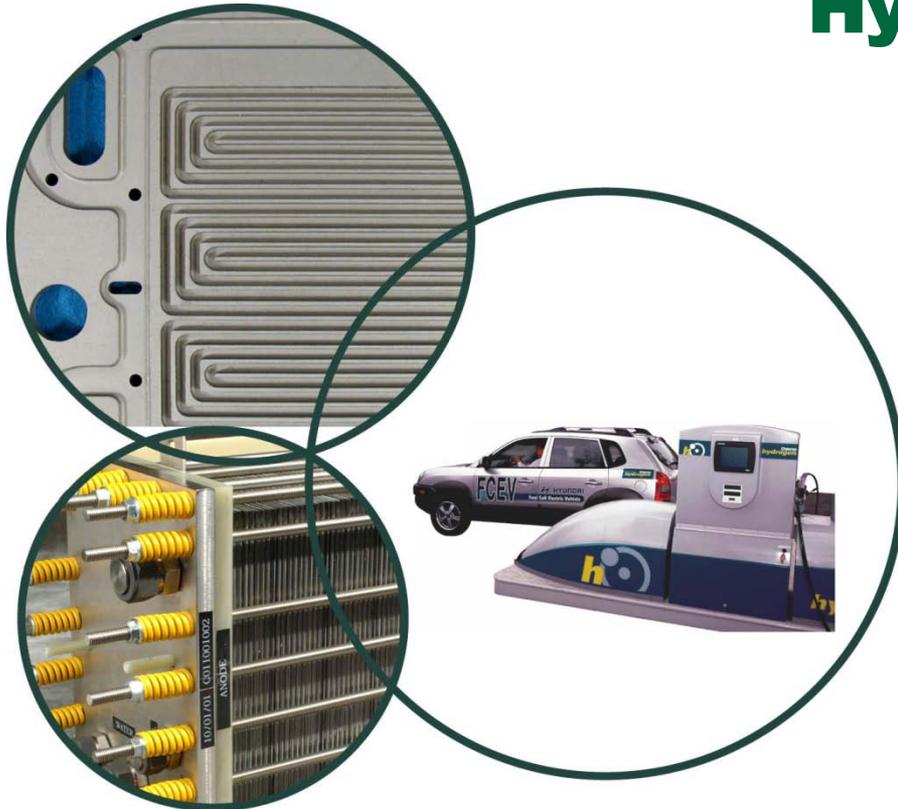


2000-2010 DOE Hydrogen Program: Hydrogen Knowledge and Opinions Assessment



Rick Schmoyer

Oak Ridge National Laboratory

June 10, 2010

Project ID #ED018

This presentation does not contain any proprietary, confidential, or otherwise restricted information

Overview

Timeline

- **Start: April 2003**
- **End: September 2012**
- **Percent complete: ~80%**

Budget

- **Total project funding**
 - DOE share: 100%
 - Contractor share: 0%
- **Funding received in FY09: \$38,800**
- **Funding for FY10: \$20,000**

Barriers

- B. Mixed Messages**
- E. Regional Differences**
- F. Difficulty of Measuring Success**

Partners

- **Contacts with national and international organizations to obtain clarifications, data, and feedback on survey instruments and samples**
- **Opinion Research Corporation (polling and market research)**
- **Oak Ridge National Lab, project lead**

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 a 2004 survey baseline (except for safety and codes officials)**
 - To analyze and summarize results for use in developing strategies and tactics for the Hydrogen Education Program**

Relevance

Without an understanding of population-specific knowledge levels and opinions about hydrogen and fuel cell technologies, the Hydrogen Education Program may not supply appropriate information to intended audiences. Findings based on statistically designed surveys of targeted populations provide a critically important measurement of knowledge and awareness for each population.

Approach

- Review literature on surveys of hydrogen or fuel cell knowledge and opinions and publish update of earlier (2006) literature review
- Review/revise survey questionnaire used in the 2004 surveys and develop a new questionnaire for safety and codes officials
- Obtain approval from the Office of Management and Budget (OMB) to carry out each survey
- Design and publish a plan for sampling, data quality assurance, and data analysis (all surveys are statistically designed)
- Conduct surveys of the five target populations
- Analyze 2008 and 2009 survey results and compare with the 2004 baselines for each target population
- Summarize and publish the Results of the 2008/2009 Knowledge and Opinions Surveys report

Summary: A comprehensive approach to this research and analysis ensures that the findings are accurate and scientifically valid, up-to-date, and useful to the Hydrogen Education Program

Examples of Survey Questions (All Surveys)

- **Technical Questions**
 - Hydrogen gas is toxic (true/false)?
 - Hydrogen has a distinct odor (true/false)?
 - When using pure hydrogen, fuel cell vehicles generate electricity, water, and what else (multiple choice: carbon dioxide, nitrous oxides, heat, all of these, don't know)?
- **Opinion Questions**
 - How would you feel if your local gas station also sold hydrogen? Answers: frightened, uneasy, at ease, pleased, don't know/no opinion.
 - Using hydrogen will reduce U.S. dependence on foreign oil—disagree, are neutral, agree, no opinion.
- **Information Resource and Demographic Questions**
 - How often do you get energy information from different types of mass media (never, sometimes, frequently, don't know)?: television, radio, internet, newspapers, etc.
 - Age, sex, education level, etc. (for statistical purposes)

Milestones

Month Year	Milestone	Percent Complete
June 2006	Publish “Results of the 2004 Knowledge and Opinions Survey...”	100%
September 2008	Complete and publish plan for data quality assurance and data analysis for 2008/09 surveys	100%
October 2008	Publish updated literature review	100%
June 2009	Complete 2008/09 surveys	100%
September 2009	Analyze 2008/09 survey findings, compare with 2004 baseline, and publish draft report	100%
June 2010	Revise report per reviewers comments. Publish final report.*	100%

*See <http://www.osti.gov/bridge/servlets/purl/977112-ubLWXJ/977112.pdf>

Technical Accomplishments—Overview

- **Groundwork**

- Completed and published compendium of related surveys conducted since the 2003 literature review
- Obtained OMB approval to repeat surveys of four populations (general public, students, state and local governments, and end users)
- Developed the questionnaire for a national survey of safety and codes officials and obtained OMB approval to conduct the survey

- **Analysis**

- Completed surveys of the five target populations (June 2009)
- Analyzed results and prepared draft report (September 2009)
- Published final report (available at <http://www.osti.gov/bridge/servlets/purl/977112-ubLWXJ/977112.pdf>)

