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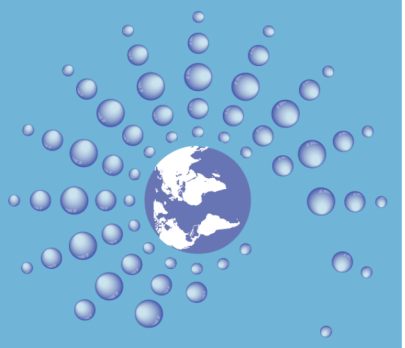

Nuclear Energy and Sustainability Program

# Public Attitudes Toward America's Energy Options:

## Insights for Nuclear Energy

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MIT-NES-TR-008
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# Abstract

In 2002, as part of the MIT study on *The Future of Nuclear Power*, the first MIT Energy survey investigated public attitudes toward nuclear power in light of other sources of electric power. The survey found cost and environmental harm to be key drivers behind public preferences regarding energy sources. In February 2007, the survey was repeated using similar sampling methodologies and the same core questionnaire, augmented by questions about global warming, waste treatment, and transfer of nuclear technology.

Public preferences exhibit considerable stability in the five years between surveys. Americans hold extremely optimistic views of alternative energy sources – solar, wind, and hydroelectric – especially as far as price is concerned. They have more realistic views of traditional fuels – fossil fuels plus nuclear power. In the aggregate, public opinion continues to reflect the relative pricing and environmental harm of these energy sources. Cost and harm, in turn, strongly influence public desires to expand or reduce different energy sources. Concern about global warming rose somewhat from 2002 to 2007, but remains only weakly associated with preferences about electricity generation.

The most notable change in survey responses is the decline of oil's popularity. Americans now strongly wish to reduce the use of oil, and they view this energy source less favorably than any other source of power. Coal, seen as moderately priced but very harmful to the environment, also remains quite unpopular. Five years ago, nuclear power was viewed similarly poorly; it now seems to have gained modestly in support and is approaching natural gas in terms of favorability.

# Acknowledgments

The present report, expanded to consider public attitude toward nuclear power in more detail, is based on the "Report of the 2007 MIT Energy Survey: Public Attitudes Toward America's Energy Options."

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# Overview

The prospects of global warming and potential shortages of oil have brought energy to the forefront of national, indeed global, problems that governments, corporations, and society must address. In the abstract, it is easy to imagine solutions to these problems, such as taxes or regulations that will affect the price of energy and change behaviors, or expansion of the use of fuels that are abundantly available and do not emit large amounts of carbon into the atmosphere. Nuclear power, carbon capture, and generation of power through wind and sunlight offer the most commonly discussed means of avoiding future carbon emissions. Actually implementing solutions, however, can prove quite difficult and will require at least some degree of public support.

In 2002, as part of the MIT study on *The Future of Nuclear Power*, the first MIT Energy survey considered public attitudes toward nuclear power in light of other sources of electric power. This survey offered a new approach to understanding energy alternatives. The questionnaire was designed to tap how the public views many different energy sources, not just one energy source in isolation. Questions ascertained the respondents' perceptions of the attributes of the energy sources – perceived costs and environmental harms – and respondents' preferences about the nation's energy portfolio. For each of the energy sources we asked whether the fuel was harmful to the environment or not, whether the cost of electricity from that fuel was expensive, moderately priced or cheap, and whether the respondent felt the government and companies should increase or decrease use of the fuel in electricity production. We could then examine perceptions of and support for any single fuel, especially nuclear power, and also compare fuels.

That survey found that the two key drivers behind public preferences about energy sources are general environmental harm and cost of electricity. To gauge the relative importance of perceived harms and economic costs on preferences, I employed a multiple regression analysis in which perceived costs and environmental harms were used to predict preferences about each energy source. Both proved statistically meaningful

predictors, but environmental harm systematically had stronger effects on preferences. To push this further, I conducted an experiment with the survey in which half of the respondents were given no information and half were given some factual information, either about prices or environmental harms. The price information had strong effects, while the environmental information did not. Respondents typically had incorrect perceptions about the cost of electricity from each source. When they learned the correct price information from the experiment, they changed their opinions in response. In the case of environmental information, the story is somewhat more complex. The regression analyses in 2002 showed that perceived general environmental harm affects people's preferences, but concern about global warming does not. The experiments suggest that neither issue changed preferences, which, in the case of global warming, was because Americans still do not draw a strong connection between global warming and electricity generation. In the case of general environmental harm, no change occurred because people (on average) already had internalized the correct information.

In February 2007, we replicated the energy survey. The same survey firm, Knowledge Networks, conducted both surveys, using similar sampling methodologies. Both surveys had sample sizes of 1,200 (slightly higher in 2002). The core questionnaire from the 2002 survey was repeated exactly, but augmented with further questions about global warming, waste treatment, and transfer of nuclear technology. Much of this report will focus on the economic and environmental perceptions and preferences about future energy use and changes between 2002 and 2007.

