one mentioned state or local governments.

On the subject of the most appropriate policy to promote commercialisation, respondents were asked to rank 5 policies. The results are detailed below:

**Table 3a. Policy Ranking**

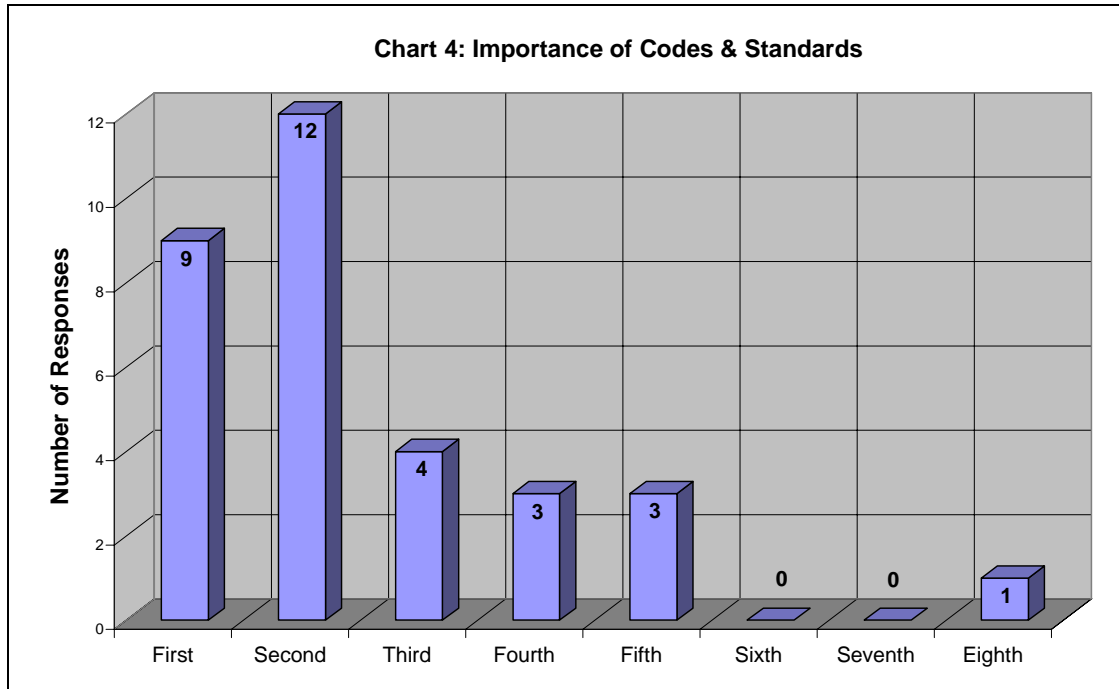
| <b>Impact of Policy Action</b>                  | <b>Crucial</b> | <b>Very Positive</b> | <b>Positive</b> | <b>Minimal</b> | <b>None at all</b> | <b>Total Responses</b> |
|-------------------------------------------------|----------------|----------------------|-----------------|----------------|--------------------|------------------------|
| <b>Govt. Support for Extensive Field Trials</b> | 15             | 12                   | 4               | 4              | 1                  | 36                     |
| <b>Tax Incentives</b>                           | 13             | 15                   | 4               | 0              | 2                  | 34                     |
| <b>Introduction Subsidies</b>                   | 13             | 12                   | 6               | 2              | 1                  | 34                     |
| <b>Govt. Research and Development Grants</b>    | 5              | 9                    | 12              | 8              | 1                  | 35                     |
| <b>Ratification of the Kyoto Protocol</b>       | 2              | 7                    | 20              | 6              | 1                  | 36                     |

As can be seen 15 respondents view government support for field trials as 'Crucial' and 12 see this as 'Very Important'. Indeed, it is virtually impossible to distinguish between fuel cell industry advocacy of tax incentives, introduction subsidies and government-backed field trials. However, it is equally clear that such policies attract significantly more enthusiasm than research and development grants or ratification of the Kyoto Protocol. This could be interpreted as being indicative of a technical maturing within the industry, reflecting the move out of the laboratory into the field.