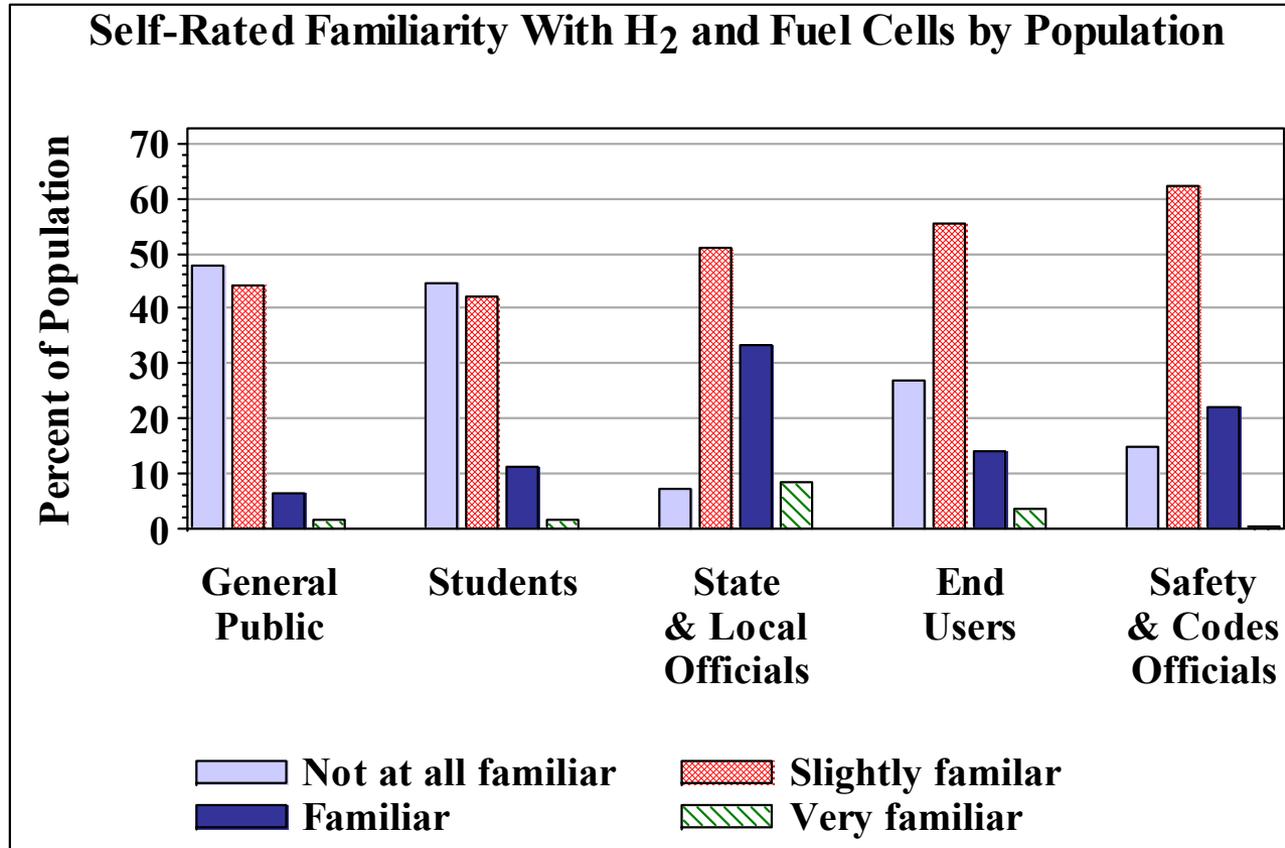
Examples of analysis findings are shown in the following slides.

Sample Sizes and Response Rates (for Completed Surveys)

Population	Sample size		Response rate (%)		Response rate difference (percentage points)
	2004	2008/9	2004	2008/9	
General public	889	1,000	24.8	23.0	-1.8
Students	1,000	1,004	27.5	29.5	+2.0
Government agencies	236	220	95.9	89.4	-6.5
End users	99	601	29.1	17.0	-12.1
Safety and codes officials	N/A	193	N/A	77.2	N/A

Response rates are a challenge in all telephone surveys these days, but to some extent nonresponse bias cancels in cross-year comparisons. Another challenge is coverage because of increasing percentages of cell-phone-only households.

Self-Rated Familiarity with H2 and Fuel Cells Technologies by Population (2008 only)



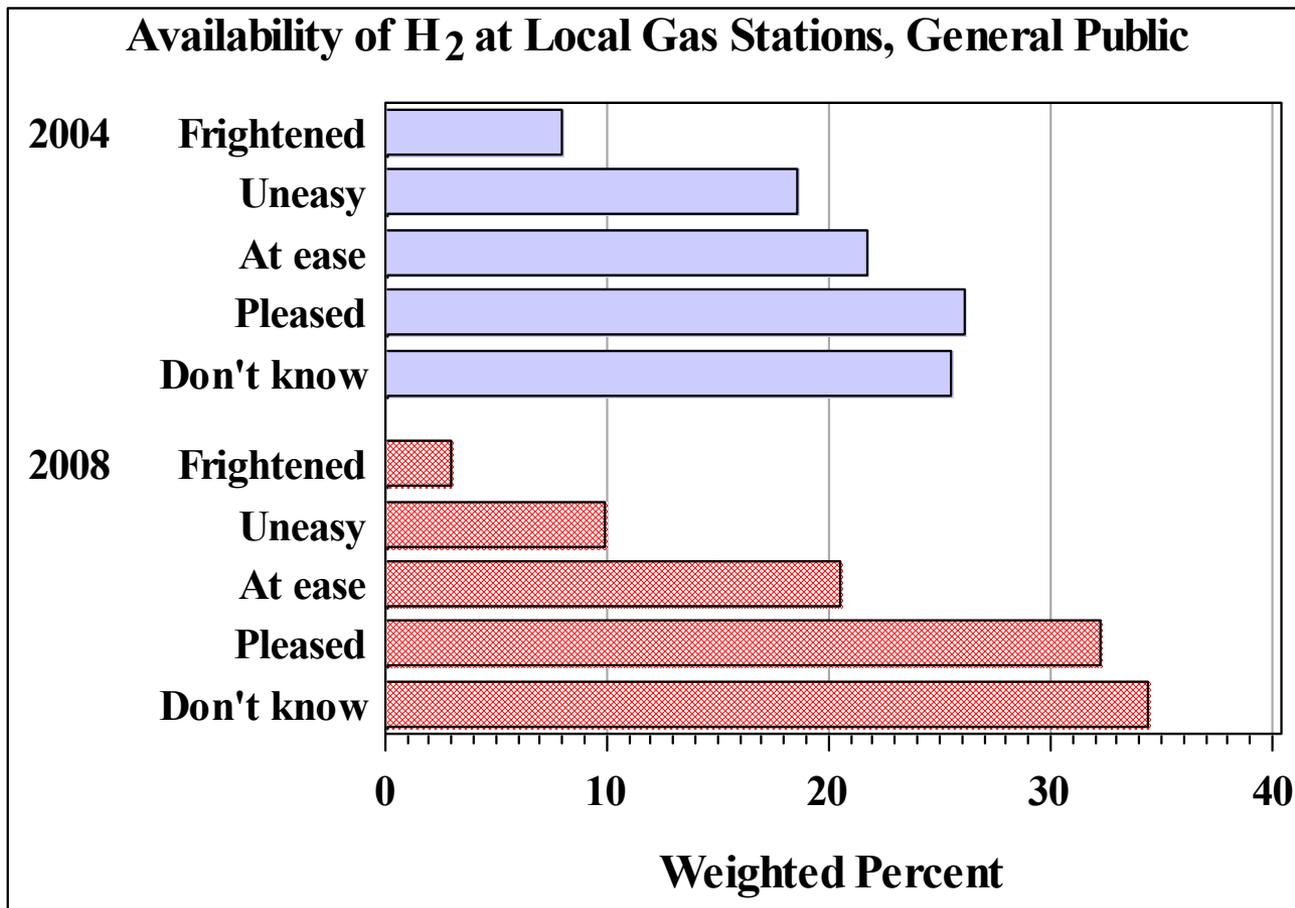
Of the five populations, state and local officials had the highest self-rated familiarity with hydrogen and fuel cell technologies.