Over the five years between the surveys, several key aspects of the energy and environment picture changed. First, global warming emerged as the primary environmental concern in the country following increased public debate and media attention to the issue. Second, the United States went to war with Iraq and occupied it to establish stability. Third, oil prices rose substantially. Fourth, North Korea and Iran developed nuclear arms programs and the United States reached agreement with India on nuclear technology transfers, raising concerns about proliferation.

Despite these changes in the energy sector, public preferences about energy exhibit considerable stability. Americans hold extremely optimistic views of the alternative energy sources – solar, wind, and hydroelectric – especially as far as price is concerned. They have more realistic views of traditional fuels – fossil fuels plus nuclear power. Public opinion, in the aggregate, reflects the relative pricing of these energy sources and relative environmental harms. Cost and harm, in turn, strongly influence public desires to expand or reduce different energy sources. Concern about global warming rose somewhat from 2002 to 2007, but it remains only weakly associated with preferences about electricity generation.

The most notable change in survey responses is the decline of oil's popularity. Oil has lost much of its luster. It has supplanted nuclear power as the least liked energy source. Americans now strongly wish to reduce the use of oil, and they view this energy source less favorably than any other source of power. Coal, seen as moderately priced but very harmful to the environment, also remains quite unpopular. Five years ago, nuclear power

was viewed similarly poorly. It now seems to have gained modestly in support and is approaching natural gas in terms of favorability.

# Energy Futures

The central question of interest in this study is whether Americans support or oppose increased use of various energy sources.

> *Consumers, such as you, have more and more say in how electricity is produced in the United States.*
>
> *To make more electricity to meet the country's needs over the next 25 years, new power plants will have to be built. Companies and government agencies need to start planning today. How should we meet this demand? For each power source indicate whether you feel the U.S should increase or reduce its use, or not use at all.*

Respondents could choose Reduce A Lot, Reduce Somewhat, Keep the Same, Increase Somewhat, Increase A Lot, or Not Use. Table 1 reports the responses to this question in 2007.

Table 1. Distribution of Preferences About Alternative Energy Sources, 2007.

| | Not Use | Reduce A Lot | Reduce Somewhat | Keep Same | Increase Somewhat | Increase A Lot |
|---|---|---|---|---|---|---|
| Coal | 6.6% | 22.1 | 25.6 | 27.0 | 11.4 | 7.4 |
| Dams | 4.0 | 2.1 | 8.8 | 45.1 | 27.3 | 12.6 |
| Gas | 3.5 | 6.8 | 19.7 | 38.8 | 21.4 | 9.9 |
| Nuclear | 11.3 | 14.1 | 13.9 | 25.0 | 21.4 | 14.3 |
| Oil | 6.4 | 36.4 | 31.3 | 18.1 | 4.7 | 3.1 |
| Solar | 2.7 | 3.1 | 4.4 | 13.1 | 25.3 | 51.5 |
| Wind | 3.8 | 1.6 | 3.6 | 14.2 | 24.0 | 52.8 |

Nuclear power evokes the most divided response. Thirty-nine percent would like to reduce use of nuclear power; thirty-five percent would like to increase its use. Equal numbers would like to Reduce Use of Nuclear Power A Lot and Increase Use of Nuclear Power A Lot, and of all energy sources nuclear power has by far the highest fraction of people who would choose not to use it at all (11%).

Nuclear power, however, is not the least popular fuel source in 2007- oil is, followed by coal. Seventy-four percent of those in the sample wanted to decrease use of oil. Fifty-four

percent of those in the sample wanted to decrease use of coal. Despite their relative unpopularity, though, fewer chose to "not use" these at all to generate electricity compared with nuclear power.

The two fuel sources that attracted the highest expressions of support are Solar and Wind power. Outright majorities would choose to "Increase A Lot" use of these two fuels, and better than three out of four Americans would like to increase these fuels in the U. S. energy portfolio.

Natural gas and hydroelectric power production appear as intermediate options. High percentages of the public would choose to keep these two power sources at their current levels or increase them somewhat.

Support for the fuel sources can be ordered according to the average and median preference in the public. On the 6 point scale, with Not Use equal to 0 and Increase A Lot equal to 5, Oil has the lowest average level of support at 1.9 (Reduce), followed by Coal at 2.4 and Nuclear Power at 2.7 (midway between Reduce Somewhat and Keep Same). Natural Gas has an average level of support of 3 and Hydroelectric 3.2 (both Keep Same). Solar and Wind averaged 4 (Increase Somewhat).

Comparison with 2002 shows considerable stability in public preferences about the nation's energy options, with some subtle shifts. Table 2 presents the distribution of respondent's preferences about power sources in the 2002 survey.

