The DOE Hydrogen Baseline Survey: Assessing Knowledge and Opinions about Hydrogen Technology

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Overview

Purpose:
To learn what people know and don't know about the hydrogen economy and hydrogen technologies. The data will –

- Guide education program development and activities
- Provide a quantifiable baseline from which to measure changes in knowledge of and opinions about hydrogen technologies over time

Target Audiences:

- **General Public**
- **Students**
- **State and Local Government Officials**
- **Potential Large-Scale End Users**

**Target audience categories were selected based on input from the Hydrogen Education kick-off workshop held December 2002 and the National Hydrogen Energy Roadmap*

Overview

Project Team

- ORNL
  - → Tykey Truett, PI
  - → Rick Schmoyer, PhD, Statistics

- Opinion Research Corporation (ORC)
  - → 70+ years experience in market and opinion research
  - → Ongoing work with EERE – ORC CARAVAN Omnibus Survey feeds “Transportation Facts of the Week”
  - → Support to hydrogen baseline survey –
    - →Provided input to development of hydrogen survey instruments
    - →Assisted with identifying target audience contact lists
    - →Conducted surveys

Literature Review

- Published October 2003
- Purpose:
  - → Determine relevance of/need for DOE hydrogen survey
  - → Help inform and guide development of potential DOE hydrogen survey
- Scope:
  - → Scientific (claiming statistical validity) and non-scientific surveys
  - → Surveys focused only on hydrogen and fuel cells, as well as other energy-related surveys that included a section on hydrogen and fuel cells
- Findings:
  - → Few surveys to determine existing knowledge of hydrogen technologies have been published
  - → No single survey previously published has covered all of the DOE program's targeted audiences on a national level
  - → No other survey has plans to repeat an identical survey at a future point to measure changes in knowledge or opinions

Survey Design

- Four survey instruments – one for each target audience
- Questions developed with input from National Hydrogen Association and U.S. Fuel Cell Council
- Each survey included –
  - → Technical questions about hydrogen and fuel cell technologies (common to all four surveys)
  - → Opinion questions (common to all four surveys)
  - → Questions specific to the target audience
- All questions used “closed-end” format to facilitate data collection and analysis
- Questions and answers included true-false and multiple choice
- Respondents were assured there were no trick questions and in all cases, “don’t know” or “no opinion” was an acceptable answer
- Average time to complete interview was expected to be 10-12 minutes

Survey Questions

Sample Technical Questions:

- **Hydrogen can be produced using which of the following sources of energy?**

  (A) *Natural gas*, (B) *Sunlight*, (C) *Organic matter*, (D) *All*, (E) *Don't know*

- **When using pure hydrogen, fuel cells generate electricity, water, and what else?**

  (A) *Carbon dioxide*, (B) *Nitrous oxides*, (C) *Heat*, (D) *All*, (E) *Don't know*

- **True/False/Don't Know:**

  → Hydrogen gas is toxic

  → Hydrogen is lighter than air

  → Hydrogen has a distinct odor

- **In which state or condition can hydrogen be stored?**

  (A) *Chemical compound*, (B) *Liquid,* (C) *Both*, (D) *Neither*, (E) *Don't know*

Survey Questions, continued

Sample Opinion Questions:

- **Which of the following would you most closely associate with the word *hydrogen*?**

  (A) *The H Bomb*, (B) *Chemistry class,* (C) *Fuel*, (D) *The Hindenburg*, (E) *Don't know/No opinion*

- **How would you feel if your local gas station also sold hydrogen?**

  (A) *Frightened*, (B) *Uneasy,* (C) *At ease*, (D) *Pleased*, (E) *Don't know/No opinion*

- **Agree/Disagree/Neutral/No Opinion:**

  → Using hydrogen as a vehicle fuel will reduce U.S. dependence on foreign oil

  → Using hydrogen as a vehicle fuel will improve air quality

  → Using hydrogen as a vehicle fuel is as safe as using gasoline or diesel

Survey Questions, continued

Sample Audience-Specific Questions:

Public –

- **Which of the following is more important to you when selecting a power supply?**
  (A) *Safety*, (B) *Low cost*, (C) *Environmental protection*, (D) *Convenience*, (E) *Don't know*

Students –

- **Have you ever…(Yes/No/Don't Know)**
  → *Received instruction on hydrogen and fuel cells*
  → *Used a model fuel cell car kit*

State and Local Governments –

- **How often do you use the following as a source of energy information? (Never/Sometimes/Frequently)**
  (A) *Teacher/schools*, (B) *Friends/family*, (C) *Environmental groups*, (D) *Utilities*, (E) *Federal government*, (F) *State government*, (G) *Local government*

Potential Large-Scale End-Users –

- **Have you received information about hydrogen and fuel cells at your workplace? (Yes/No/Don't Know)**

Strategy

Survey Methodology

Computer Assisted Telephone Interviews (CATI) – trained ORC interviewers read scripted questions and simultaneously enter responses into a database

- Responses do not need to be interpreted
- Less chance of skipping questions or making other errors
- Interviewees/respondents are randomly selected
- Responses cannot be “stacked”
- Survey of a national audience is repeatable
- CATI surveys can accurately and efficiently handle large numbers of scheduled appointments
  - → Automated system handles “ring-no answers” and “busy” records
  - → Staff can process respondent requests for removal from the call list

Implementation & Results

Implementation & Results

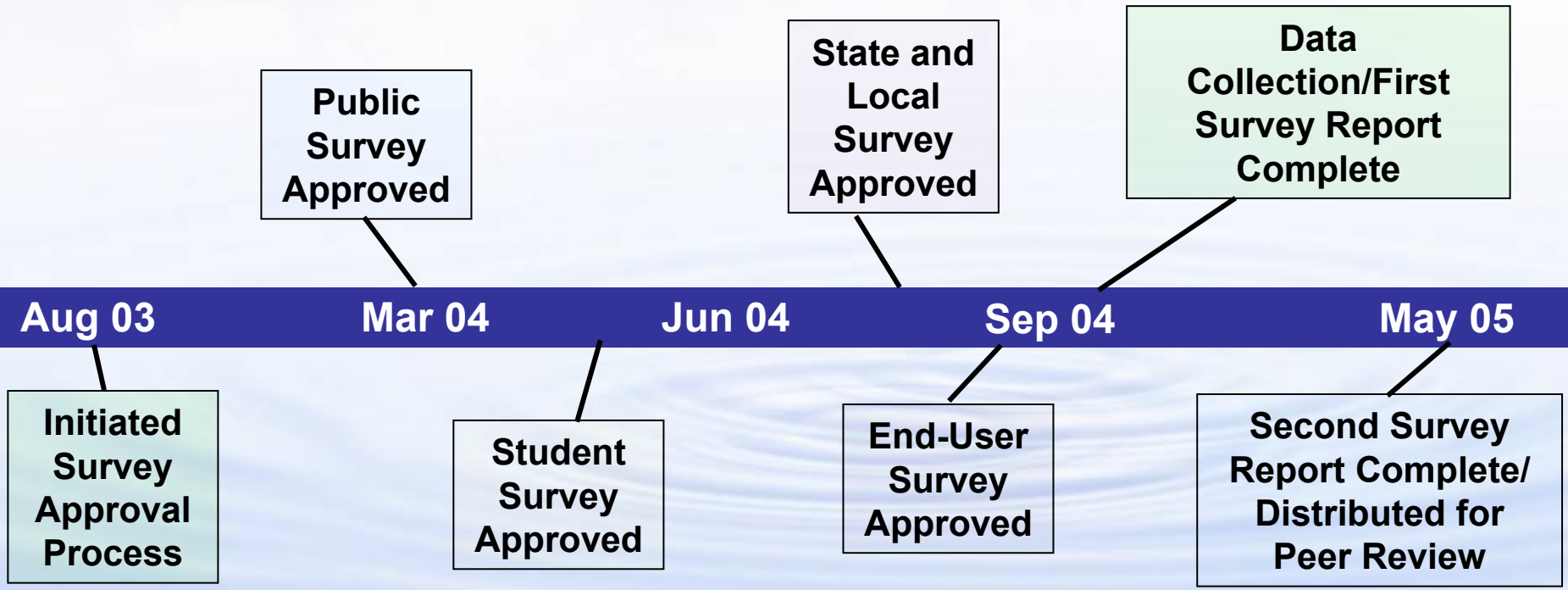
Pilot Testing

- General public and student surveys were pilot-tested – 50 public interviews and 37 student interviews were conducted
- State and local government and large-scale end user surveys were not pilot tested – survey instruments were similar to public and student survey instruments

Implementation & Results

OMB Approval and Timeline

- Paperwork Reduction Act of 1995 requires OMB approval of Federal agency surveys
  - → Approval process included two Federal Register Notices (published August 2003 and January 2004) seeking public comment on DOE intent to collect information – no comments were received
  - → OMB required approval of each individual data collection – both the survey instrument and the methodology (sample selection, etc.)