Average Technical Scores by Population

Population	Sample size		Average technical score (% correct)		Score difference (percentage points)
	2004	2008-09	2004	2008-09	
General public	889	1,000	35.2	35.2	+0.0
Students	1,000	1,004	35.3	39.8	+4.5
Government agencies	236	220	66.6	66.6	+0.1
End users	99	601	46.3	47.9	+1.6
Safety and codes officials	N/A	193	N/A	51.5	N/A

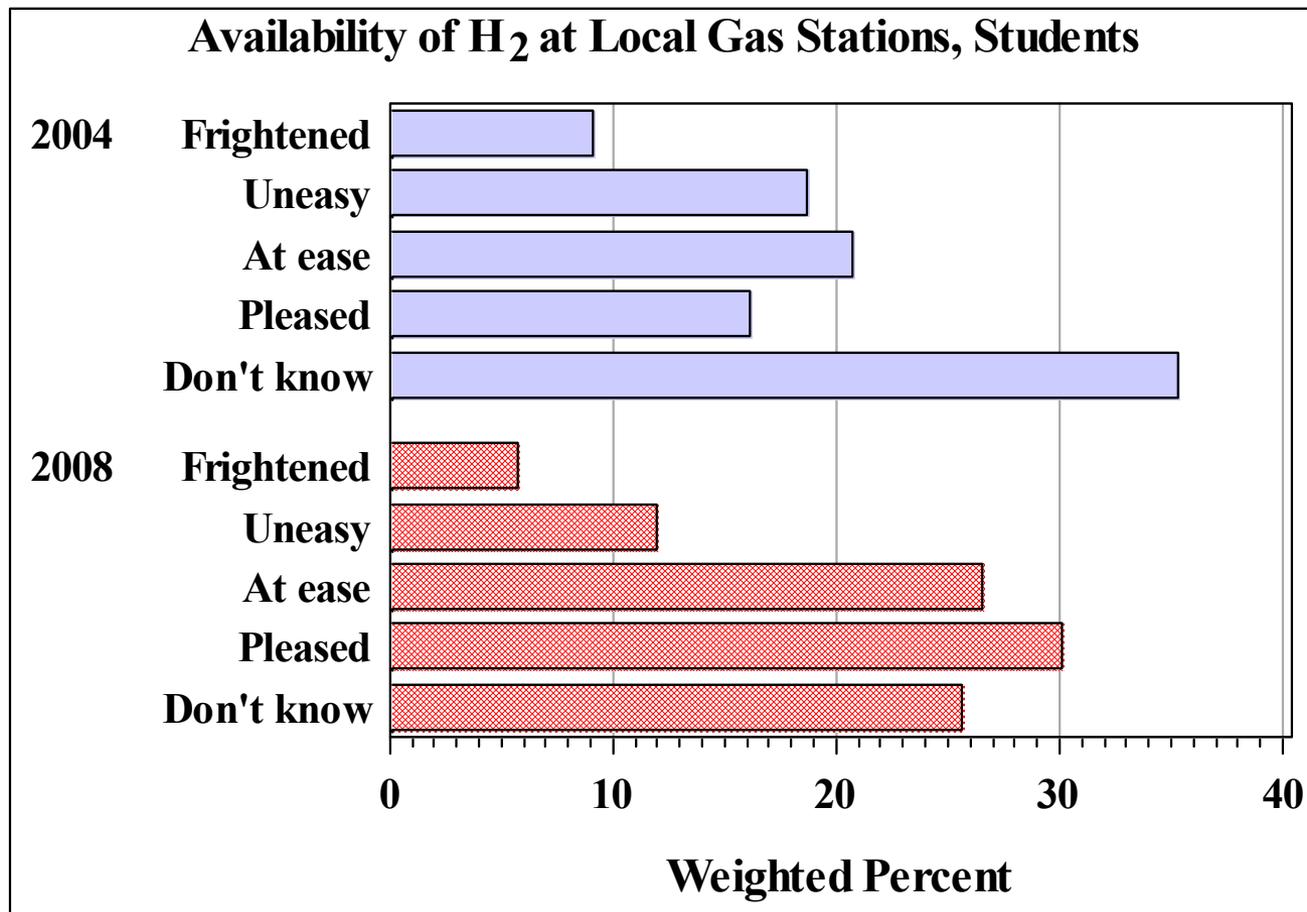
Although there was little change in the average technical scores, the scores improved slightly. Students showed the greatest improvement +4.5% in average technical scores, which is statistically significant ($p < 0.0001$).

Comparison of 2004 and 2008 Survey Results Regarding Opinions about the Availability of Hydrogen at a Local Gas Station, General Public



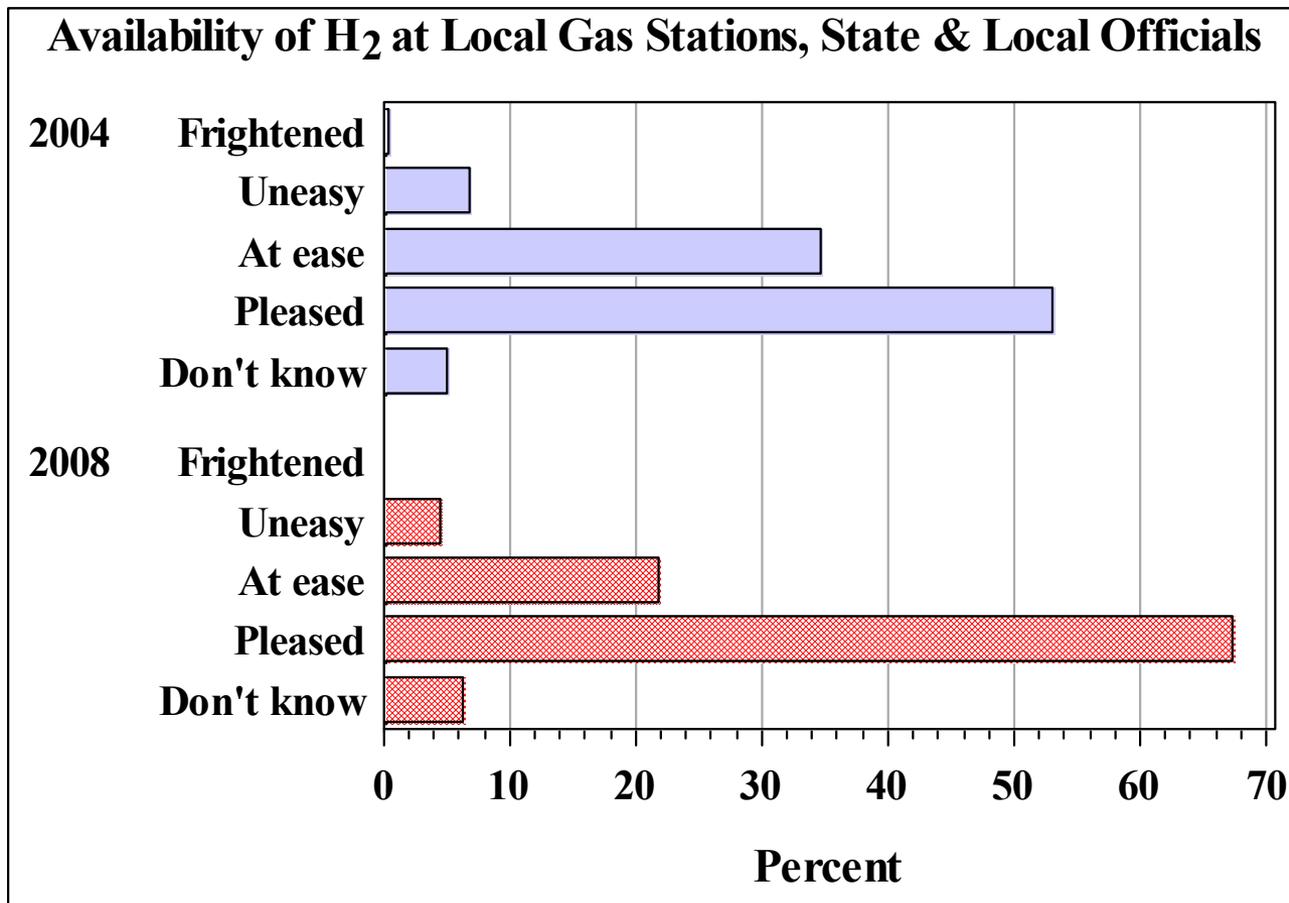
The proportion of respondents indicating they would be frightened or uneasy by a hydrogen fueling station decreased significantly ($p < .0001$) between 2004 and 2008.

