IX.1 Hydrogen Knowledge and Opinions Assessment

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Subcontractor:
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Project End Date: 2012

Objectives

- To measure the current level of awareness and understanding of hydrogen and fuel cell technologies in five target populations:
  - General public
  - Students
  - State and local government agencies
  - Potential end users
  - Safety and codes officials
- To compare the current level of awareness and understanding to results of the 2004 baseline.
- To analyze and summarize results for use in developing strategies and tactics for the Hydrogen Education sub-program.

Technical Barriers

This project addresses the following technical barriers from the Education section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

(B) Mixed Messages
(E) Regional Differences
(F) Difficulty of Measuring Success

Contribution to Achievement of DOE Education Milestones

This project will contribute to achievement of the following DOE milestones from the Hydrogen Education section (Section 3.9) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- **Milestone 28:** Complete baseline assessment of knowledge and opinions of hydrogen technologies for key target audiences. (4Q, 2004)
- **Milestone 29:** Evaluate knowledge and opinions of hydrogen technology of key target audiences and progress toward meeting objectives. (4Q, 2009)
- **Milestone 30:** Evaluate knowledge and opinions of hydrogen technology of key target audiences and progress toward meeting objectives. (4Q, 2012)
- **Milestone 31:** Evaluate knowledge and opinions of hydrogen technology of key target audiences. (4Q, 2015)

Accomplishments

- Groundwork
  - Completed compendium review of related surveys conducted since the 2003 literature review (Fiscal Year 2007).
  - Revised (slightly) survey instruments for the four surveys conducted in 2004 and developed the survey instrument for the Safety and Codes Officials Survey.
  - Obtained Office of Management and Budget (OMB) approval of four surveys and prepared 60-day Federal Register Notice for the new Safety and Codes Officials Survey.
- 2008 General Public Survey completed.
- 2008 State and Local Government Officials Survey underway.
- Preliminary analysis of General Public Survey results.

Introduction

Designing and maintaining an effective education program entails measuring baselines and periodically measuring what has been learned. The purpose of the Hydrogen Knowledge and Opinions Assessment project is to collect and analyze statistical data to establish baselines and changes in understanding and awareness about hydrogen, fuel cells, and the notion of a hydrogen economy. Statistical surveys that were conducted

in 2004 are being conducted again in 2008, and are envisioned to be fielded yet again in approximately 2011. Scientific sampling is used to survey five populations: (1) the general public, ages 18 and over; (2) students, ages 12-17; (3) state and local government officials from state departments of transportation and environmental protection, state energy offices, and functionally similar personnel from cities and counties; (4) potential hydrogen end-users in three business categories: transportation, businesses requiring uninterrupted power supplies, and industries with large power requirements; and (5) safety and codes officials.

The surveys are designed to accomplish specific objectives. Technical questions are posed to measure technical understanding and awareness of hydrogen technology. Opinion questions measure attitudes about safety, cost, the environment, performance, and convenience. Questions are posed to assess visions about the likelihood of various future applications of hydrogen technology. For most of the questions, "I don't know" or "I have no opinion" are perfectly acceptable answers. Questions about information sources (teachers, friends, government, etc.) and media (radio, Internet, magazines, etc.) are posed to assess how energy technology information is received.

Approach

The approach to the current survey work is essentially the approach taken to the 2004 surveys. Current literature on hydrogen and fuel cell knowledge and attitudes was first reviewed to update a previous (2003) literature review [1]. The 2004 survey questionnaires were also reviewed and revised slightly for use in the 2008 surveys. With only a few exceptions, consistency was maintained across the years to facilitate unbiased comparisons with the previous surveys. A separate questionnaire for the Safety and Codes Officials Survey was developed. All of the surveys have similar but slightly different questionnaires, which include (in addition to routine demographic questions) a mixture of technical, opinion, and information resource questions. An example of one of the technical questions is "Hydrogen gas is toxic [true/false]?" An example of an opinion question is "How would you feel if your local gas station also sold hydrogen? [Answers: frightened, uneasy, at ease, pleased, don't know/no opinion]." An example of an information resource question is "How often do you get energy information from different types of mass media (television, radio, internet, newspapers, etc.)? [Answers: never, sometimes, frequently, don't know]."