Implementation & Results

Target Audiences:

→ General Public

→ Students

→ State and Local Government Officials

→ Potential End Users

Key Results

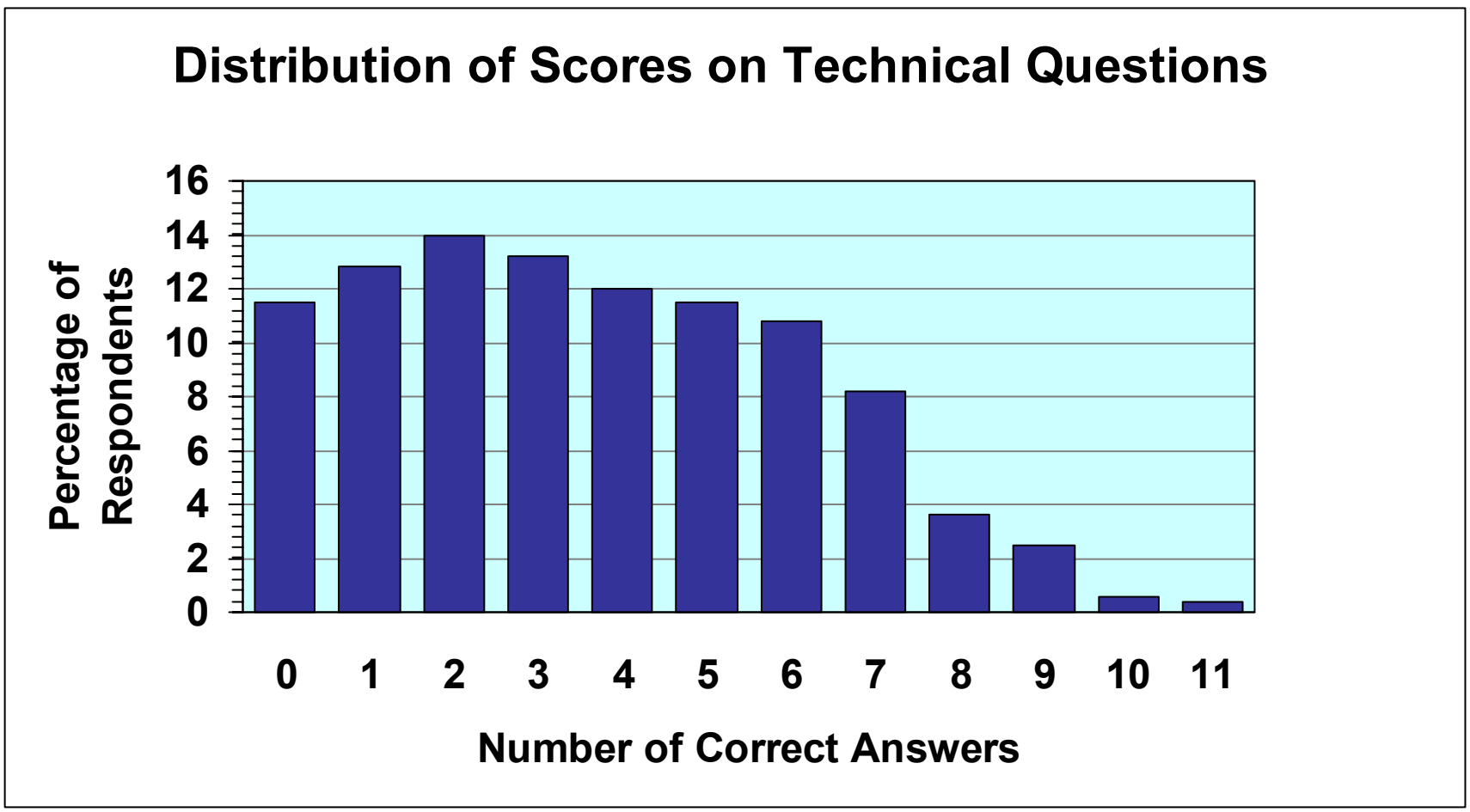
General Public Survey

- Used GENESYS system (listed and unlisted telephone numbers) and random digit dialing
  - → General public (ages 18+) – statistical sampling population essentially infinite
  - → Random selection within the household based on most recent birthday
- 25% response rate, for a total of 889 completed interviews

Key Results

General Public – Technical Knowledge

- Mean score for General Public was 33%
- 43% of the responses were “Don’t Know”
- Only 6% scored a ‘Passing Grade’ (8 or more correct answers)



Key Results

General Public – Technical Knowledge

- Only 19% knew that when pure hydrogen is used, fuel cells produce electricity, water, and heat
- 38% could correctly identify the sources of energy from which hydrogen can be produced
- 37% said hydrogen is toxic
- More than 40% didn't know hydrogen is lighter than air

Key Results

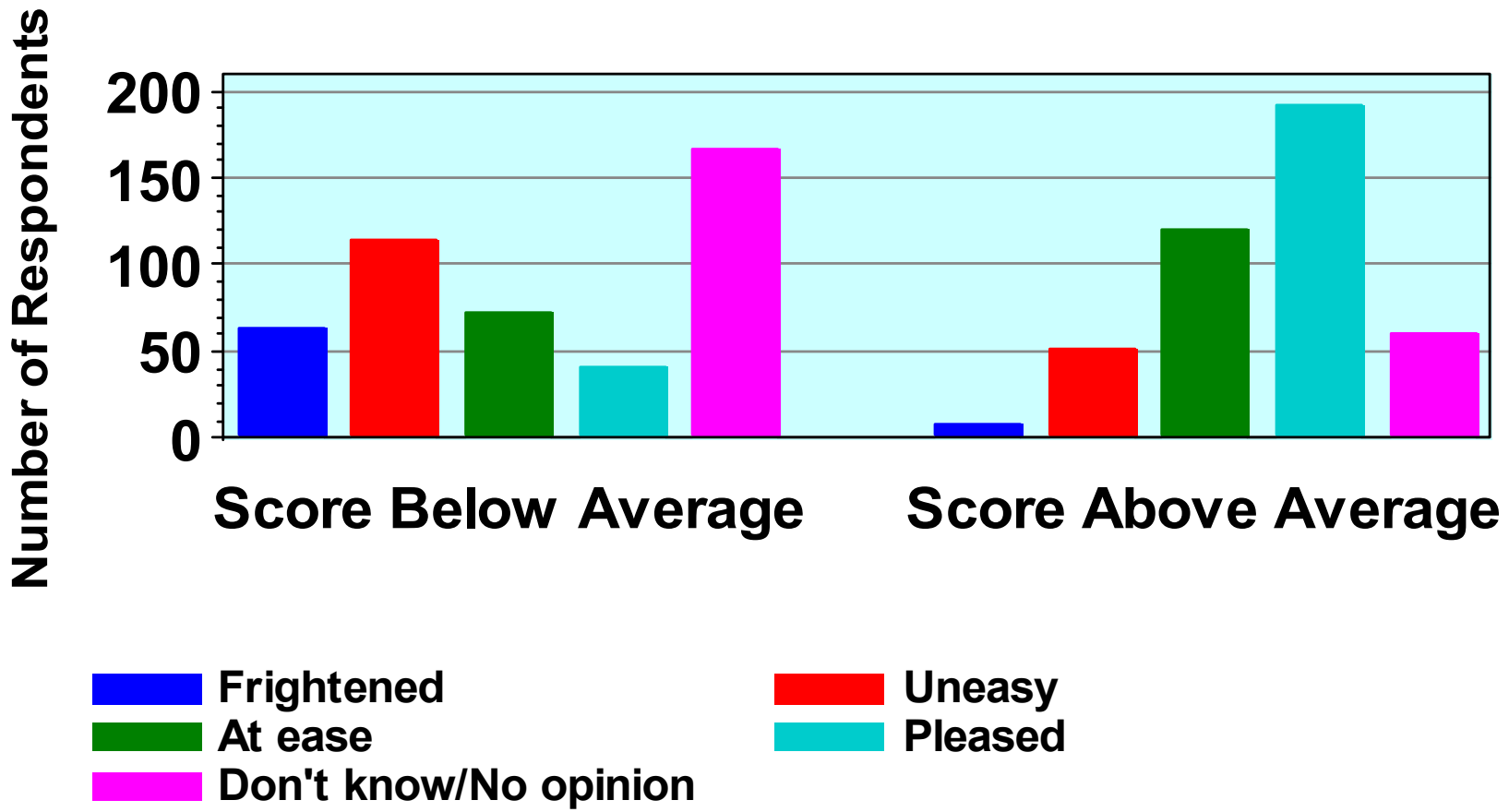
General Public – Opinions

- When asked how they'd feel if their local gas station also sold hydrogen, more than 50% of the public said they'd feel frightened, uneasy, or "don't know"
- 41% thought that hydrogen is too dangerous for everyday use
- When selecting a fuel supply, the public considered safety as the most important factor; cost and the environment were next in importance; and convenience ranked as least important

Key Results

General Public

Relationship between technical knowledge and opinions of hydrogen safety:
How would you feel if your local gas station also sold hydrogen?



Key Results

Target Audiences:

→ General Public

→ Students

→ State and Local Government Officials

→ Potential End Users

Key Results

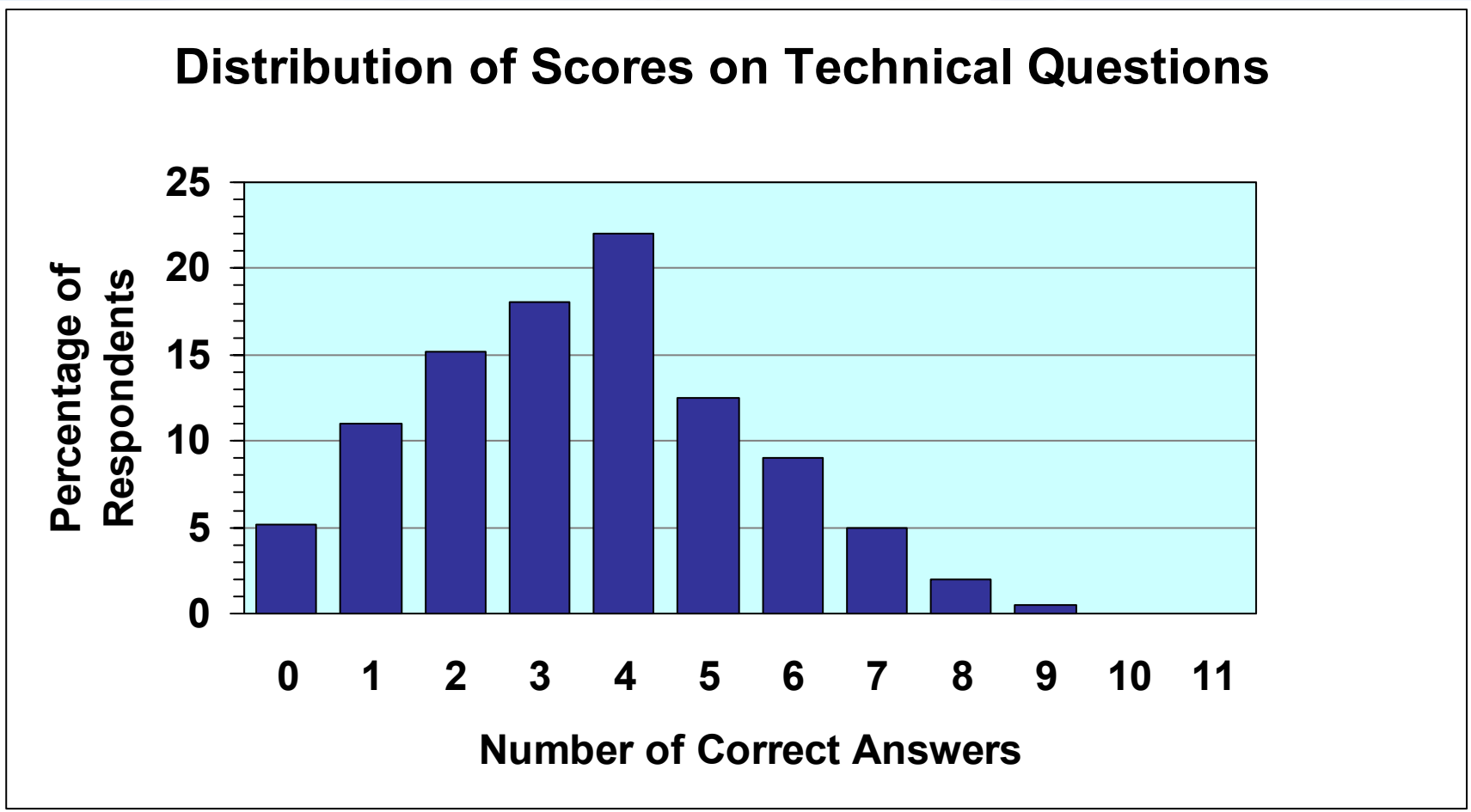
Student Survey

- Used GENESYS system (listed and unlisted telephone numbers) and random digit dialing
  - → Students (ages 12 – 17)
  - → Random selection within the household based on most recent birthday
- 28% response rate, for a total of 1,000 completed interviews

Key Results

Students – Technical Knowledge

- Mean score for Students was 32%
- 32% of the responses were “Don’t Know”
- Only 3% scored a ‘Passing Grade’ (8 or more correct answers)



Key Results

Students – Technical Knowledge

- Almost 40% thought that hydrogen gas is toxic
- Only 16% knew that when pure hydrogen is used, fuel cells produce electricity, water, and heat
- Knew much more about hydrogen than about fuel cells:
  - → Answered 40% of the hydrogen-related technical questions correctly
  - → Answered only 11% of the fuel cell-related technical questions correctly

Key Results

Students – Opinions and Experience

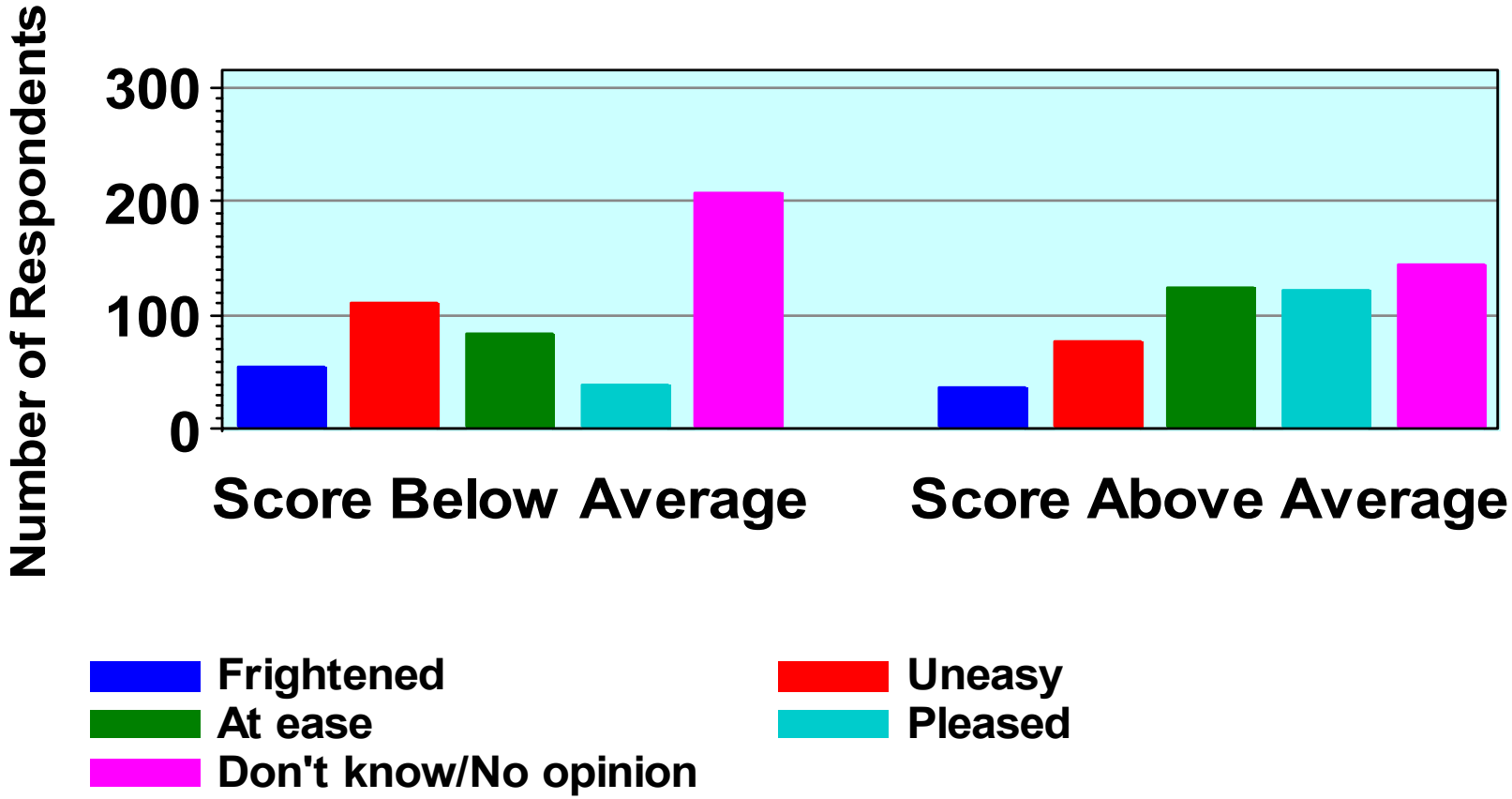
- About 45% thought that hydrogen is too dangerous for everyday use by the public
- When asked how they'd feel if their local gas station also sold hydrogen, more than 60% of the students said they'd feel frightened, uneasy, or "don't know"

- When students were asked about hydrogen, fuel cells, and energy studies in school –
  - → 52% said they have received some level of instruction about hydrogen and fuel cells in school
  - → 59% said they have received some level of instruction about energy use, fuels, and emissions in school
  - → 9% said they have used a fuel cell model kit in school

Key Results

Students

Relationship between technical knowledge and opinions of hydrogen safety:
How would you feel if your local gas station also sold hydrogen?



Key Results

Target Audiences:

→ General Public

→ Students

→ State and Local Government Officials

→ Potential End Users

Key Results

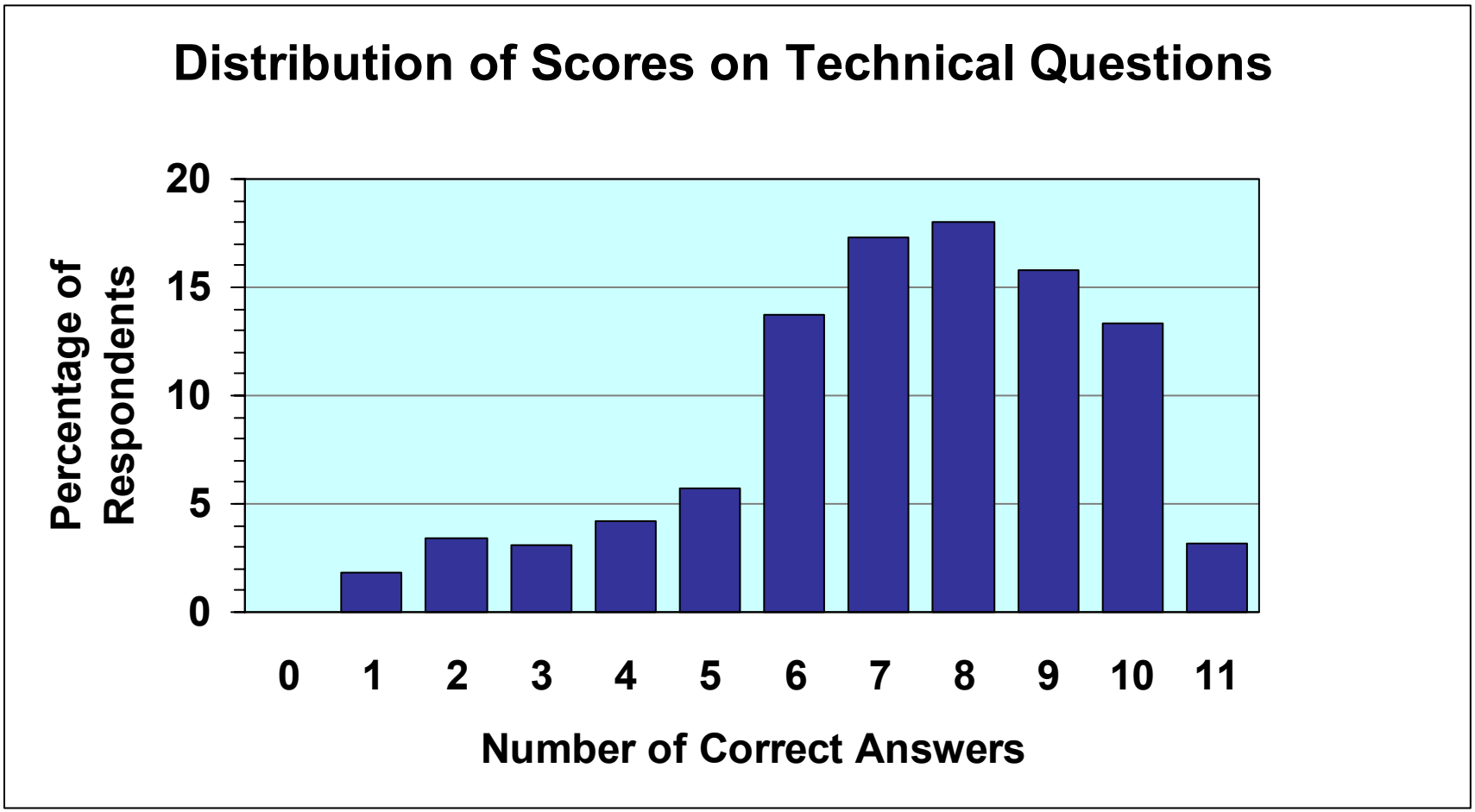
State and Local Government Survey

- Used national databases to compile contacts
  - → DOE sent letters to entire state and local government sample in advance of survey to improve response rate
- Targeted Organizations
  - → State-level – directors of State Energy Offices, DOTs and DEPs
  - → City- and county-level – mayors and supervisors in the 12 most populous cities and counties of the four U.S. census regions
  - → For cities and counties combined in a single office (e.g., City and County of Denver), only one call was made and the next largest county was selected for interviewing
- 96% response rate, for a total of 236 completed interviews