Comparison of 2004 and 2008 Survey Results Regarding Opinions about the Availability of Hydrogen at a Local Gas Station, Students



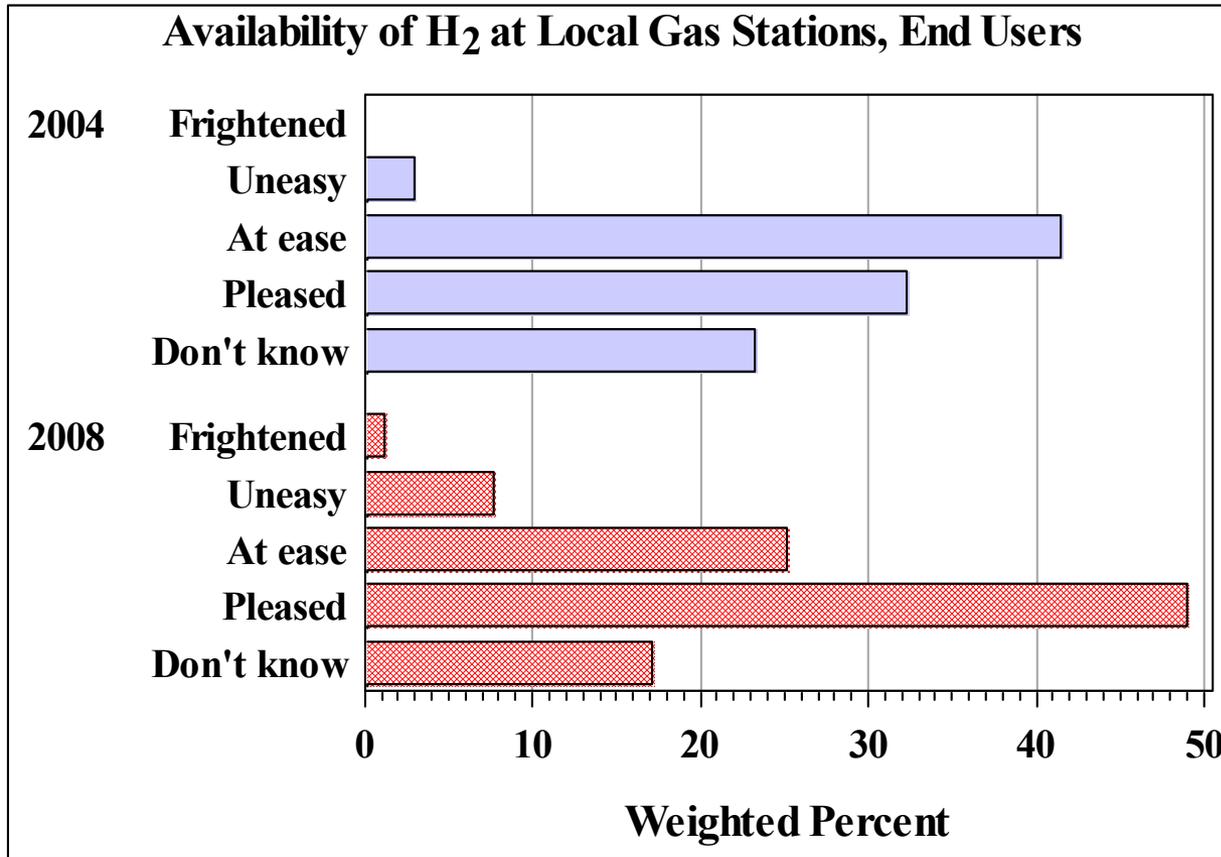
The proportion of students indicating they would be pleased by a hydrogen fueling station increased significantly ($p < .0001$) between 2004 and 2008.

Comparison of 2004 and 2008 Survey Results Regarding Opinions about the Availability of Hydrogen at a Local Gas Station, State and Local Officials



The proportion of respondents indicating they would be pleased by a hydrogen fueling station increased 14% (significantly, $p < .0001$) between 2004 and 2008.

Comparison of 2004 and 2008 Survey Results Regarding Opinions about the Availability of Hydrogen at a Local Gas Station, End Users



The proportion of respondents indicating they would be pleased by a hydrogen fueling station increased by 17% (significantly: $p=0.0009$), between 2004 and 2008; however, the proportion indicating they would be frightened or uneasy also increased slightly.

Relationship Between Technical Score and Comfort Level with Hydrogen Technologies

Technical understanding appears to influence opinions about safety. For all five survey groups, respondents with above-average scores on the technical questions were more likely to have an opinion (i.e., fewer “don’t know” responses), and for those respondents who expressed an opinion, their opinion was more likely to be positive.

These differences were statistically significant.

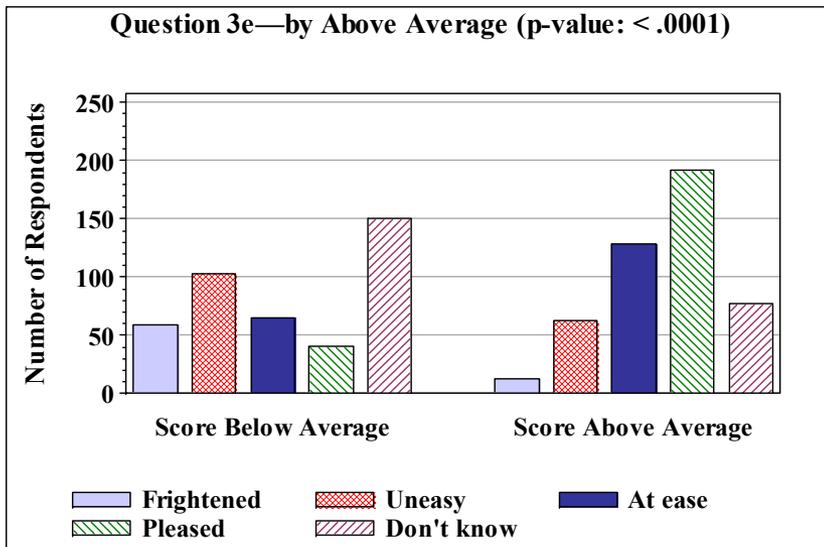
These differences were evident in both the 2004 and 2008 survey findings.

Positive Association of Technical Understanding and Opinions About Safety, General Public

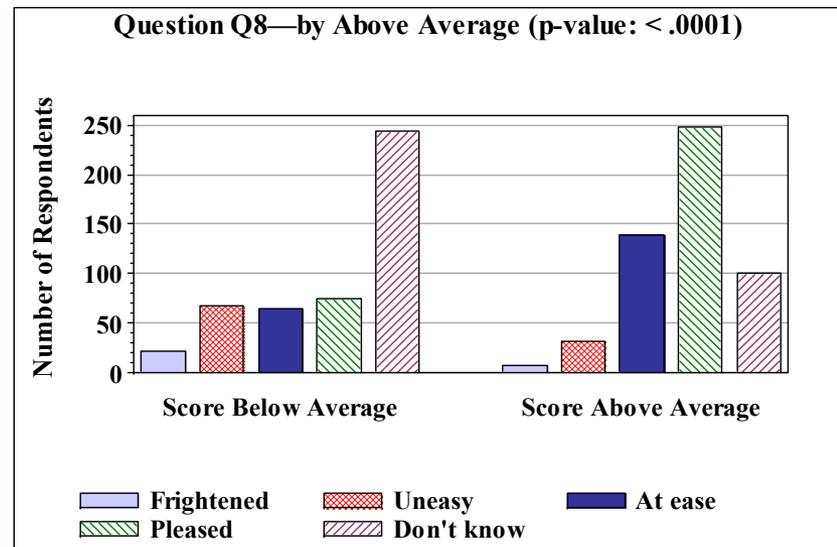
Question Q8 (Question 3e in 2004): “How would you feel if your local gas station also sold hydrogen?”