On balance the results suggest a marked contrast between the call for government support and the generally ambiguous regard in which government help appears to be held.

## Theme: Codes & Standards

Codes and standards ranked second overall in terms of importance for the mass-market introduction of fuel cells. Chart 4 below details how the 32 votes cast for codes and standards were distributed:



On the basis of 'First' votes, codes & standards ranked fourth but scored more 'Second' votes than any other issue. Thus 65% rated this issue either 'First' or 'Second' in terms of importance for the mass-market introduction of fuel cells, placing it on a par with the issue of political and fiscal support.

The significance attributed to codes & standards is supported by the response to the specific question,

**“How important is the establishment of Europe-wide Codes & Standards to commercialisation?”**

Table 4 below details the result:

**Table 4: Importance of the Establishment of Codes and Standards**

| Establishment of Codes & Standards | Unavoidable | Very Important | Important | Minor Importance | Irrelevant | Total Responses |
|------------------------------------|-------------|----------------|-----------|------------------|------------|-----------------|
| <b>Responses</b>                   | 13          | 12             | 11        | 0                | 0          | 36              |

The responses are clearly skewed towards the 'Unavoidable' end of the spectrum. In order to get an idea of how pressing the establishment of codes and standards is viewed with respect to commercialisation the following question was posed:

**“How urgent is the establishment of Europe-wide Codes & Standards to commercialisation?”**

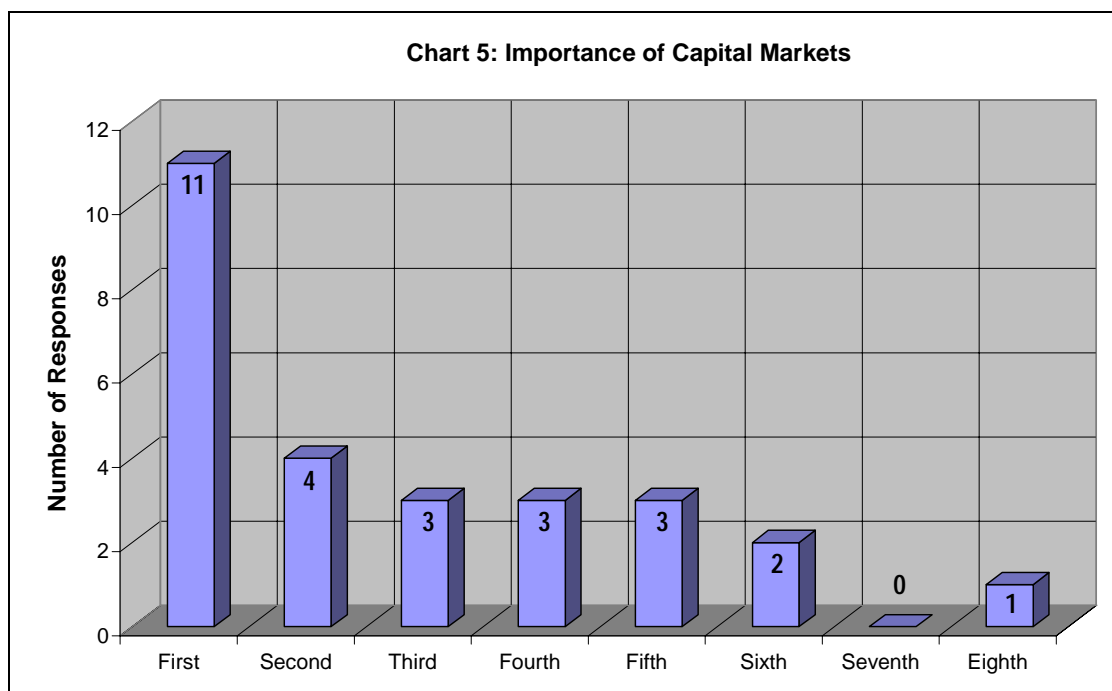
**Table 4a: Urgency of the Establishment of Codes and Standards**

| Urgency of Codes & Standards | Extremely Urgent | Very Urgent | Urgent | Not very Urgent | Not at all Urgent | Total Responses |
|------------------------------|------------------|-------------|--------|-----------------|-------------------|-----------------|
| <b>Responses</b>             | 5                | 16          | 10     | 3               | 1                 | 35              |

As can be seen above, responses to the question of how urgent the establishment of codes & standards is much more evenly spread, perhaps being indicative of technical hurdles and a lack of field test experience.