A plan for quality assurance and data analysis was designed [2], and contracts were arranged with Opinion Research Corporation to conduct the survey interviews. Each survey component requires the Paperwork Reduction Act approval by the OMB. OMB approval has been obtained to conduct the 2008 editions of the previously conducted survey components (General Public, Student, State and Local Government, and End-User Surveys). Approval for the Safety and Codes component has been requested from OMB. All survey components are conducted using computer assisted telephone interviewing. The General Public and Student Surveys are conducted using random digit dialing. After the survey data has been collected, it will be analyzed and a report will be prepared similar to the report for the 2004 surveys [3].[1]

Results

Telephone interviewing for the 2008 General Public Survey is complete and a preliminary analysis was conducted of the survey results. Because the other 2008 survey components have not been analyzed yet, only the General Public results are considered here. A complete analysis (as in [3]) will be performed when the other component results are available.

Overall the general public's responses to the technical questions in 2008 were remarkably similar to the 2004 results. The percentages of correct answers to eight core technical questions differed somewhat for individual questions, but the overall average percentage of correct answers was 35.19 ± 1.03 (standard error) in 2008 as opposed to 35.18 ± 0.89 in 2004. Responses to opinion questions in 2008 were also similar to the 2004 results. Figure 1 shows the 2004 profiles of responses to the question "How would you feel if your local gas station also sold hydrogen?" for respondents scoring above and below the average percent correct (35.18%) on the technical questions. An inference from Figure 1 is that hydrogen technology acceptance and technical awareness are highly correlated ($p < 0.0001$ in a test for association). Figure 2 shows the similar profiles seen in the 2008

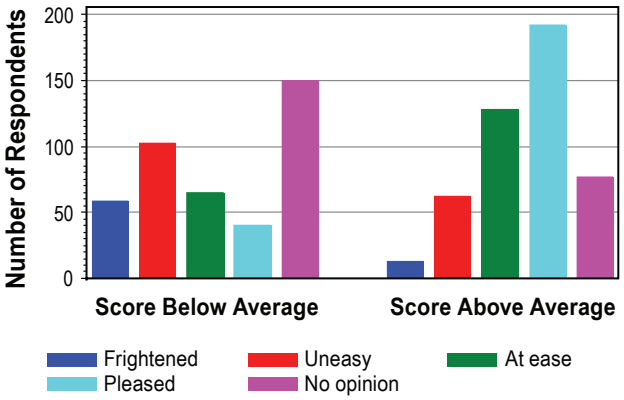

FIGURE 1. 2004 profiles of responses to "How would you feel if your local gas station also sold hydrogen?" for respondents scoring above and below average on eight core technical questions.

[1] See http://www1.eere.energy.gov/hydrogenandfuelcells/hydrogen_publications.html.

survey, which support the same inference. Although technically it is correlation and not causation that is supported here, the tenet that technical awareness leads to technical acceptance is a useful principle in developing a technology awareness and acceptance program.

A difference between the 2004 and 2008 survey results can be seen in how respondents rank the attributes safety, cost, environmental impact, and convenience according to which is most important to them personally when selecting a fuel or power supply (Figures 3 and 4). A fifth category performance was included in 2008, but that does not affect the relative rankings of the first four attributes. In general, safety and cost are ranked higher than the environment, which is in turn ranked higher (i.e., has lower average rank) than convenience. In 2008, however, cost is the most highly ranked attribute, whereas safety was highest in 2004. This change is consistent with increased public concern about fuel cost and ramifications to alternative fuels.

The results discussed above pertain to the General Public Surveys conducted in 2008 and 2004. The other 2008 survey components will be analyzed in FY 2008 and FY 2009. Additional results for the 2004 survey are discussed in [3].