Respondents with above average technical scores are more likely to feel good (“at ease”; “pleased”) about it.

2004 (889 respondents)

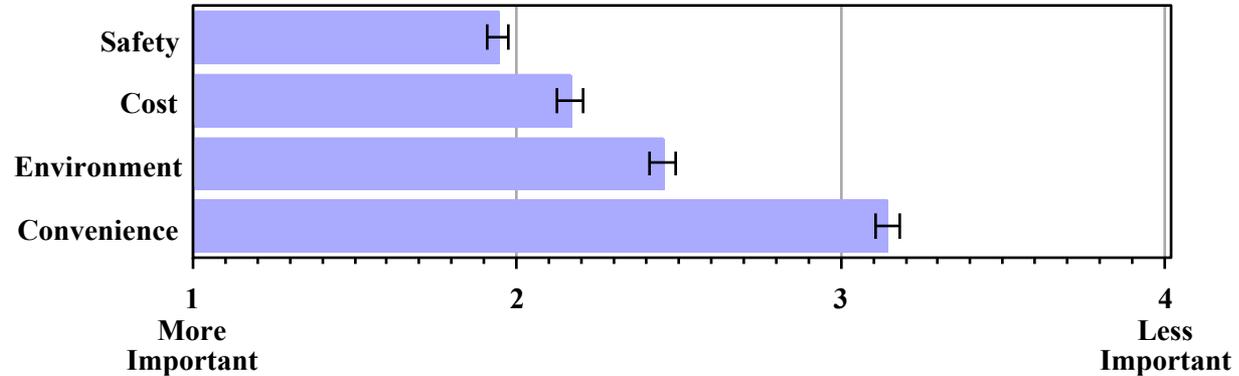


2008 (1,000 respondents)