## Theme: Capital Markets

Capital markets scored an overall rank of third in terms of their importance to commercialisation in Europe. A total of 27 votes were cast, the distribution of which is shown in Chart 5 below:



Of the eleven 'First' votes recorded, 10 were cast by European, mainly non-quoted though not all independent companies and one by a non-quoted US firm. By contrast, of the 7 'Second' & 'Third' votes recorded, 6 were cast by quoted companies while a unit of a quoted company cast the 7th. Three come from the US and four from Europe. Both the ranking and the distribution of votes imply an awareness of the importance financial markets will play in the commercialisation process.

This is supported by the distribution of responses to the question ...

**“Capital markets are becoming increasingly interested in the industry. How important a role will they play in the commercialisation process in Europe?”**

- the results of which are detailed in Table 5 below:

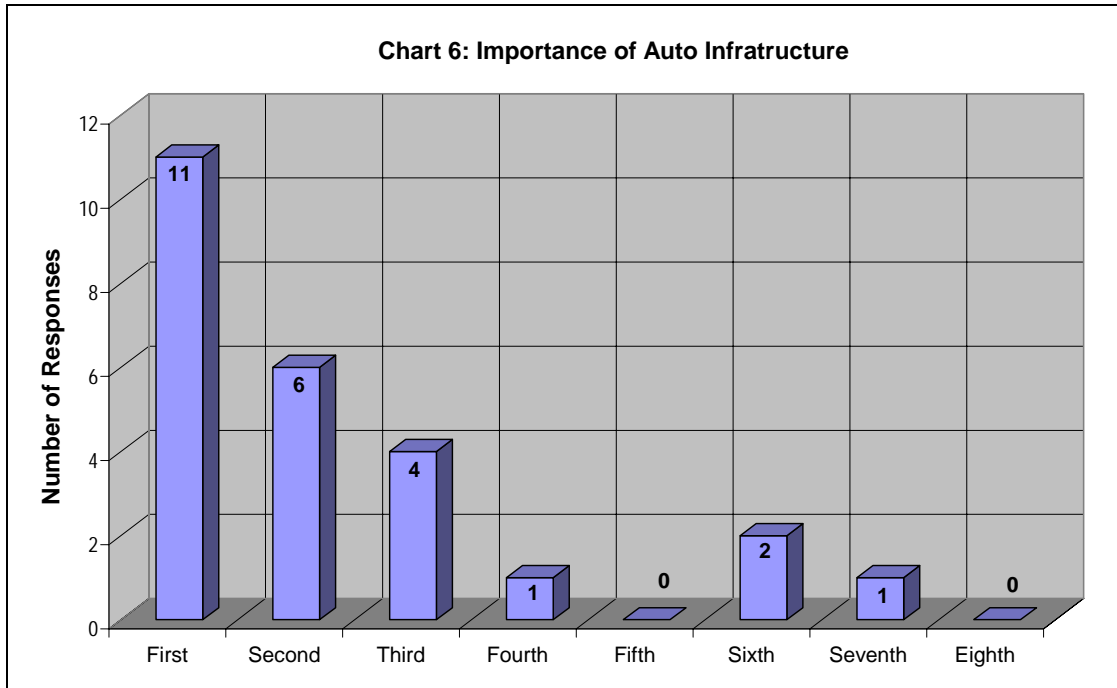
**Table 5: Role of Capital Markets in European Commercialisation**

| Role of Capital Markets | Unavoidable | Very Important | Important | Of Minor Importance | Irrelevant | Total Responses |
|-------------------------|-------------|----------------|-----------|---------------------|------------|-----------------|
| Responses               | 6           | 13             | 12        | 5                   | 0          | 36              |

An interesting aspect of these results is highlighted by the fact that there is not a single pure fuel cell stock quoted on any Europe stock exchange. By contrast, the US financial markets have already supplied significant amounts of capital to the fuel cell industry – around \$1bn in 2000 and almost \$500 this year. In its turn, European capital markets can be expected to supply a significant proportion of the vast sums of cash that will be required should the technology be produced in commercial volumes.