Table 2. Distribution of Preferences About Alternative Energy Sources, 2002.

| | Not Use | Reduce A Lot | Reduce Somewhat | Keep Same | Increase Somewhat | Increase A Lot |
|---|---|---|---|---|---|---|
| Coal | 4.8% | 23.3 | 29.9 | 25.0 | 10.7 | 6.0 |
| Dams | 1.4 | 3.8 | 11.2 | 31.1 | 34.2 | 18.0 |
| Gas | 1.3 | 6.3 | 24.1 | 37.2 | 22.7 | 8.1 |
| Nuclear | 9.2 | 19.2 | 18.6 | 24.6 | 18.3 | 9.8 |
| Oil | 3.4 | 19.7 | 33.6 | 30.2 | 9.5 | 3.2 |
| Solar | 1.4 | 2.3 | 4.9 | 13.6 | 27.0 | 50.4 |
| Wind | 1.6 | 2.5 | 4.7 | 13.9 | 24.4 | 52.6 |

Preferences toward several of the power sources did not change at all. Then, as now, Coal was disliked by about 55 percent of the respondents. Solar and Wind power were as popular five years ago as they are today, with nearly identically sized majorities supporting expansion of these fuel sources. Natural Gas seemed to be the "safe option." Most people wanted to keep its use the same, or increase or decrease it slightly.

Oil, hydroelectricity, and nuclear power show noticeable changes in support. Nuclear power evoked the most disparate reactions in 2002, but there has been a noticeable growth in support. Forty-seven percent wanted to reduce use of nuclear power in 2002; today that figure stands at 39 percent. That being said, nuclear power does not enjoy the favored status of solar and wind; a majority do not want to increase its use. Hydroelectricity has moved in the opposite direction. It was more popular five years ago, and support for using dams to generate power is off slightly. Oil shows the biggest decline. In 2002, 56 percent of the respondents would have decreased use of oil. Today, that figure exceeds three-fourths of the public. Oil is the most disliked power source. Oil's fall likely reflects a combination of factors, especially rising prices and questions about supply sparked by tensions in the Middle East.

Both the 2002 and the 2007 surveys reveal distinct clusters in public support for fuels. Coal and Oil provide one group, anchoring the low end of the spectrum of support, while Solar and Wind reflect a second group that anchors the high end of support. Hydroelectricity, Nuclear Power, and Natural Gas represent intermediate options. How they fit into this picture depends on what attributes people use to distinguish energy options. Environmental and economic impact surely shape public perceptions, but just looking at public support can reveal little as to how much weight these factors have. Natural Gas is a fossil fuel, and might be viewed as such; it also emits less pollution and costs relatively little. Solar, Wind, and Hydro emit little pollution and are costly but popular. Nuclear power emits little carbon, but is more expensive than coal and has been hamstrung by the problem of waste disposal. Also, the facts one may glean from reports and expert debate may have little relationship to public perceptions of cost and harm.

# Energy Attributes

The survey asked two questions to gauge how accurately people perceive the costs and environmental harms associated with different electricity sources. Before asking preferences about expansion or reduction of energy sources, we asked how expensive respondents thought it would be to produce electricity from each source and how much the different fuel sources damage the environment.

Consider, first, the question of cost. We asked directly:

> *How expensive do you think it is to produce electricity from each of the following fuels?*
>
> *Very Expensive*
> *Somewhat Expensive*
> *Moderately Priced*
> *Somewhat Cheap*
> *Very Cheap*

Table 3 shows the distribution of perceived costs and the average value for the 2007 and 2002 samples.

Table 3. Perceived Cost

2007 SAMPLE

| Fuel | Expensive Very (1) | Somewhat (2) | Moderately Priced (3) | Inexpensive Somewhat (4) | Very (5) | Avg. |
|---|---|---|---|---|---|---|
| Coal | 12.9% | 21.3% | 31.9% | 23.5% | 10.4% | 3.0 |
| Nuclear | 32.4 | 29.5 | 20.7 | 11.7 | 5.7 | 2.3 |
| Natural Gas | 16.0 | 33.7 | 35.0 | 13.4 | 2.0 | 2.5 |
| Oil | 33.3 | 37.8 | 21.1 | 6.4 | 1.3 | 2.0 |
| Hydroelectric | 5.6 | 18.4 | 36.2 | 27.0 | 12.8 | 3.2 |
| Solar | 9.2 | 20.1 | 20.7 | 23.9 | 26.2 | 3.4 |
| Wind | 4.6 | 16.7 | 19.3 | 25.5 | 33.8 | 3.7 |

2002 SAMPLE

| Fuel | Expensive Very (1) | Somewhat (2) | Moderately Priced (3) | Inexpensive Somewhat (4) | Very (5) | Avg. |
|---|---|---|---|---|---|---|
| Coal | 13.4% | 24.5% | 35.1% | 21.4% | 5.6% | 2.8 |
| Nuclear | 38.8 | 33.0 | 19.3 | 7.4 | 2.0 | 2.0 |
| Natural Gas | 11.8 | 32.8 | 42.5 | 11.5 | 1.3 | 2.6 |
| Oil | 25.2 | 42.1 | 26.7 | 5.3 | 0.7 | 2.1 |
| Hydroelectric | 9.9 | 24.5 | 34.7 | 22.4 | 8.9 | 3.0 |
| Solar | 9.9 | 19.4 | 22.7 | 28.1 | 19.9 | 3.3 |
| Wind | 4.5 | 11.6 | 19.3 | 31.1 | 33.5 | 3.8 |

Very little changed in the distribution of perceived costs from 2002 to 2007. Oil, already seen to be expensive, was perceived to be even more expensive in the more recent survey. Nuclear power, on the other hand, was seen to be slightly less expensive.