Key Results

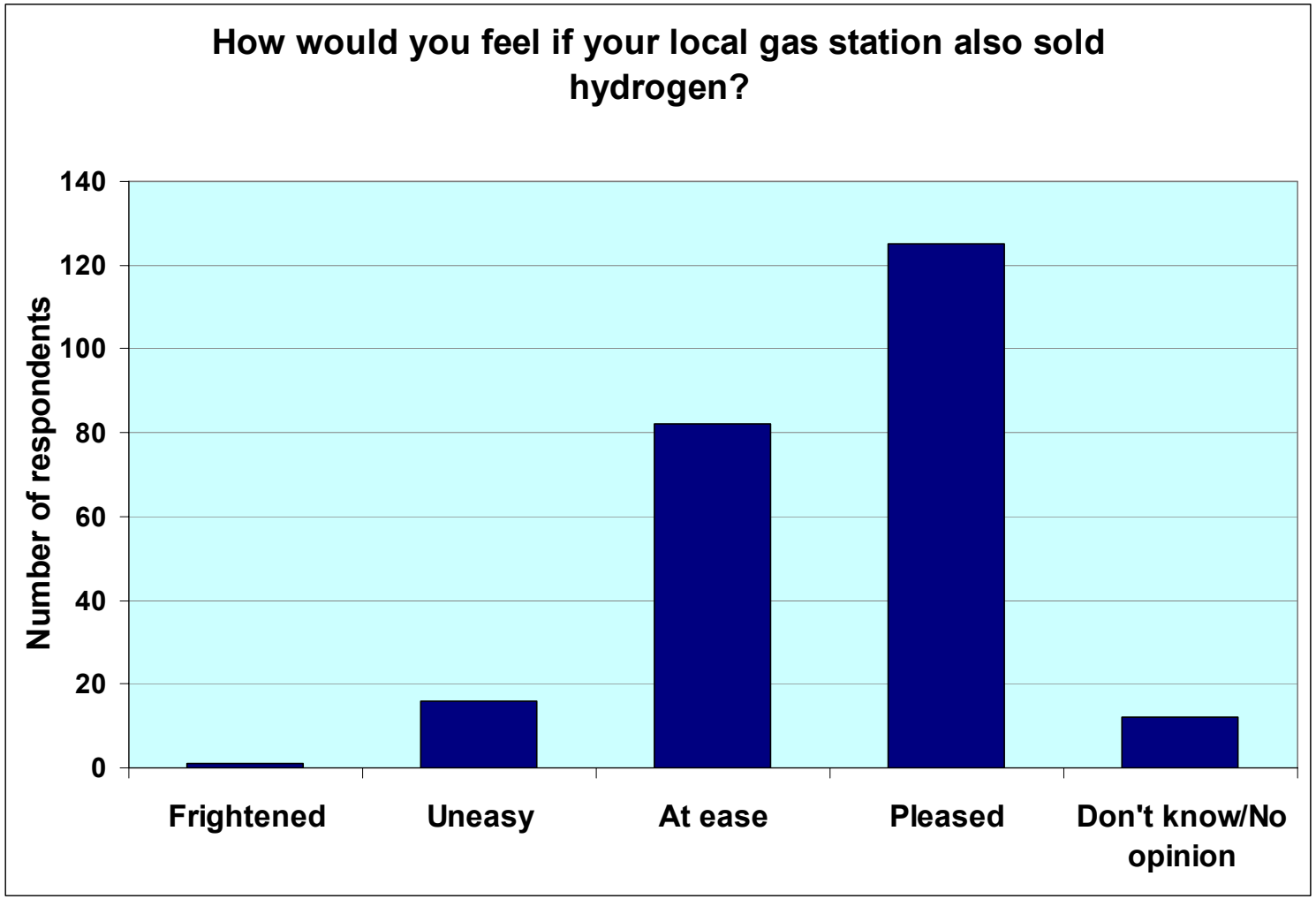
State and Local Government Officials

- Mean score for State and Local Government was 66%
- 18% of the responses were “Don’t Know”
- 50% scored a ‘Passing Grade’ (8 or more correct answers)



State and Local Government Officials

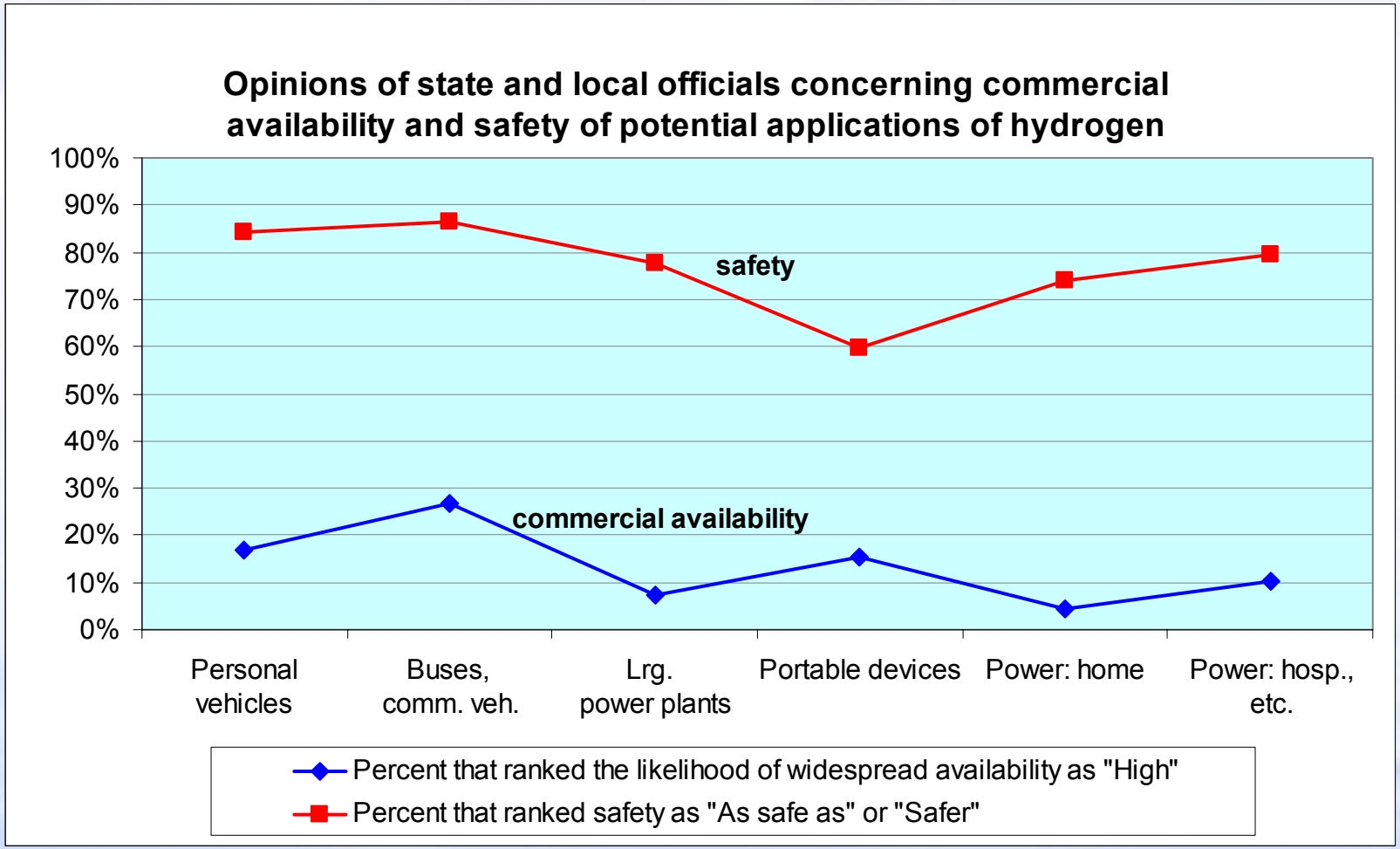
88% said they'd feel pleased or at ease if their local gas station also sold hydrogen