## Theme: Automotive Infrastructure

Automotive infrastructure ranked fourth overall in terms of its importance for mass-market commercialisation. Chart 6 shows the distribution of the 25 votes assigned to this issue:



Of the 25 companies that rated automotive infrastructure, 11 ranked the issue 'First' in terms of importance for the mass-market introduction of fuel cells. A further 6 ranked auto infrastructure 'Second'.

The fact that 18 of the 36 respondents indicated they were not active in automotive applications in part explains why this issue was *only* rated fourth in terms of importance.

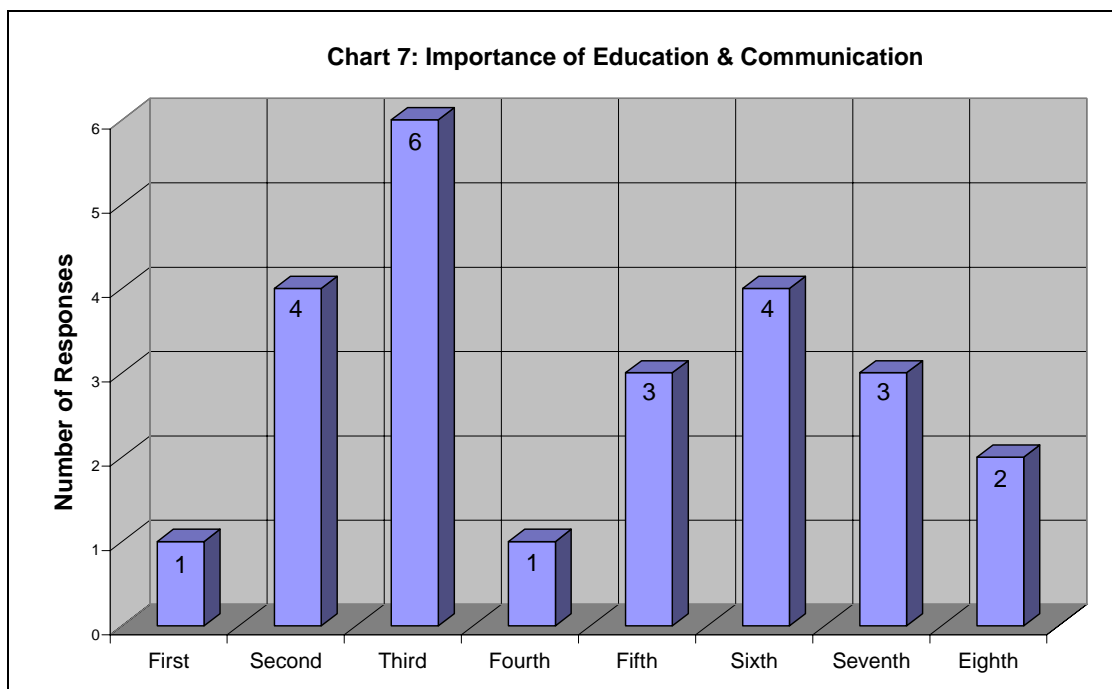
Not surprisingly, the single most important issue raised with respect to automotive infrastructure was the question of fuel supply. 15 respondents highlighted the issue of fuel availability independently and unprompted while 7 pointed to the problems of hydrogen production and storage as shown in table 6 below:

**Table 6:**

| Infrastructure Issues | Fuel Availability | Resolution of Hydrogen Issues | Total Responses |
|-----------------------|-------------------|-------------------------------|-----------------|
| Responses             | 15                | 7                             | 16              |

## Theme: Public Education & Communication Programs (Outreach)

The issue of outreach was ranked 5<sup>th</sup> overall. The distribution of its 24 responses is shown in Chart 7 below.