Two patterns capture the most salient features of perceived cost. First, people see "alternative" fuels – hydroelectricity, solar, and wind – as cheap and conventional fuels as expensive. Perceptions of coal, natural gas, nuclear fuel, and oil ranged from Somewhat Expensive to Moderately Priced. Perceptions of the alternatives ranged from Moderately Priced (in the case of Hydro) to Somewhat Inexpensive (in the case of Wind). The modal response for Solar and Wind was Very Inexpensive. This is clearly a misperception of the cost of electricity from these fuel sources. This view might reflect confusion about pricing; it might also reflect wishful thinking.

Second, among the traditional fuels people get the relative prices right. Of the conventional fuels, using oil is the most expensive way to provide electricity and coal is the cheapest. Natural gas and nuclear power lie somewhere in between. This relative ordering is impressive and suggests a strong degree of collective understanding in the public. Individuals may get the pricing wrong, but on average, public opinion reflects the correct ordering of price information about traditional fuels. I find this impressive because individuals do not actually know where their electricity comes from and they do not directly shop for energy sources. Where such information comes from is a good question worth exploring further, but not of immediate interest.

The survey also asked about perceived environmental harms in the forms of toxic wastes, air pollution, and waste water. The questionnaire did not include global warming and CO2 in this list, as that is not technically considered a pollutant by the EPA and other questions sought to isolate how concerns about the global climate shape energy attitudes. Immediately before asking about costs, the survey asked respondents to assess the overall environmental damage done by various energy production alternatives.

> *Some ways of generating electricity may be harmful to the environment we live in because they produce air pollution, water pollution, or toxic wastes. How harmful do you think each of these power sources is?*
>
> *Very Harmful*
> *Moderately Harmful*
> *Somewhat Harmful*
> *Slightly Harmful*
> *Not Harmful*

Table 4 presents the distribution of perceived environmental harms as well as the average value for each fuel source in 2007 and 2002.

As with perceived cost, the public sees a clear difference between traditional fuels and the "alternative energies" of hydroelectricity, solar, and wind power. Coal is perceived as the most harmful to the environment, followed by oil and nuclear power. All are seen as, on average, moderately harmful to the environment. Natural gas and hydroelectric power are seen as somewhat harmful. Solar and Wind are seen as not harmful at all. Setting aside global warming, this rank ordering is roughly correct. It certainly captures the gross differences in environmental impact of the methods of energy production

Table 4. Perceived Harm

2007 SAMPLE

| | Very (1) | Moderately (2) | Somewhat (3) | Slightly (4) | Not (5) | Avg. |
|---|---|---|---|---|---|---|
| Coal | 33.5% | 27.4% | 24.9% | 9.7% | 4.5% | 2.2 |
| Nuclear | 36.8 | 17.1 | 17.9 | 17.5 | 10.7 | 2.5 |
| Natural Gas | 4.5 | 17.8 | 33.4 | 27.5 | 16.8 | 3.3 |
| Oil | 24.9 | 30.0 | 25.9 | 14.9 | 4.3 | 2.4 |
| Hydroelectric | 2.6 | 7.2 | 17.9 | 27.0 | 45.3 | 4.1 |
| Solar | 1.3 | 1.8 | 4.0 | 8.9 | 84.0 | 4.7 |
| Wind | 1.5 | 1.7 | 5.2 | 10.8 | 80.8 | 4.7 |

2002 SAMPLE

| | Very (1) | Moderately (2) | Somewhat (3) | Slightly (4) | Not (5) | Avg. |
|---|---|---|---|---|---|---|
| Coal | 32.9% | 31.7% | 24.2% | 9.0% | 2.3% | 2.2 |
| Nuclear | 45.1 | 22.5 | 17.3 | 10.4 | 4.7 | 2.1 |
| Natural Gas | 6.9 | 18.0 | 35.0 | 29.4 | 10.8 | 3.2 |
| Oil | 23.4 | 37.1 | 28.0 | 8.6 | 2.8 | 2.3 |
| Hydroelectric | 6.0 | 12.0 | 19.0 | 29.2 | 33.8 | 3.7 |
| Solar | 2.7 | 3.1 | 8.9 | 14.0 | 71.2 | 4.5 |
| Wind | 1.7 | 2.9 | 6.9 | 12.8 | 75.8 | 4.6 |

The 2007 survey focused on additional attributes of power sources, including siting, waste management, and technology transfer. These problems have long discouraged support for nuclear power, but they present obstacles to the development of other fuels as well.