Key Results

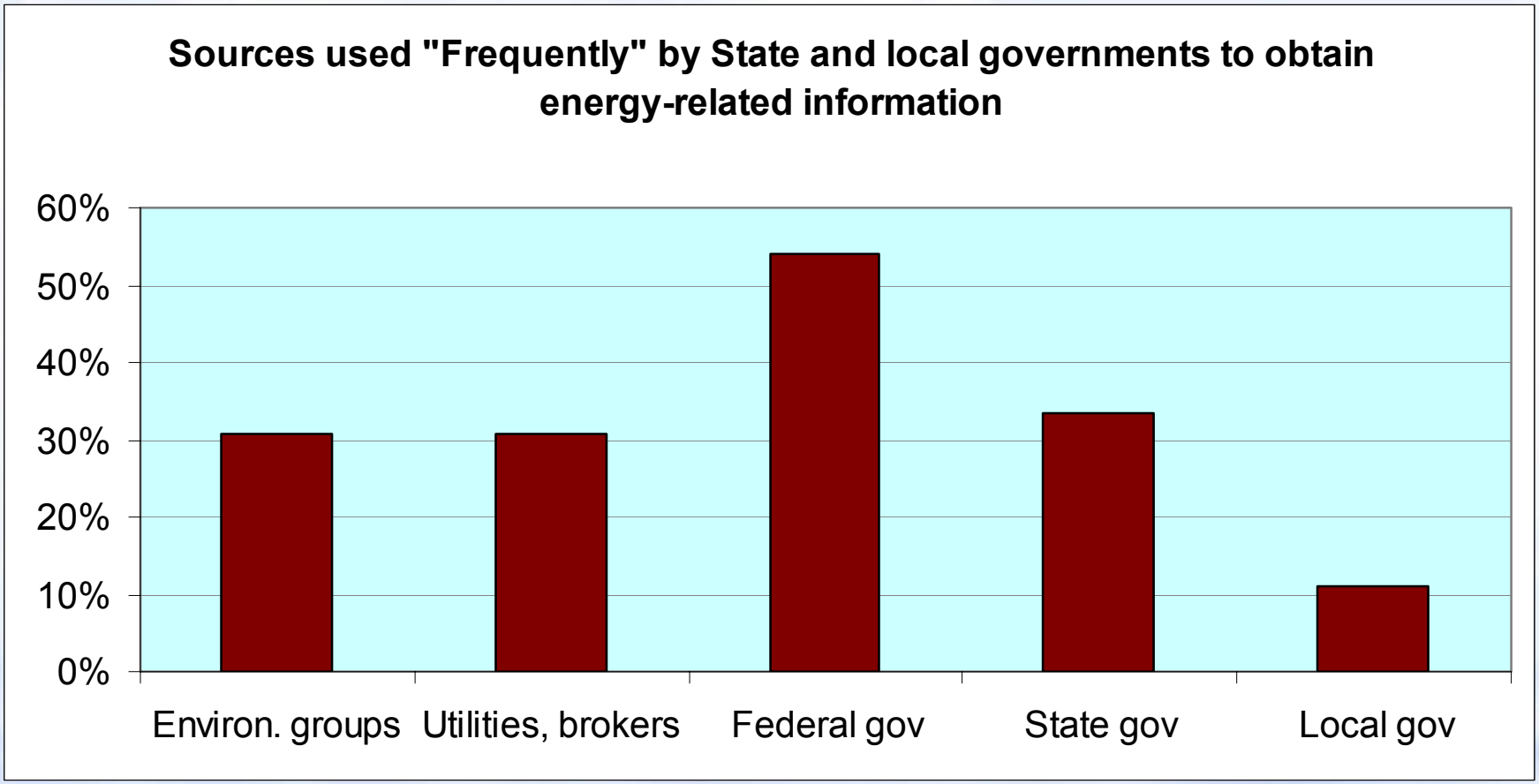
State and Local Government Officials

Consider use of hydrogen and fuel cells as safe as current technologies, but believe that the likelihood of near-term usage is low



State and Local Government Officials

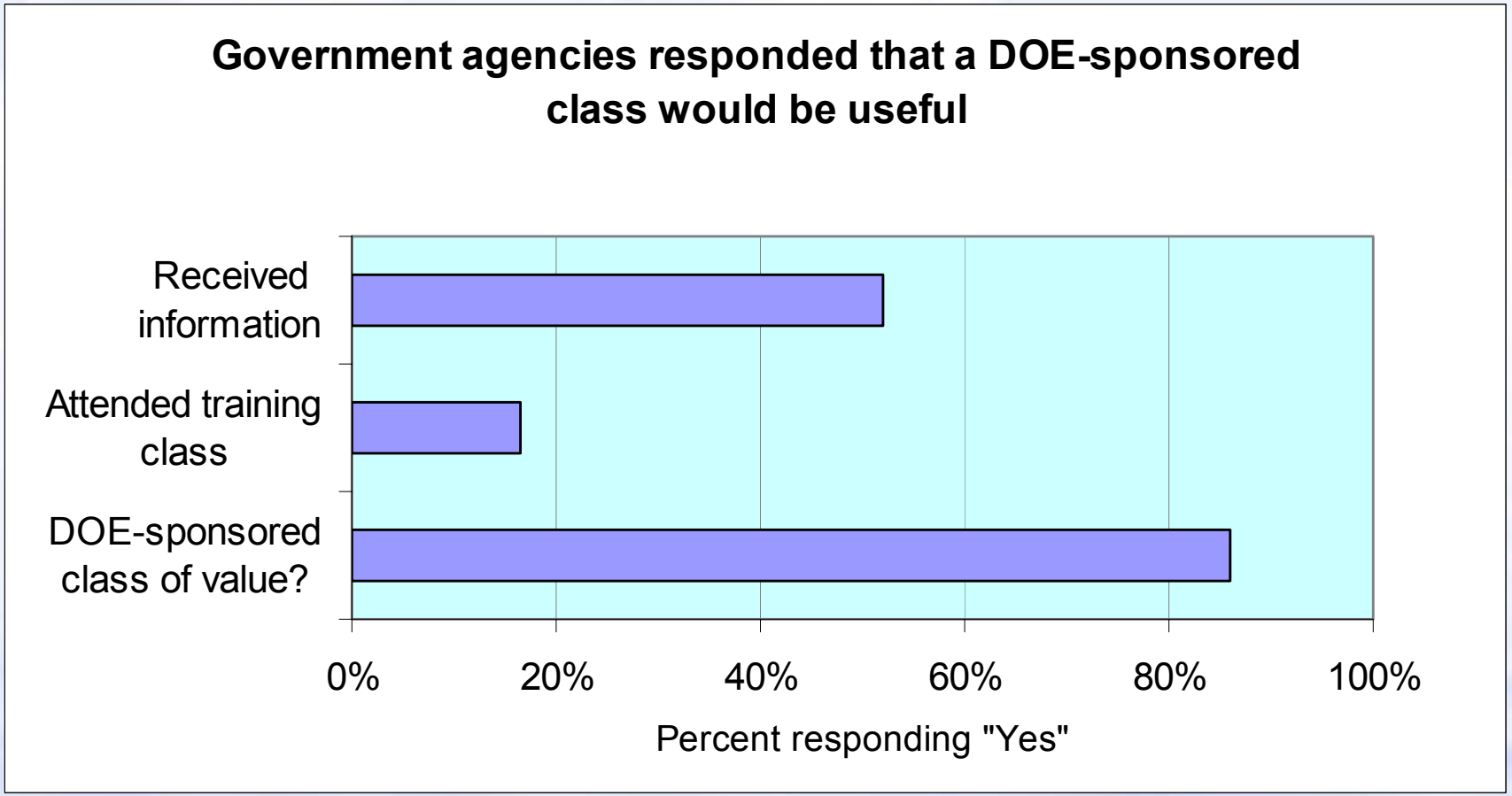
The Federal government is a frequently used source of information for State and Local Government Officials



Key Results

State and Local Government Officials

Almost 90% of the government agencies thought that a class or workshop on hydrogen and fuel cells would be valuable



Key Results

Target Audiences:

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→ Potential End Users

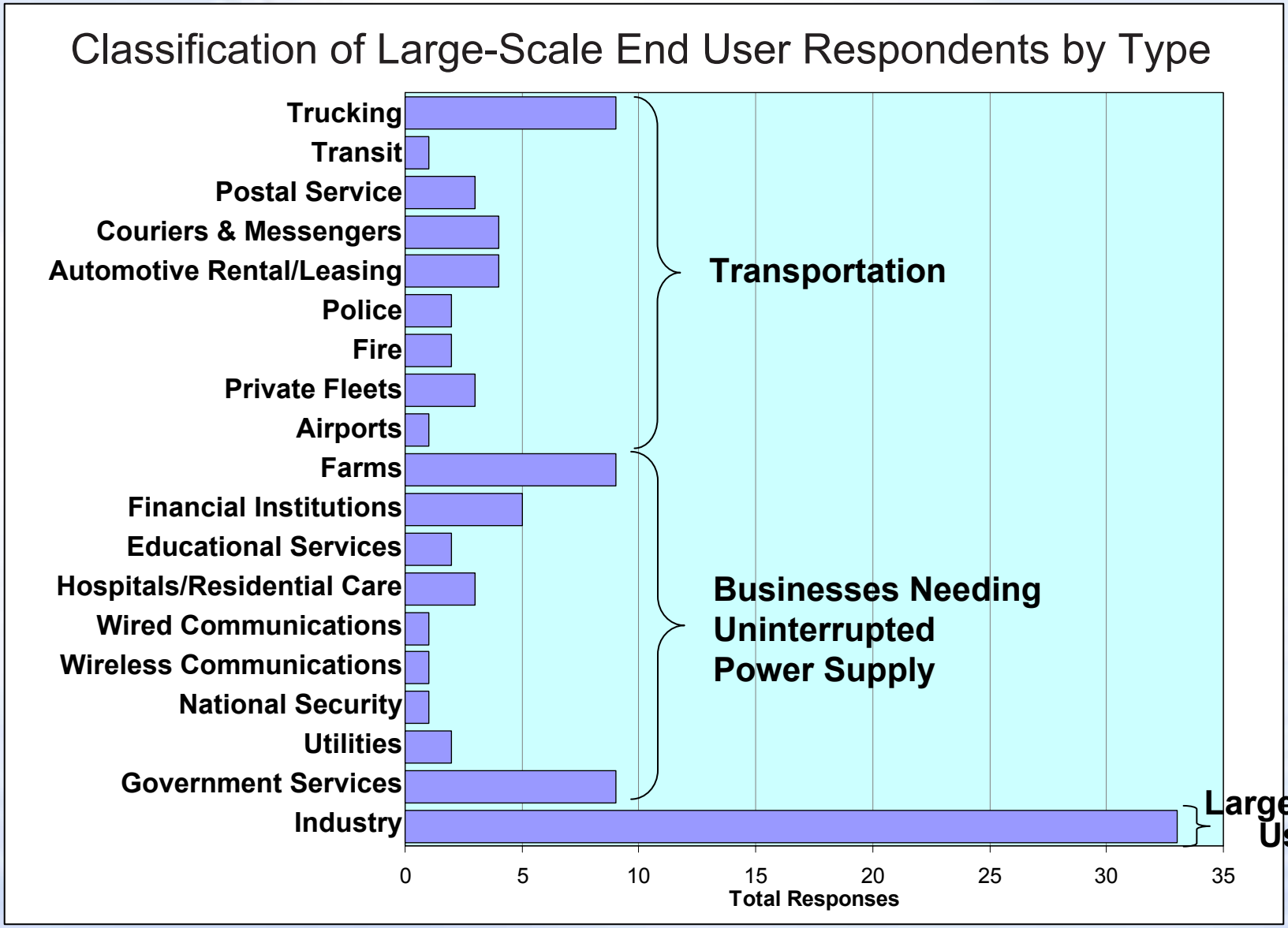
Key Results

End Users Survey

- Potential respondent businesses were identified by North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes
  - → Grouped into three categories and ranked by number of employees or revenue
    - → *Transportation services* – public and private fleets (# of employees)
    - → *Businesses needing uninterrupted power supplies* – hospitals, financial institutions (# of employees)
    - → *Industries with large power requirements* – mills, wastewater treatment and other plants (revenue)
  - → Within each category, the largest 0.3% were identified and randomly sampled
  - → Contact lists were purchased from Dun & Bradstreet Market Place database
- 29% response rate, with 99 completed interviews