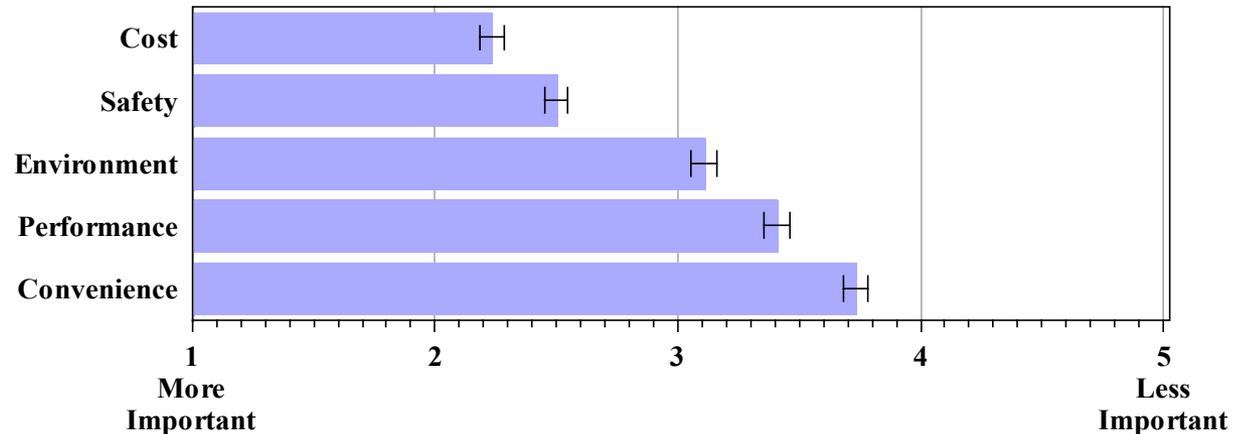


Average Value Rankings, General Public

2004

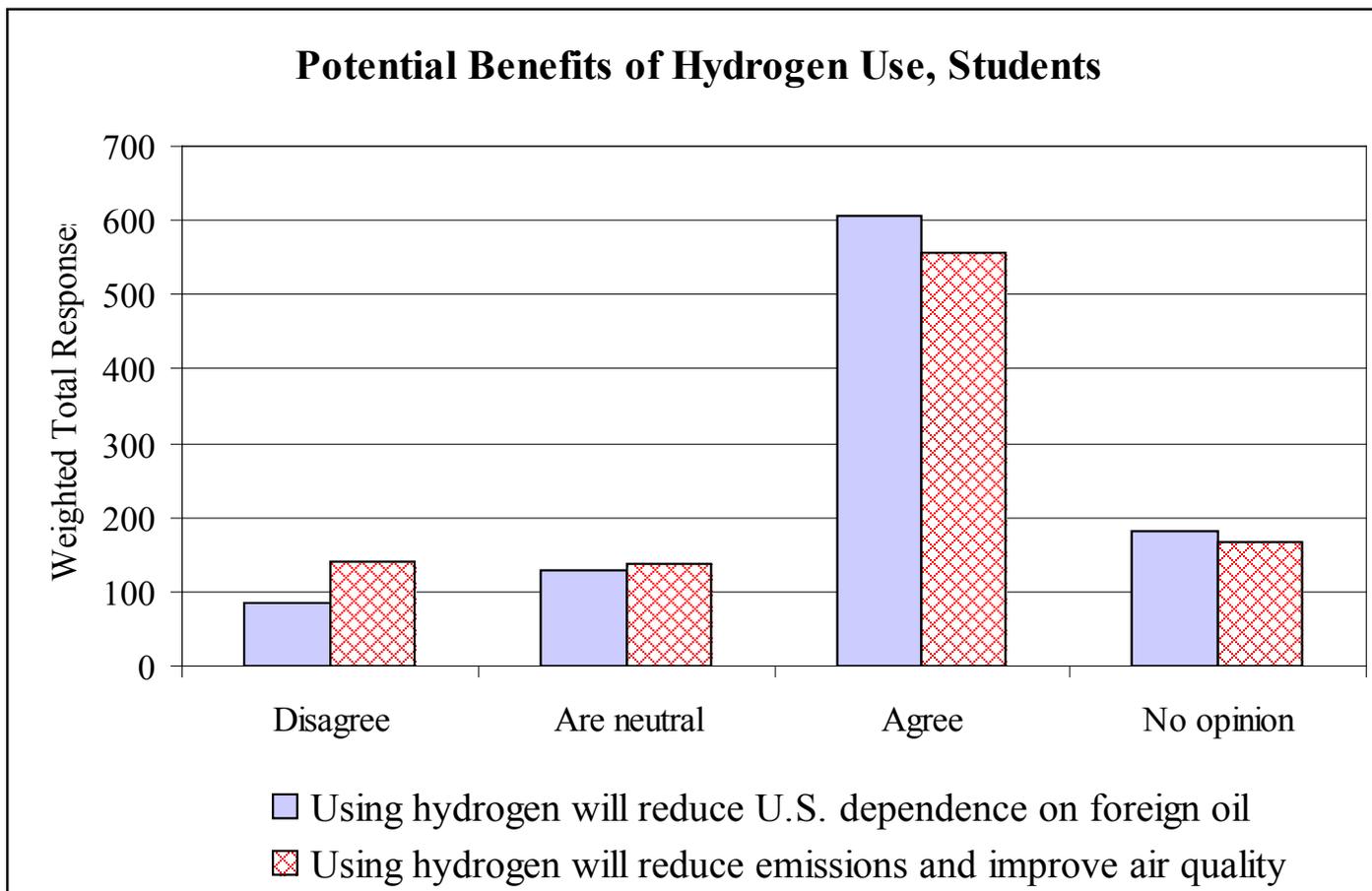


2008



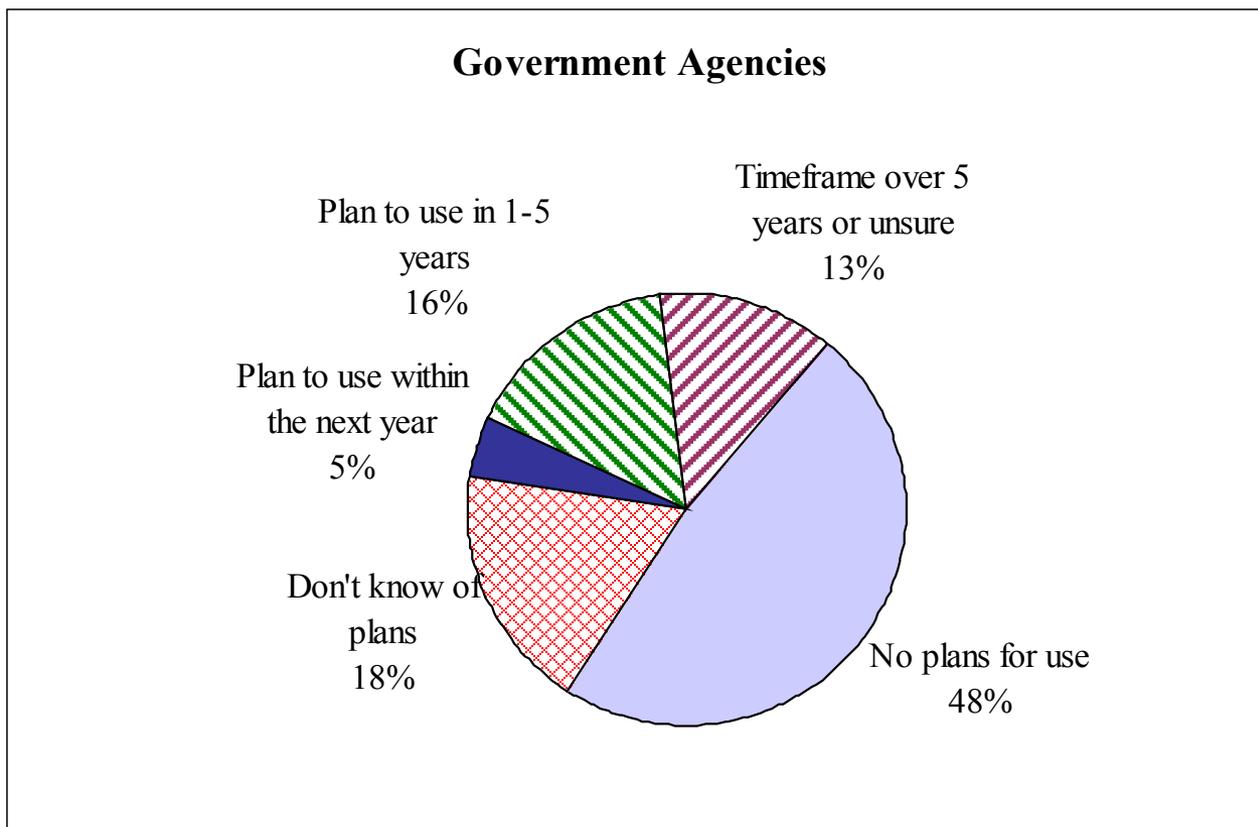
- The “|—|”s on the charts are 95% confidence intervals. The differences within years are clearly statistically significant.
- The “performance” category was added for 2008
- Rankings reported by a few individuals were partial.
- Cost and safety are most important when selecting a fuel or power source, but note the switch in their order between 2004 and 2008.

Responses to Statements about the Potential Benefits of Hydrogen Usage, 2008 Student Survey



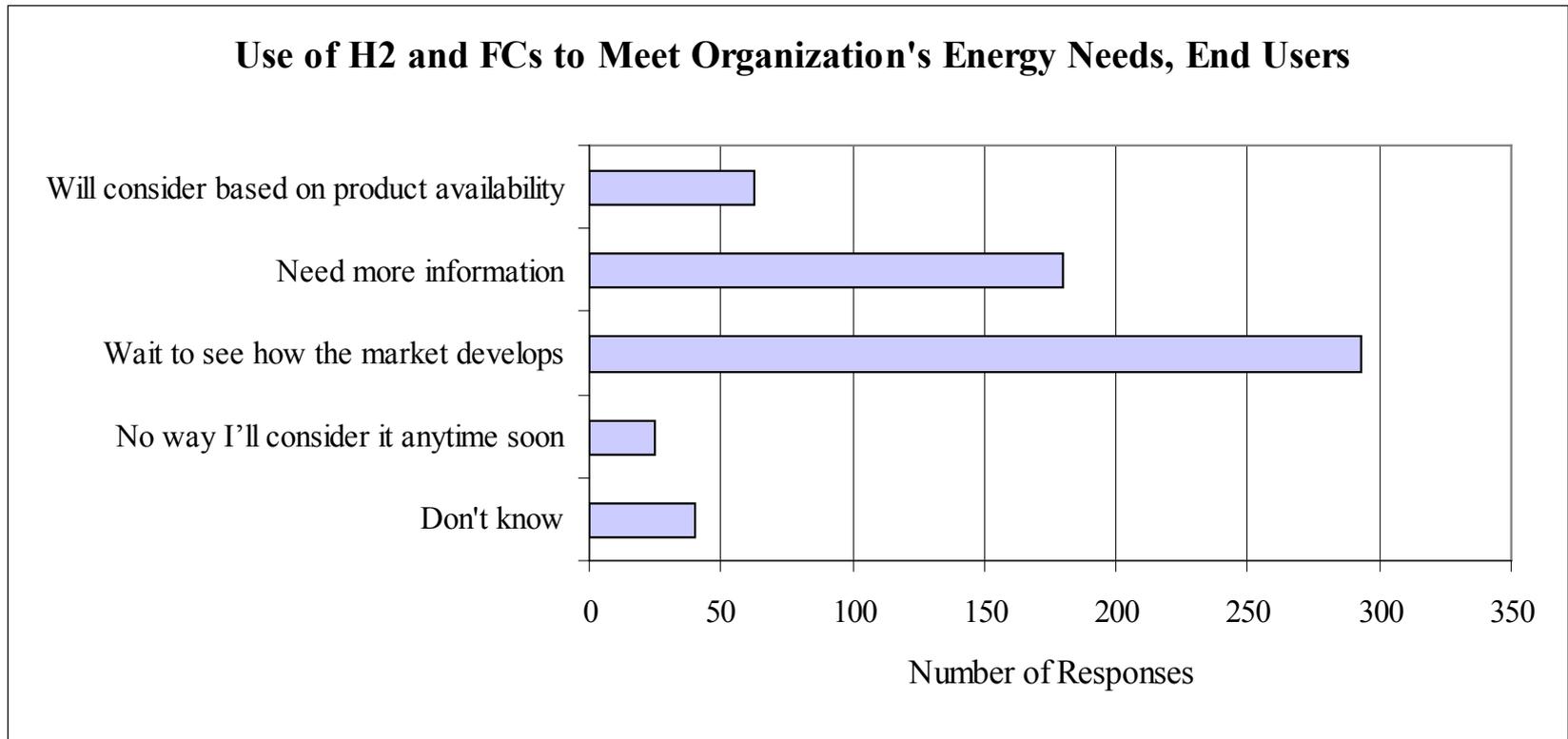
Students generally “Agree” that the use of hydrogen will reduce emissions, improve air quality, and reduce U.S. dependence on foreign oil