> *How would you feel if a [type of facility] were built within 25 miles of your house?*
>
> *Strongly Oppose*
> *Oppose Somewhat*
> *Support Somewhat*
> *Strongly Support*

The survey presented respondents with several different sorts of facilities – a natural gas-fired power plant, a coal-fired power plant, a nuclear power plant, and a wind power facility (with 100 250-foot towers). We also described carbon capture and sequestration and asked

> *If carbon dioxide were pumped deep under ground within 25 miles of your home, would you support such a facility?*

Table 5 summarizes the responses to these questions in 2007. The same questions were asked for coal, natural gas, and nuclear power plants in 2002 and virtually the same pattern emerged.

Table 5. Support for and Opposition to Construction of Local Energy Facilities

| | Type of Facility | | | | |
|---|---|---|---|---|---|
| | Wind | Gas | Carbon | Coal | Nuclear |
| Strongly Oppose | 7% | 20% | 38% | 41% | 54% |
| Somewhat Oppose | 16 | 33 | 24 | 34 | 21 |
| Somewhat Support | 47 | 41 | 10 | 19 | 18 |
| Strongly Support | 28 | 5 | 3 | 3 | 5 |
| Not Sure | 2 | 2 | 18 | 2 | 2 |

Public support for and opposition to such facilities varies greatly. Wind power generating facilities enjoy support of a strong majority of fully 75 percent of the sample. However, only wind seems to receive majority support. A bare majority opposes construction of a natural gas-powered electric power plant within 25 miles of their homes (53% against versus 46% for). Almost two-thirds oppose pumping carbon underground within 25 miles of their home (carbon capture and sequestration). Fully three fourths oppose construction of either a coal power plant or a nuclear power plant nearby, with the strongest opposition to a nuclear facility.

Local opposition to coal and nuclear facilities is not just a problem of "not in my back yard." These are among the least popular forms of electricity generation period, and most people want to reduce their use. Opposition is especially intense, however, the closer the facilities get to home. Wind power is relatively popular as a general matter and as a local development.

I can further generally gauge the relative intensity of local opposition to and support for energy projects by combining the responses to the five types of projects considered. Ten

percent of the sample opposed all 5 sorts of projects. In contrast, only 1 percent supported all 5. That ten-to-one ratio may be taken as a measure of the relative intensity of the NIMBY (Not In My Back Yard) reaction to the PIIMBY (Put It In My Back Yard) reaction.

Waste storage poses a particularly thorny problem for nuclear power, as some of the most toxic products remain a threat to health for hundreds of thousands of years. The United States has not pursued reprocessing as aggressively as some other countries have; instead, the United States has pursued an underground storage strategy and developed one such facility at Yucca Mountain, Nevada, which has yet to be put into operation.

Waste storage is a show-stopper for nuclear power. Much of the opposition to this fuel stems from waste. In our sample, only 28 percent agreed with the statement of "nuclear waste could be stored safely for long periods of time." Two-thirds of the sample said that they would support a significant expansion of nuclear power "if there were effective waste storage." Unfortunately, only 19 percent thought that Yucca Mountain should be used without further delays and another 25 percent would agree to its use "only if the state of Nevada assents." Deep boreholes, a more speculative storage solution, were either supported outright or "worth consideration" according to 40 percent of the respondents, but 35 percent opposed the idea and another 25 percent were not sure.

Surprisingly, reprocessing proved highly *popular*. The survey explained that reprocessing is used in France, Japan, and elsewhere, and that this means of recycling fuel reduces the lifespan of the most toxic wastes from 100,000 years to 1,000 years. Sixty percent of the sample said that they supported the expansion of the Department of Energy's reprocessing program, and half of the sample said that they would support a significant expansion of nuclear energy in the United States if the country reprocessed its fuel.

The presentation of reprocessing to the respondents did not discuss plutonium and proliferation. The final pair of energy questions in the survey asked about technology transfers as way of getting at concern about proliferation of nuclear technologies. The two questions asked whether the respondent would support the U. S. government in allowing American firms to sell nuclear technologies to countries that already have nuclear weaponry, such as India, and whether they supported sale of nuclear technology to countries that do not yet have that technology. Respondents disapproved of both proposals overwhelmingly.

# Explaining Preferences

Our analysis of energy preferences in 2002 found that perceived costs and environmental harms shape public attitudes about energy alternatives. I measured the effects of perceived attributes two ways. First, I used perceptions of costs and harms to predict preferences about future deployment of specific energy sources. Second, I implemented an experiment within the survey in which one half of the sample was provided no information and one half was provided information about costs or environmental harms.

Differences across these groups provide further information about sensitivity of consumers to the costs and harms of energy sources.