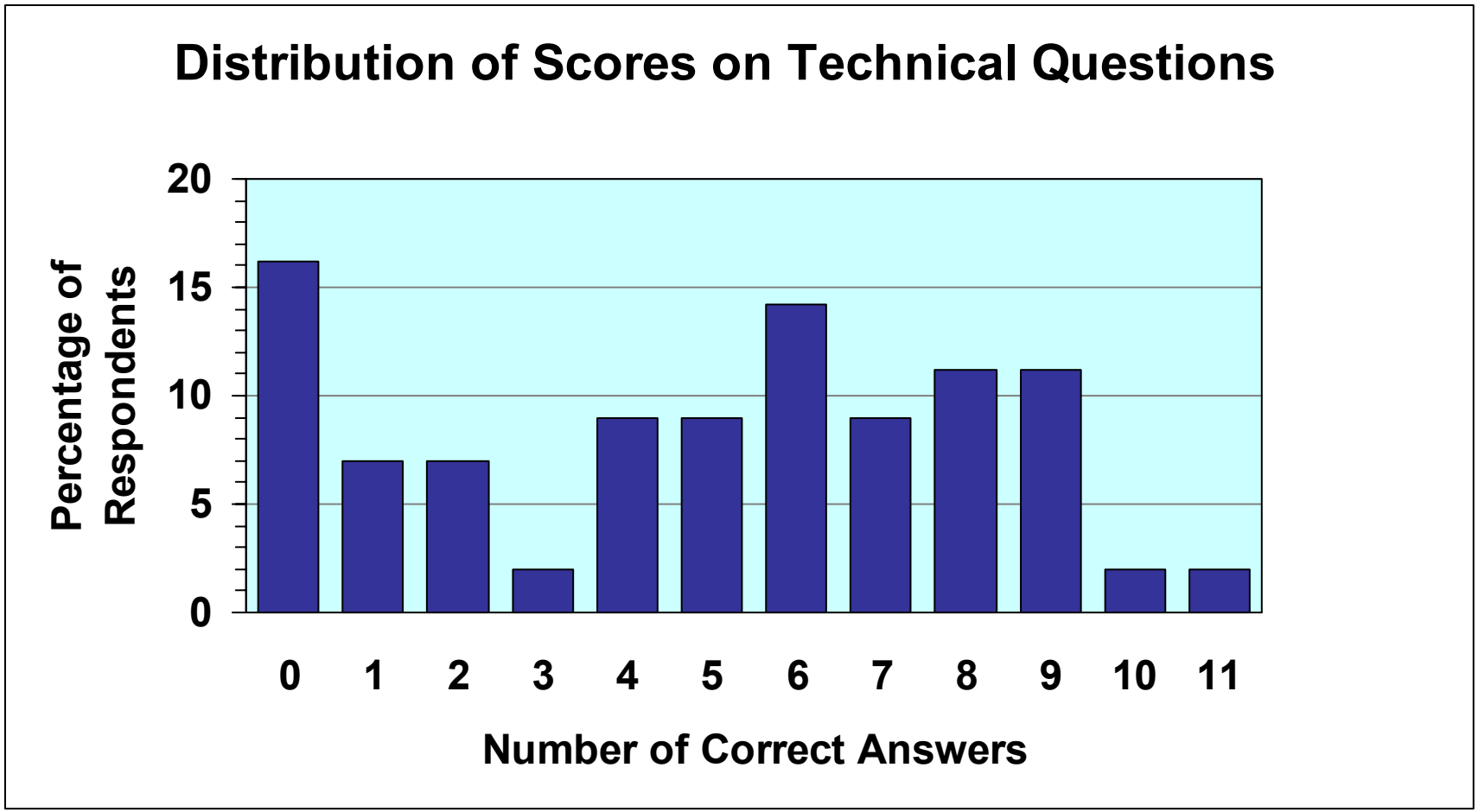
Key Results

End Users



End Users – Technical Knowledge

- Mean score for End Users was 44%
- 42% of the responses were “Don’t Know”
- 26% scored a ‘Passing Grade’ (8 or more correct answers)



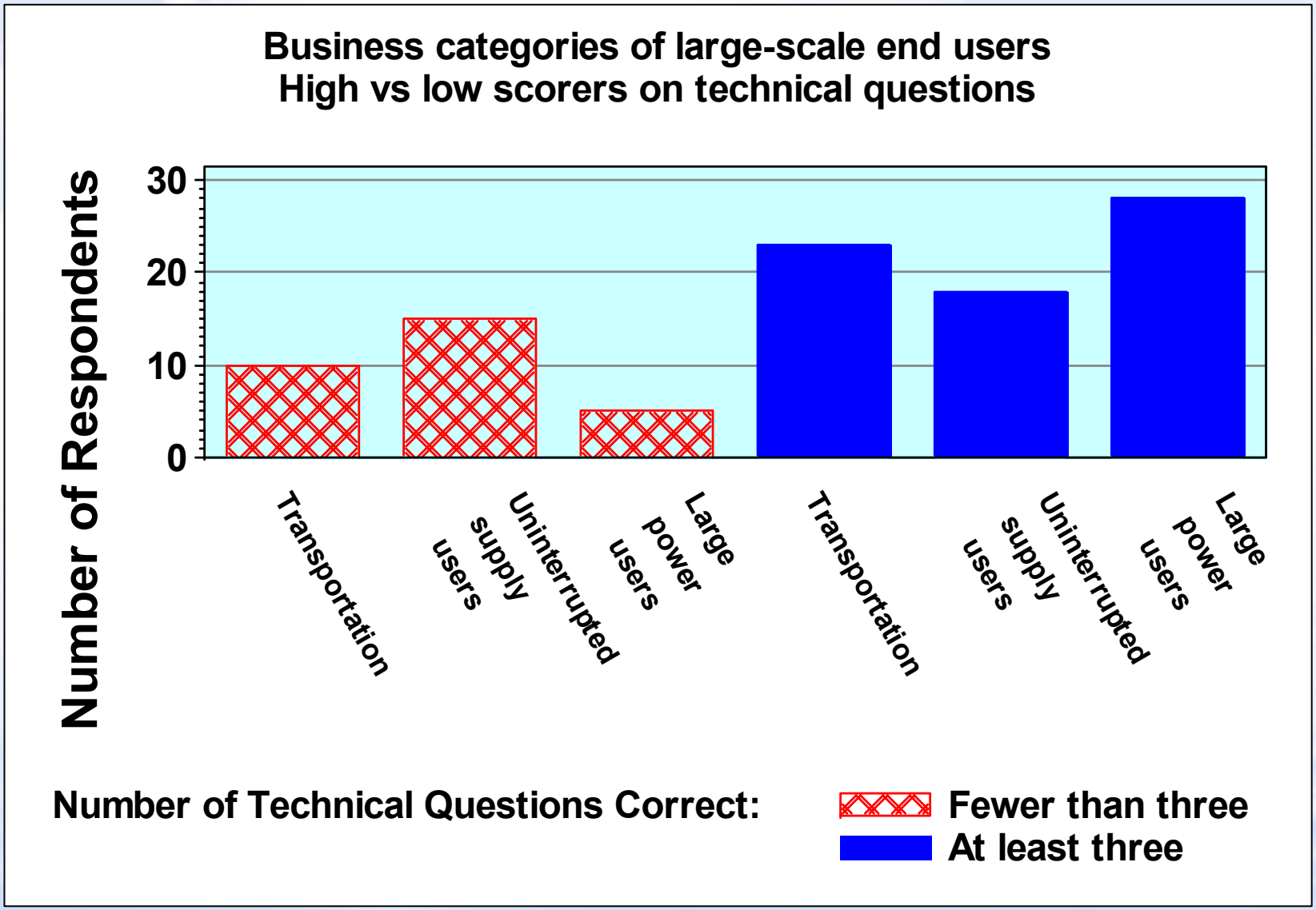
Key Results

End Users

- Results for technical questions comprise a bi-modal curve
  - → 2/3 answered three or more technical questions correctly
  - → 1/3 answered fewer than three questions correctly
    - → Half of the lower 1/3 were "users needing uninterrupted power supplies"
    - → The lower 1/3 was more likely to respond "Don't know" to questions
- 9% indicated that their organizations currently use hydrogen and/or fuel cell technologies
- When asked about future use, 8% responded that future plans include hydrogen or fuel cells