Far more interesting than the overall ranking of outreach was the response to the question of educating key groups as detailed below:

**Table 7: Relevance of Educating and Communicating Specific Groups**

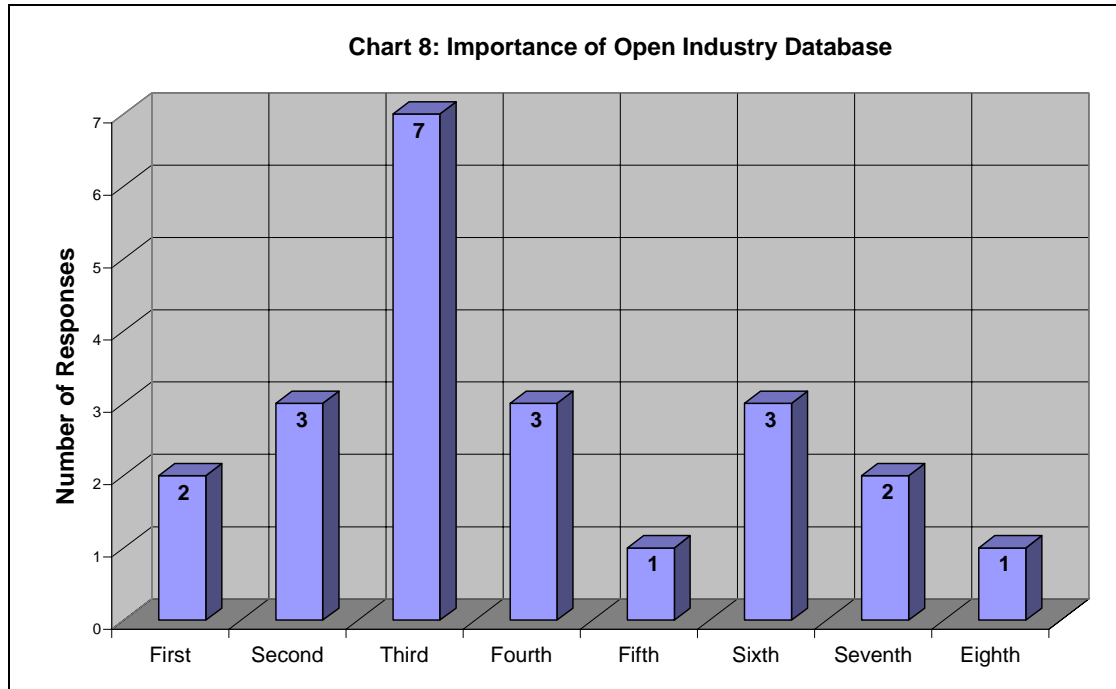
| Outreach Targets       | Crucial | Very Important | Important | Not Very Importance | Irrelevant | Total Responses |
|------------------------|---------|----------------|-----------|---------------------|------------|-----------------|
| Government Agencies    | 10      | 21             | 3         | 1                   | 0          | 35              |
| Schools & Universities | 5       | 10             | 14        | 7                   | 0          | 36              |
| General Public         | 1       | 7              | 21        | 5                   | 1          | 35              |

The overwhelming majority of respondents regarded the task of educating government agencies as either 'Crucial' (10) or 'Very Important' (21). Only 15 respondents considered the targeting of schools and universities as 'Crucial' (5) or 'Very Important' (10). Just one respondent saw targeting the general public as 'Crucial'.

These results could be seen as reinforcing the view that key government officials not only need to be educated in the potential offered by fuel cells, but also that governments could do more to provide a solid framework for fuel cell commercialisation.

## Theme: Industry Database

The question of the importance of an open database achieved an overall ranking of 6. The distribution of the 22 responses is shown in Chart 8 below:



Perhaps more important than the ranking of this theme was the unanimity of response to the question...

**“Would you be interested in contributing to an open industry database?”**

... detailed in Table 8 below.

**Table 8: Interest in Database**

| Industry Database | Definitely | Probably  | Not at all | Total Responses |
|-------------------|------------|-----------|------------|-----------------|
|                   |            |           |            |                 |
| <b>Responses</b>  | <b>5</b>   | <b>29</b> | <b>1</b>   | <b>35</b>       |

As can be seen the overwhelming majority indicated that they would probably contribute to an open industry database while 5 stated they would definitely contribute to such a database.