The relationship between preferences about future use and perceptions of cost and harms is shown in Table 6. Each column presents the results of a regression analysis in which the answers to questions ascertaining perceived costs and harms are used to predict answers to questions about which fuels the respondent preferred expanding or contracting. The main entries (larger font) are regression coefficients. In parentheses below each coefficient is the standard error. A statistically significant relationship is one in which the absolute value of the coefficient is at least two times the standard error. The interpretation of the coefficients is the change in the dependent variable for a unit change in the specific independent variable, holding other factors constant. I will focus on the effects of perceived harms and costs.

The dependent variables in the analyses shown in Table 6 are the preferences about future expansions and reductions of each energy source. Each consists of a 6-point scale running from 0 (do not use at all) to +5 (increase a lot). These are the variables presented in Table 1. The key independent variables of interest are two five-point scales: 'perceived costs,' which runs from –2 (very expensive) to +2 (very cheap), and 'perceived harm,' which runs from –2 (very harmful) to +2 (not harmful at all). These are presented in Table 3.

The analysis includes other variables to capture sensitivity to costs and harm. Other measures of sensitivity to electricity costs are the respondent's income, which takes values ranging from 1 (less than $15,00) to 17 (more than $175,00), and the respondent's estimated monthly electricity bill, which has a minimum value of 1 for less than $10 and a maximum value of 14 for over $200. The survey also asked the seriousness of Global Warming --- i.e., it requires immediate action, governments should take a more cautious approach, more research is needed, or it is not a problem. Responses to this question are captured in Global Warming Real. Willingness to Pay captures the amount the respondent is willing to pay each month to reduce global warming and reflects both price sensitivity and environmental concern. Taken into account are several variables that capture perceptions of nuclear technology in particular, including whether the respondent believes that waste can be stored safely, how likely a nuclear accident is in the next 10 years, and whether the respondent approves of the sale of nuclear technology to other countries (a key factor in proliferation). Finally, the analyses controlled for the respondent's income, education, and region of the country. Three categorical variables capture three of the four regions, with the South left as the comparison group.

Perceived harms and costs strongly predict preferences about energy sources, as was the case with the 2002 study. In fact, the results of the 2007 strongly resemble the patterns evident five years ago. Perceived environmental harms very strongly predict preferences concerning energy alternatives; costs also shape preferences, but their effects are secondary to perceived harms.

Table 6. Explaining Preferences About Expansion and Reduction of Fuel Sources

| | Preferences About Future Growth of Each Fuel In order to meet growing electricity demand | | | | | | |
|---|---|---|---|---|---|---|---|
| | Coal | Gas | Nuclear | Oil | Dams | Wind | Solar |
| Perceived Harm | **.67** | **.31** | **.65** | **.31** | **.37** | **.48** | **.39** |
| (1 to 5: High to None) | (.04) | (.05) | (.05) | (.04) | (.05) | (.07) | (.06) |
| Perceived Cost | **.11** | **.22** | **.13** | **.15** | **.17** | **.13** | **.11** |
| (1 to 5: Expensive to Cheap) | (.04) | (.06) | (.05) | (.05) | (.05) | (.05) | (.04) |
| Global Warming Concern | -.03 | .08 | .03 | -.05 | .12 | .10 | .13 |
| | (.06) | (06) | (.06) | (.05) | (.06) | (.06) | (.05) |
| Willingness to Pay | -.05 | -.04 | -.04 | -.07 | -.03 | .05 | .04 |
| (0 to 10: $0 to $100/mo) | (.02) | (.02) | (.03) | (.02) | (.02) | (.02) | (.02) |
| Electric Bill | .02 | -.03 | -.01 | .00 | -.04 | -.03 | -.04 |
| | (.02) | (.03) | (.02) | (.02) | (.03) | (.03) | (.02) |
| Nuclear Waste | .02 | .03 | -.13 | .07 | .10 | .09 | .07 |
| (1 to 5: Safe Store to Not) | (.04) | (.05) | (.05) | (.04) | (.05) | (.05) | (.05) |
| Allow Nuclear Tech. Sales | -.06 | -.07 | .04 | -.03 | -.09 | -.20 | -.18 |
| | (.04) | (.05) | (.05) | (.04) | (.05) | (.05) | (.04) |
| Nuclear Accident Likely | .04 | .03 | -.04 | .04 | -.02 | .05 | .00 |
| | (.04) | (.05) | (.05) | (.04) | (.05) | (.05) | (.04) |
| Income | .01 | .04 | .04 | .01 | .03 | .05 | .04 |
| (1 to 17) | (.01) | (.01) | (.01) | (.01) | (.01) | (.01) | (.01) |
| Education | .04 | .06 | .13 | .01 | .05 | .18 | .11 |
| | (.04) | (.06) | (.06) | (.05) | (.05) | (.06) | (.05) |
| NE v. South | -.14 | -.20 | -.10 | -.17 | -.29 | -.21 | -.21 |
| | (.13) | (.14) | (.14) | (.13) | (.14) | (.15) | (.13) |
| MW v. South | -.16 | -.06 | -.02 | -.11 | -.26 | -.27 | -.16 |
| | (.11) | (.13) | (.13) | (.11) | (.13) | (.13) | (.12) |
| West v. South | -.17 | .18 | .01 | -.08 | -.21 | -.15 | -.11 |
| | (.12) | (.14) | (.14) | (.12) | (.13) | (.14) | (.12) |
| Intercept | .19 | 1.07 | .04 | .77 | 1.40 | .63 | 1.58 |
| | (.28) | (.31) | (.31) | (.27) | (.35) | (.43) | (.36) |
| R-squared | .45 | .18 | .53 | .20 | .18 | .23 | .23 |
| MSE | .99 | 1.11 | 1.12 | 1.00 | 1.22 | 1.16 | 1.02 |