Key Results

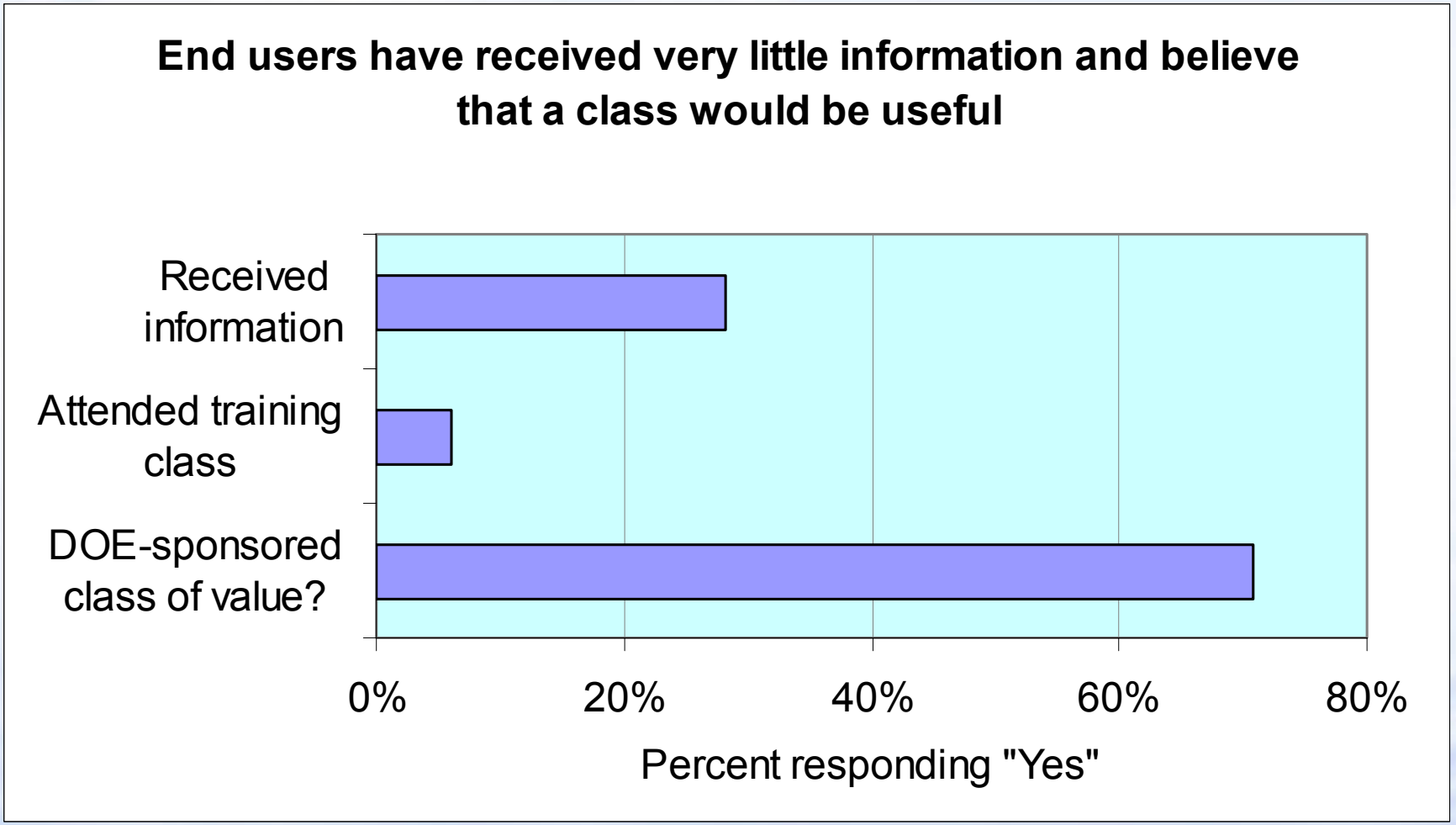
End Users



Key Results

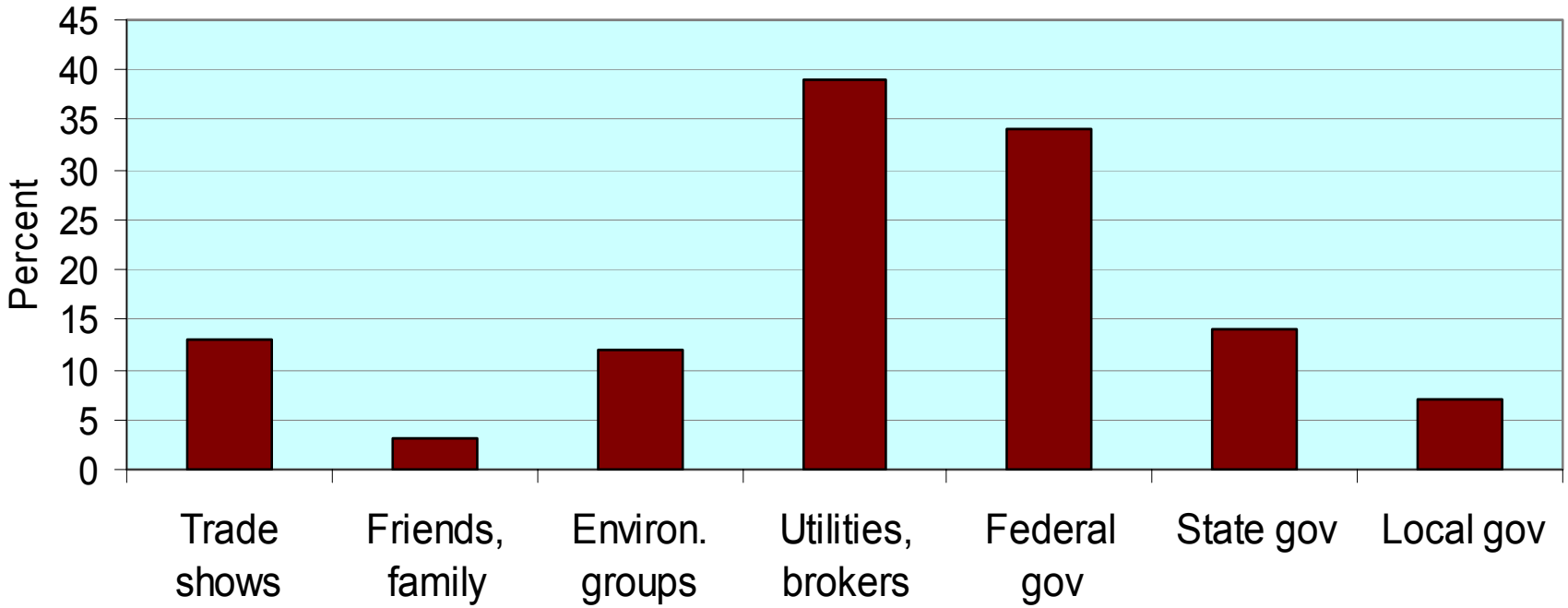
End Users

End users thought that a class or workshop would be valuable



Key Results

End Users



Key Results

End Users

Opinions on safety depended significantly on whether the respondent's technical score was above or below average

- Lower-scoring respondents were much more likely to have no opinion
- Above-average scorers were:
  - →More likely to believe that hydrogen power was as safe as or safer than technology in use today
  - →Much more comfortable with the idea of onsite hydrogen power for the home
  - →Much more comfortable with the idea of hydrogen-powered cars and trucks

Summary and Conclusions

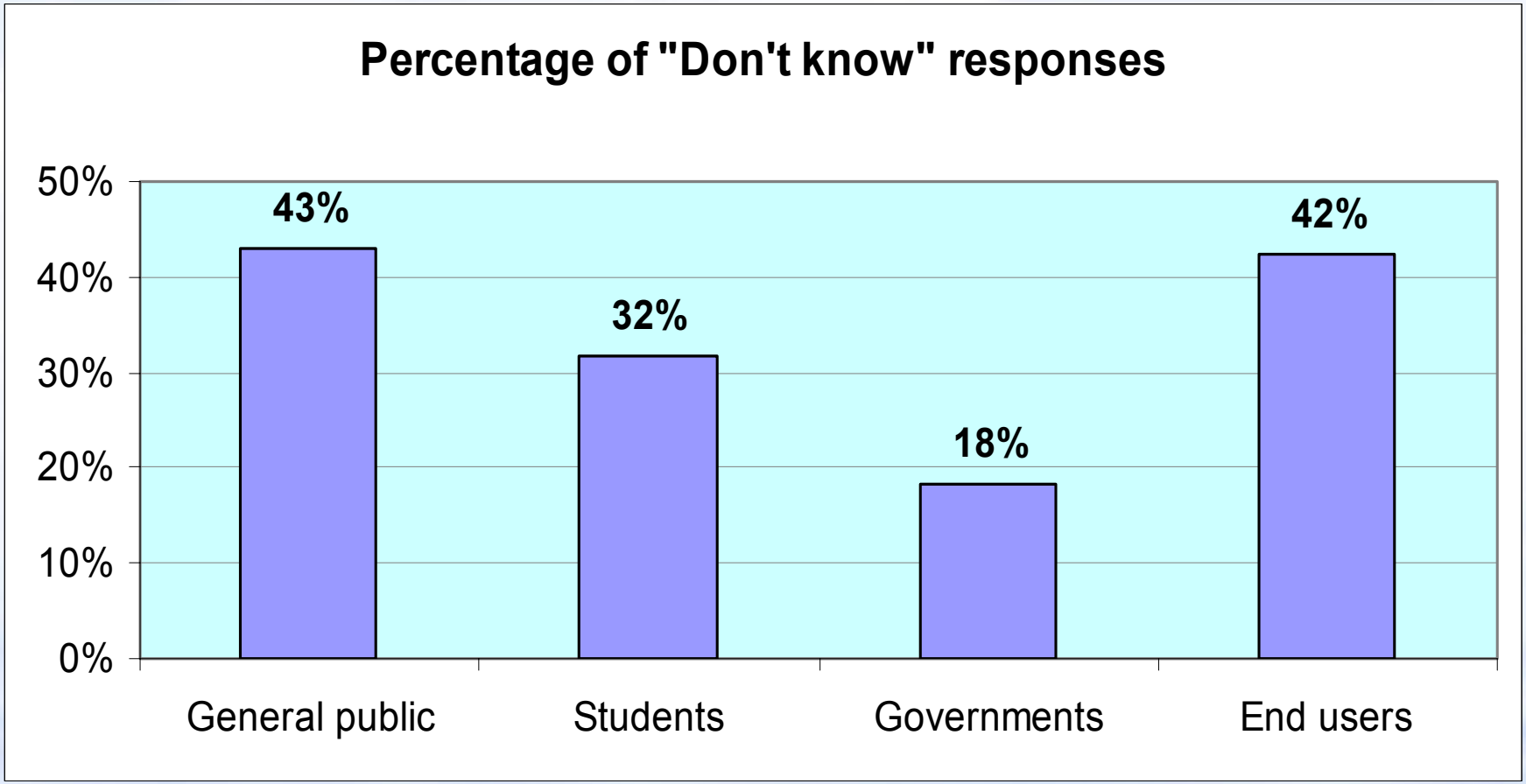
- The final report documents the survey methodology, data analysis, and results*
- The data is intended to provide a baseline from which we can measure changes in knowledge and opinions over time, but several conclusions can be drawn today…