Respondents were not short on ideas of what such a database should contain. Eighteen companies made the following proposals for information to be included:

**Table 8a: Proposed Information for Inclusion in an Industry Database**

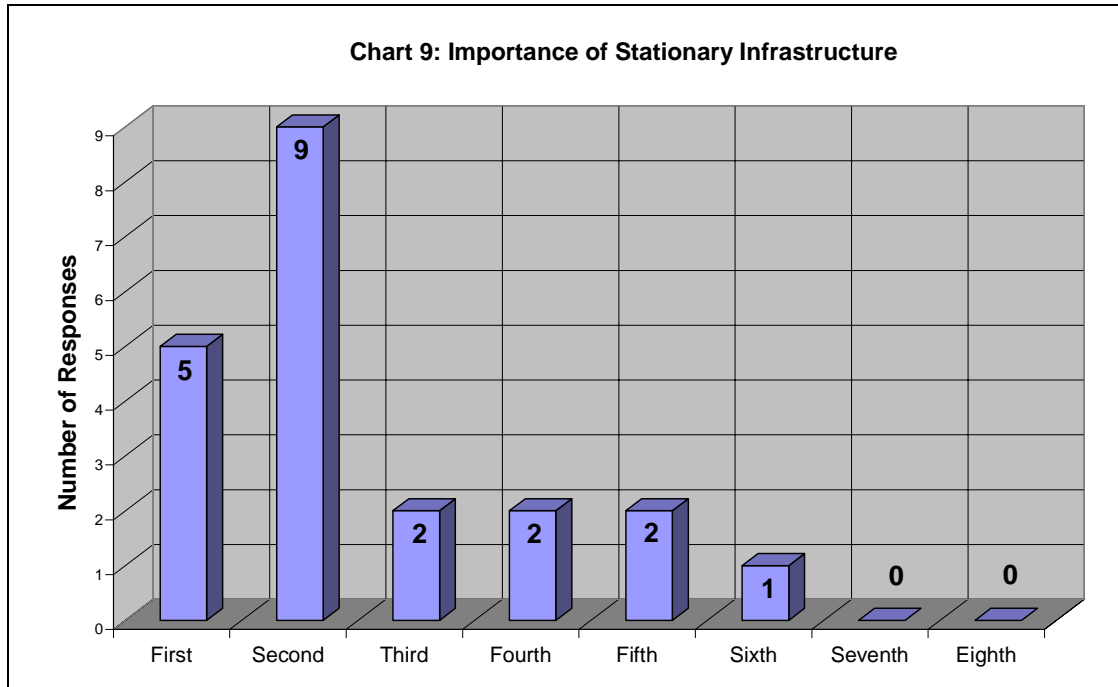
| Suggested Data   | Market Data | Application Data | Cost & Performance Data | Industry Directory | Information on Funding | Materials & Components Data | Field Test data | Public Studies |
|------------------|-------------|------------------|-------------------------|--------------------|------------------------|-----------------------------|-----------------|----------------|
|                  |             |                  |                         |                    |                        |                             |                 |                |
| <b>Responses</b> | <b>9</b>    | <b>7</b>         | <b>6</b>                | <b>5</b>           | <b>3</b>               | <b>3</b>                    | <b>2</b>        | <b>2</b>       |

Although none of the above categories was further specified, it would appear there is a demand for some easily assessable hard industry data. One respondent pointed out the need for information on the state of competing technologies.

How ‘open’ such a database could be remains to be seen.

## Theme: Stationary Infrastructure

The importance of stationary infrastructure to mass-market introduction ranked 7<sup>th</sup> overall. This subject elicited just 22 respondents, three less than the number of companies declaring an interest in this area. The distribution of those responses is shown in Chart 9 below:



Presumably the relatively low ranking of this issue reflects the fewer obstacles faced by stationary applications, at least in comparison to automotive applications.