Plans to Use Hydrogen and Fuel Cell Technologies, 2008 State and Local Government Survey



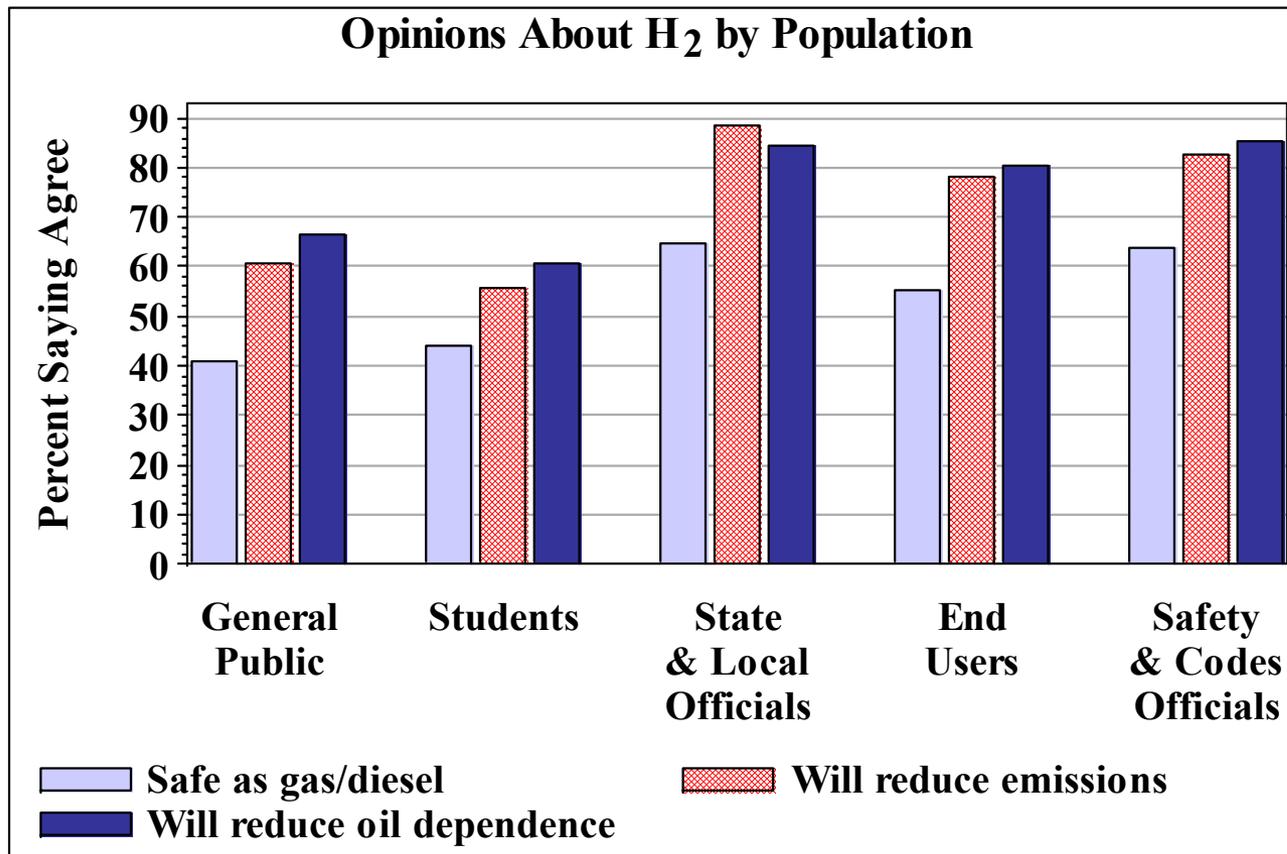
Corresponding results for the 2004 survey were similar.

End users' opinions about using hydrogen and fuel cell technologies to meet their organizations' energy needs



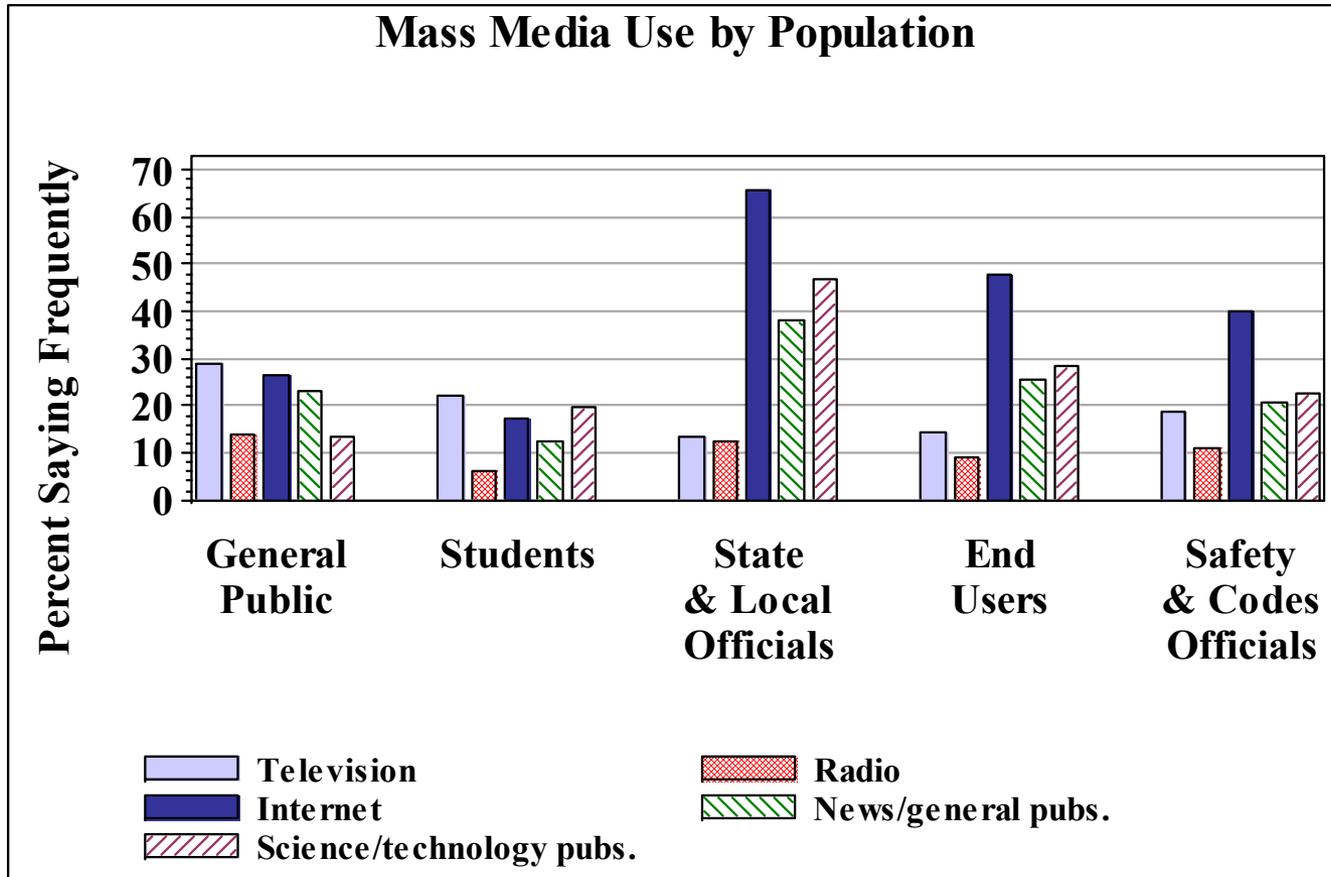
Most end users plan to wait to see how the market develops before considering the use of hydrogen and fuel cells.