* Final report expected in May 2006

Summary and Conclusions

All Populations

There is a general lack of knowledge about hydrogen and hydrogen fuel cell technologies



Summary and Conclusions

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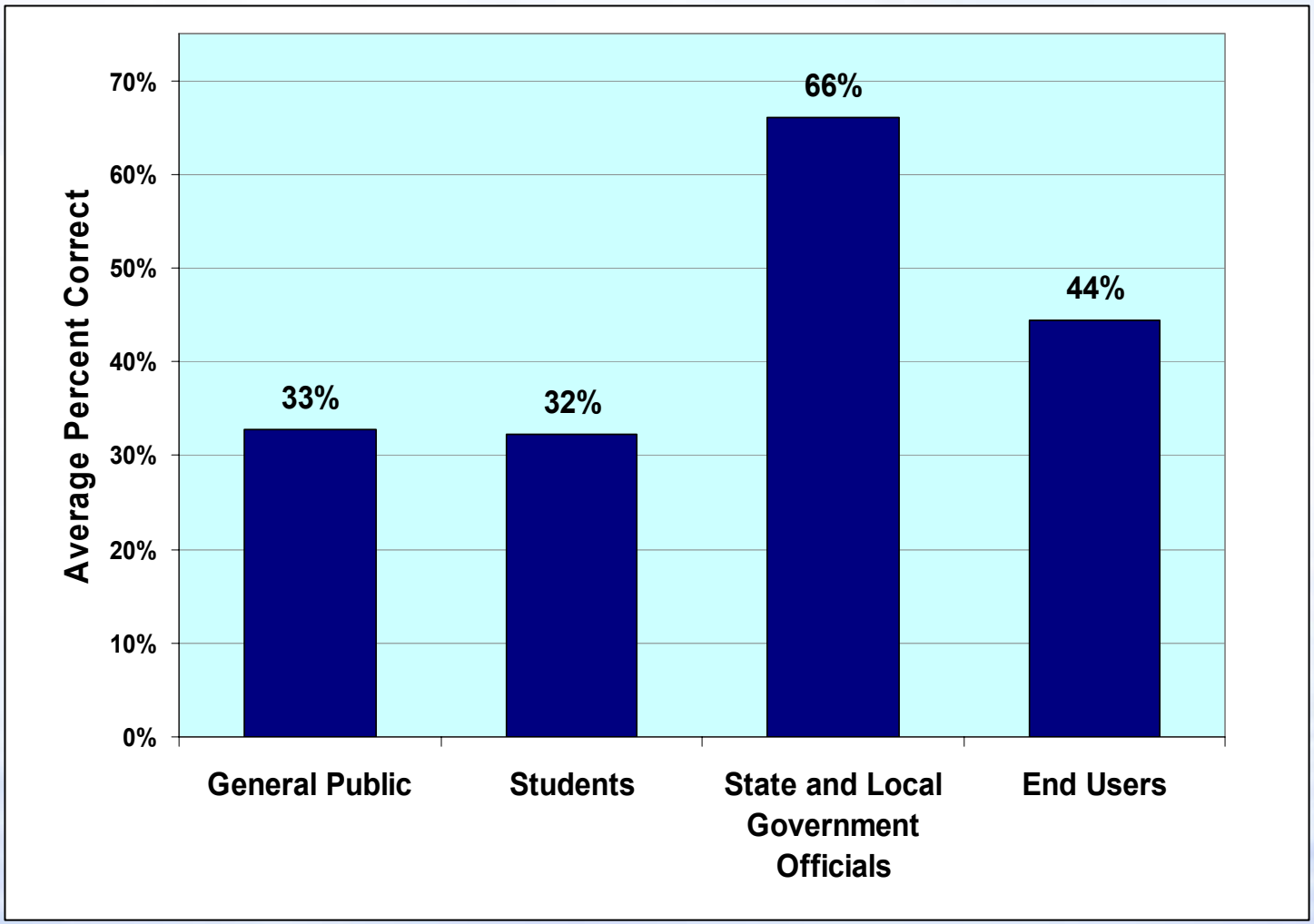
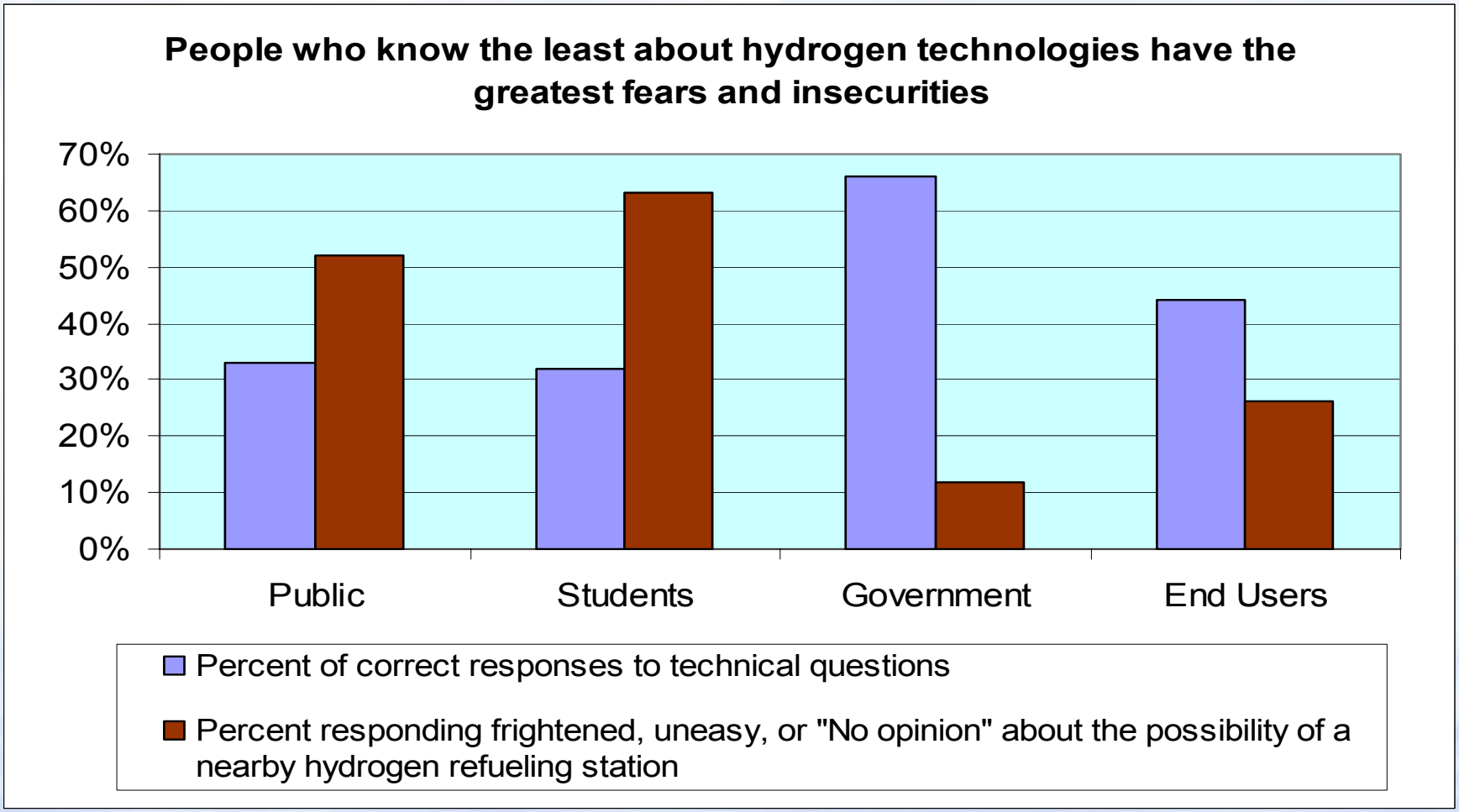


Summary and Conclusions

All Populations

There is a direct correlation between technical knowledge about hydrogen fuel cell technologies and opinions about safety



Summary and Conclusions

All Populations

There is a general desire for more information and training opportunities. Even populations that achieved *relatively high* scores on the technical knowledge questions expressed a need for "hydrogen basics" training.

→ When asked about the benefit of a class on hydrogen or fuel cells, 86% of government agencies and more than 70% of end users thought it would be valuable.

Next Steps

What's Next?

- Publish final report that includes comments from peer review – *www.hydrogen.energy.gov*
- Distribute results as widely as possible
- Complete archiving of baseline survey data and materials
- Revise multi-year hydrogen education plan as appropriate, develop and implement hydrogen education and training activities to raise technical knowledge scores among all surveyed audiences
- Prepare for out-year surveys
  - Build in survey components to measure knowledge and opinions of safety and code officials as a separate target audience category
  - Repeat surveys in 2008 and 2011 to measure changes in knowledge and opinions over time

For More Information

www.hydrogen.energy.gov

- Highlights latest program news – solicitations, announcements, etc.
- Includes key documents for download – Posture Plan, Annual Progress Report, introductory educational information
- Link to interagency task force (*www.hydrogen.gov*)

Other DOE Information Resources

→ Find a fuel cell animation and hydrogen and fuel cell education resources at ***www.eere.energy.gov/hydrogenandfuelcells***

→ Order documents from the information clearinghouse – ***877-EERE-INF(O) (877-337-3463)***