While the question of fuel availability was the burning issue for automotive, no single issue emerged in the survey where stationary infrastructure was concerned. The range of stationary specific issues raised included:

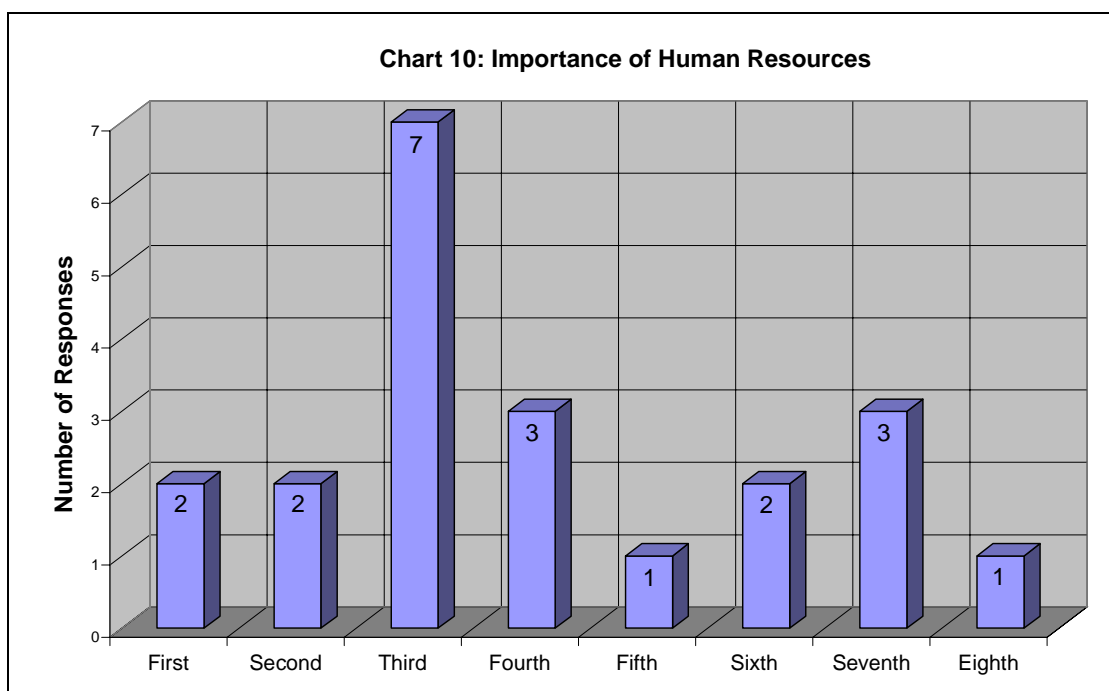
- Interconnection standards,
- Market liberalisation and
- Service and maintenance

The importance of such issues clearly highlights the radically different challenges faced by automotive and stationary applications.



## Theme: Human Resources

The issue of Human Resources was placed last in order of importance for fuel cell commercialisation. Along with stationary infrastructure the issue of labour attracted the lowest number of responses (21). The distribution of those responses is shown in Chart 10:



Exactly one third of those ranking human resources put the issue in third place in order of importance, with the other 14 responses being a fairly evenly spread.

The responses to the specific question regarding the degree to which suitably skilled labour is in short supply can be seen in Table 10 below:

**Table 10: Degree to which Skill Shortages is being Felt**

| Labour Shortage | Serious Problem | Increasing Problem | Noticeable Problem | Minor Problem | Non-existent Problem | Total Responses |
|-----------------|-----------------|--------------------|--------------------|---------------|----------------------|-----------------|
| Responses       | 1               | 9                  | 13                 | 12            | 0                    | 35              |

Labour supply problems would not appear to be significant at present. However, the distribution of the above responses shows that some are already experiencing difficulties in recruiting suitably qualified staff. 13 of the 35 respondents report that the issue of human resources is already a noticeable problem. A further 9 describe it as an increasing problem. Such problems can only be expected to intensify as the industry moves closer to production.

Without prompting, 9 respondents suggested involving the education system as a means of countering the expected rising labour shortage. This response presumably also helps explain why targeting schools and universities in outreach programmes outranked the targeting of the general public.