N=523 (control group from experiment only)

Consider the case of nuclear power. The coefficient on environmental harm is .65. A unit difference in perceived harm corresponds to a difference in support for expansion of the technology of approximately two-thirds of a point. The difference between someone who sees nuclear as very harmful and someone who sees it as not harmful at all translates into a difference of 2.5 points in terms of future expansion, roughly the difference between wanting to reduce nuclear somewhat and wanting to expand it a lot. The coefficient on cost is .13. The difference between someone who views nuclear power as very cheap and someone who sees it as very expensive corresponds to about one-half of one point on the support scale.

Examining the analyses of all of the fuels reveals that perceived environmental harm accounts for most of the systematic difference explained in the analysis. The effects are particularly pronounced for coal and nuclear power and, are weakest for oil and gas. Even for oil and gas, perceived environmental harm has the strongest effect on preferences. The difference between seeing these fuels as very harmful versus not harmful at all translates into a 1.5 point difference on the scale of support for expansion of the use of the fuel.

Perceived costs have more modest effects, but are still quite important. The effects of perceived costs are also more uniform. The coefficients range from .11 to .22, meaning that the difference between "very cheap" and "very expensive" translates into a difference of support of one-half to one full point on the scale.

Perhaps the most alarming results in the analysis concern global warming. As we discovered in 2002, concern about global warming has very little relationship to citizens' energy preferences. Public attention to this issue has risen dramatically over the past five years and it is beginning to drive national policy-making. However, the connection between electricity generation and global warming in the public's opinion remains a remote one.

Two measures capture the effects of global warming on energy attitudes. Concern About Global Warming has a statistically significant effect on preferences only for hydroelectric power generation, and the effect is substantively small. Willingness to pay proved more substantial. In most of the regression analyses, willingness to pay positively correlates with preferences. The association is negative and statistically significant for the fossil fuels (coal, gas, and oil) and positive for solar and wind. The correlations are not significant for nuclear or hydroelectricity (and are negative in both cases). In all instances the effects are modest. The difference between someone willing to pay $100 per month to solve global warming and someone willing to pay nothing is just seven-tenths of a point in support of wind or solar and 5-tenths of a point against coal or oil.

Nuclear power's other attributes – waste, safety, and proliferation – also had noticeable effects on support for that technology. The effects were comparable to the effects of perceived cost, but much smaller than perceived environmental harm. Interestingly, nuclear waste, safety, and proliferation also mattered to people's support for wind and

solar. Those who saw these as liabilities for nuclear power were more likely to support wind and solar power than those who did not see these as problems.

Lastly, demography shapes public support for energy sources. Those with higher levels of income and education support more of every power source – on average they want accelerated energy growth compared with poorer or less well educated people. The effects of income and education were particularly pronounced for wind, solar, and nuclear power. Region had slight effects. Those in the South are much more supportive of expansion of all fuel sources, but the difference across regions, other things constant, is just two-tenths of a point on the 6 point scale.

Experiments provide another way to measure sensitivity to costs and environmental harm. In 2002 we experimented with the sample by providing randomly chosen subsets of respondents different sorts of information. Environmental information had little effect, but cost information proved quite influential. People greatly underestimate the true cost of electricity from solar and wind and over estimate the cost of coal power. Upon providing that information, we observed a large shift in support for the energy sources. Support for solar and wind dropped substantially while natural gas and coal were viewed more favorably. I replicated the cost experiment in 2007, and the results closely parallel the 2002 findings.

The experiment consisted of a statement presented to the survey respondents as a lead in to the questions that ascertained preferences regarding future energy use. The sample was divided randomly into three groups. Half of the sample (615 people) was in the Control group. One quarter of the sample (308) was randomly assigned to Treatment Group A, and one quarter (333) was randomly assigned to Treatment Group B. The two treatment groups differed only in the information presented about the cost of Nuclear power.