A Comparison of Opinions about Hydrogen Usage by Population Group



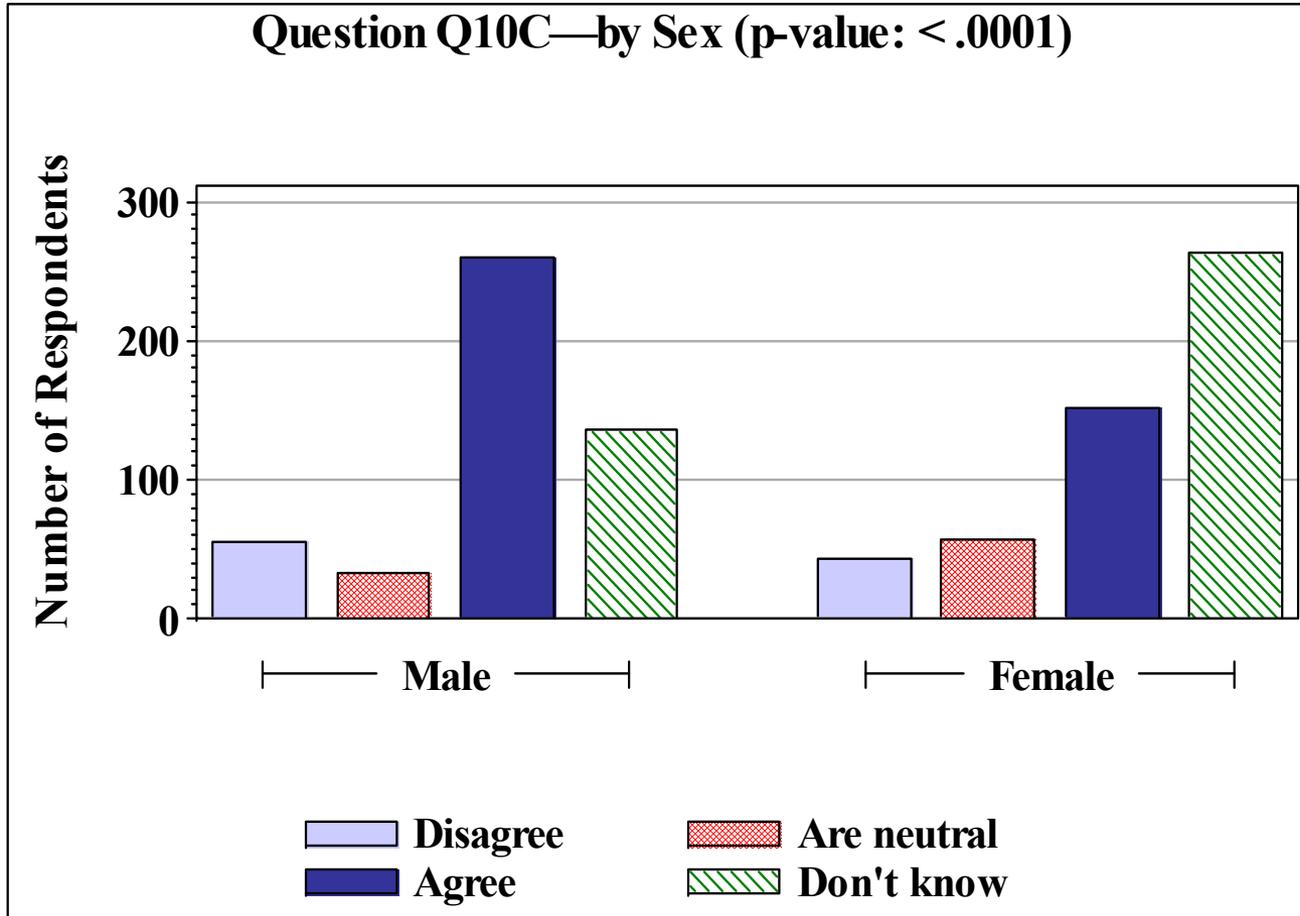
All five populations believe that hydrogen technologies will reduce emissions and dependence on oil; in addition, over 60% of government officials, over 60% of safety and codes officials, and over 50% of end user respondents considered hydrogen as safe as gasoline or diesel fuels.

Use of Mass Media to Obtain Energy Information



The Internet is the prime energy information source for government officials, safety and codes officials, and end users; television is still the most frequent source for the general public and students.

Gender differences



Responses by gender to Question 10C, “Hydrogen is as safe to use in my car as gasoline and diesel fuels,” general public survey. Males and females have significantly different response profiles.

Collaborations

- **Oak Ridge National Laboratory (primary research collaborator)**
- **National and international organizations to obtain clarifications and data; also, hydrogen and fuel cell associations (document reviews and other information)**
- **Opinion Research Corporation (polling and market research)**

Future Work

FY10

- Incorporate reviewer comments and prepare final report on 2008/09 survey findings
- Publish final report*

FY12

- Repeat surveys of all populations and compare results with the findings of the baseline survey of 2004 and the 2008/09 survey. (OMB Clearance, review/reinstate?)

*Final report is now available at

<http://www.osti.gov/bridge/servlets/purl/977112-ubLWXJ/977112.pdf>

Summary

- **Five populations (general public, students, state and local officials, and potential end users, safety & codes officials) were surveyed in 2008-2009 and the results were analyzed**
- **Findings were compared with baseline survey results from 2004**
- **Undercoverage (particularly because of cell-phone-only households) and nonresponse bias pose challenges, but to some extent cancel in cross-year comparisons**
- **Final report published:**
<http://www.osti.gov/bridge/servlets/purl/977112-ubLWXJ/977112.pdf>
- **Identical surveys are planned for 2012 to assess further changes in knowledge and opinions**

Summary (cont'd)

- **The general public is more concerned about safety and cost than the environment, but more concerned about the environment than convenience or performance.**
- **State and local officials had the highest self-rated familiarity with hydrogen and fuel cell technologies and also had the highest average score on the technical knowledge questions.**
- **The average technical knowledge score of each population group did not change significantly between 2004 and 2008; however, the scores of all population groups increased slightly (except safety & codes officials, surveyed 2009 only).**
- **The average technical knowledge score of the student respondents increased 4.5 percentage points, a statistically significant increase.**
- **For the general public, state and local officials, and end users, average technical scores did not change significantly between 2004 and 2008, but those populations and students as well all increased in levels of comfort with the use of hydrogen and fuel cell technologies.**
- **Hydrogen technology acceptance is strongly associated with hydrogen technical awareness for all five populations surveyed. This relationship was evident in both the 2004 and 2008 surveys.**

Summary (cont'd)

- In the 2008 survey, the general public and students expressed more confidence in the safety of hydrogen technologies than they did in 2004.
- The proportions of state and local officials and end users who indicated that they would be “pleased” if hydrogen were available at their local gas station increased by over 14 percentage points.
- All four survey groups overwhelmingly agreed that the use of hydrogen as a vehicle fuel would reduce U.S. dependence on foreign oil and would reduce emissions and improve air quality.
- Over 60% of government officials and over half of end user respondents believe that hydrogen is as safe as gasoline or diesel fuels.
- About 21% of the state and local agencies surveyed have plans to use hydrogen and fuel cell technologies within the next five years.
- End users have a “wait and see” attitude about implementation of hydrogen and fuel cell technologies to meet their organizations’ energy needs.
- The Internet is an important source for obtaining energy information for state and local officials and end users; television remains the most frequent source of energy information for the general public and students.