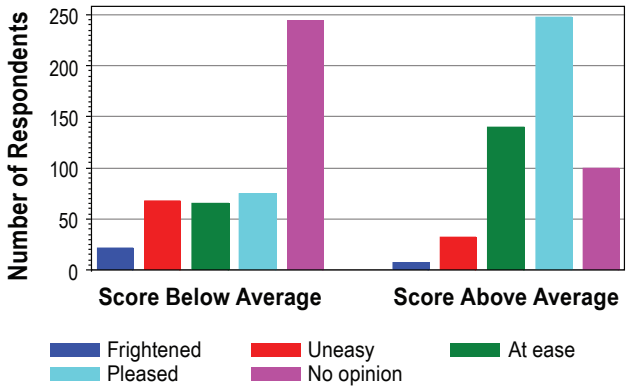

FIGURE 2. 2008 profiles of responses to "How would you feel if your local gas station also sold hydrogen?" for respondents scoring above and below average on eight core technical questions.

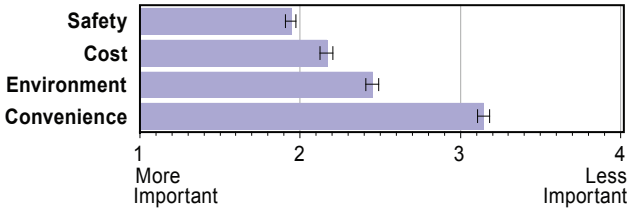

FIGURE 3. 2004 average respondent rankings (1-4) of safety, cost, environmental impact, and convenience in importance when selecting a fuel or power supply. The "|—|"s, which are 95% confidence intervals, show that the differences in the average ranks are statistically significant.

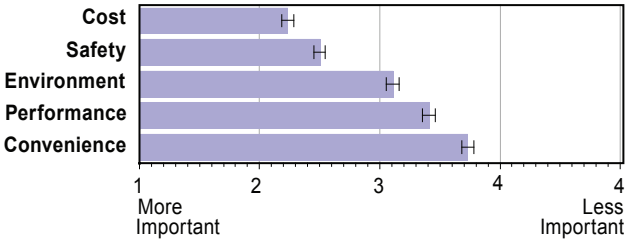

FIGURE 4. 2008 average respondent rankings (1-5) of safety, cost, environmental impact, convenience, and performance in importance when selecting a fuel or power supply. The "|—|"s, which are 95% confidence intervals, show that the differences in the average ranks are statistically significant.

Conclusions and Future Directions

The hydrogen knowledge and opinions survey data collected for the five component populations will serve as (1) references for designing the Hydrogen Education Program, and (2) baselines for measuring changes in knowledge and opinions over time. As with the 2004 survey results, the results of the 2008 surveys (including comparisons with the 2004 results) will be compiled into a data book or digest of the data, ultimately to serve in developing and adapting the Hydrogen Education Program. Designing the education program itself, however, is beyond the scope of the survey work.

Future work will include:

- Conducting the 2008 surveys of end users, students, and state and local officials (under way).
- Obtaining OMB approval for survey of safety and codes officials (may entail modifying the survey design or questionnaire).
- Conducting the survey of safety and codes officials.
- Analyzing and reporting on all survey findings (FY 2009).
- Preparing presentations and other publications about the survey results.

References

1. Tykey Truett. *Literature Review for the Baseline Knowledge Assessment of the Hydrogen, Fuel Cells, and Infrastructure Technologies Program*, ORNL/TM-2003/258 (October 2003). [updated version to appear July 2008].

2. Rick Schmoyer and Truett, Tykey, *Data Collection, Quality Assurance, and Analysis Plan for the 2008 Hydrogen and Fuel Cells Knowledge and Opinion Surveys*, (to appear September 2008).

3. Rick Schmoyer, Tykey Truett, and Christy Cooper, Results of the 2004 Knowledge and Opinions Surveys for the Baseline Knowledge Assessment of the U.S. Department of Energy Hydrogen Program, ORNL/TM-2006/417, (April 2006).