Control Group (half of sample): No Information

Treatment Group A (quarter of sample):

> *The International Energy Agency, the world's leading source of information about energy resources, has estimated the cost of a typical month of electricity for a family of 4 in the US for different power sources.*
>
> *From cheapest to most expensive their estimates are:*
>
> | | |
> |---|---|
> | *Coal* | *$100* |
> | *Natural Gas* | *$125* |
> | *Nuclear* | *$150* |
> | *Oil* | *$200* |
> | *Wind* | *$250* |
> | *Dams* | *$300* |
> | *Solar* | *$400* |

Treatment Group B (quarter of sample):

> *The International Energy Agency, the world's leading source of information about energy resources, has estimated the cost of a typical month of electricity for a family of 4 in the US for different power sources.*
>
> *From cheapest to most expensive their estimates are:*
>
> | | |
> |---|---|
> | *Coal* | *$100* |
> | *Nuclear* | *$100* |
> | *Natural Gas* | *$125* |
> | *Oil* | *$200* |
> | *Wind* | *$250* |
> | *Dams* | *$300* |
> | *Solar* | *$400* |

Table 7 presents the effects of the experiment. For all but nuclear power I combine the two treatments (there were no significant differences between the two treatment groups, validating the independence of the response to the alternatives). The first column presents the average preference among those in the control group. Again, values less than 3 mean that people want to reduce the use of that energy source, and values above 3 mean that people want to expand the use of that fuel. The second column presents the average preference among those in the treatment groups. The last row of the table separates the two treatment groups. The last column is the effect of the experiment – the difference between the mean in the control group and the mean in the treatment group.

Table 7. Effects of Cost Information on Average Level of Support for Energy Options

Dependent Variable: Preferred Growth of Energy Source [See Table 1]

| Type of Fuel | GROUP | | | | |
|---|---|---|---|---|---|
| | CONTROL | TREATMENT | | EFFECT | |
| COAL | 2.19 | 2.61 | | .42 | |
| NATURAL GAS | 2.84 | 3.06 | | .22 | |
| OIL | 1.85 | 2.00 | | .15 | |
| HYDRO ELECTRIC | 3.36 | 3.19 | | -.17 | |
| SOLAR | 4.40 | 3.80 | | -.60 | |
| WIND | 4.36 | 3.88 | | -.48 | |
| | | T-A | T-B | A | B |
| NUCLEAR | 2.47 | 2.76 | 2.89 | .29 | .42 |
| Number of Cases | 615 | 308 | 333 | | |

One important piece of statistical information not displayed is the standard deviation. The standard deviations associated with the distributions are in the range 1.1 (for natural gas, oil, and dams) to 1.3 (for coal, solar, and wind). The widest spread in the distribution is for nuclear power, which is about 1.5. The standard deviation changes noticeably for two fuels. It falls for nuclear power, dropping from 1.6 in the control group to 1.4 in treatment B. It rises for solar power, increasing from 1.1 among the control group to 1.36 in the treatment group. Using these standard deviations and the sample sizes one can calculate t-statistics to test the differences in means. All of the effects in the table are statistically significantly different from zero.

Interpretation of the effects of the experiment depends on people's prior beliefs about the costs of different energy sources. At a coarse level, I expected the experiment to lower support for solar, wind, and hydroelectric power and raise support for coal, natural gas, nuclear power, and oil. As revealed in Table 3, wind, solar, and hydroelectric power are widely viewed as somewhat or very cheap, even though these are the most expensive fuels. Coal, natural gas, oil, and nuclear power are considered moderately priced to somewhat expensive, even though these are the least expensive alternatives. On average, then, the experiment ought to have aligned perceived costs with reality. The regression analyses (both in 2007 and 2002) show that preferences respond to perceived pricing. To the extent that costs affect preferences, then, the experiment should have shifted support for each of the fuels. The shifts conformed to this general conjecture.

Coal is viewed, on the whole, as moderately priced (average value in Table 3 of 3.0) but is shown to be very cheap. The experiment raised support for coal the most. Nuclear power exhibited a similar rise in support. People see nuclear power as somewhat expensive (average value of 2.3 in Table 3). Treatment A revealed nuclear power to be Moderately priced to Somewhat cheap (depending on interpretations), and support for nuclear power rose .3 points. Treatment B revealed nuclear power to be very cheap and support rose over .4 points. Natural gas and oil experienced more modest gains, of .22 and .15, respectively.

Price information in line with the realities of electricity generation substantially lowered support for the alternative energy sources – dams, wind, and sunlight. The information provided reflected national averages, and some local areas will surely differ from these values. I used information distributed by EIA to calculate the average price differential from coal. The result was a very substantial increase in price over what the average person perceives from these sources. The public sees hydroelectricity and solar power as somewhat cheap and wind power as very cheap. The experiment placed all three in the category of very expensive. As a way of calibrating the magnitude of the differential, the prices of wind, hydro, and solar exceeded the highest value in the willingness to pay scale.

Support for all three fell substantially in response to the price information. Support for wind dropped four-tenths of a point and solar fell six-tenths of a point. Support for wind fell one-tenth of a point.

Are these shifts in support in line with the regression analyses? Some degree of calibration of the two is possible, depending on the interpretation of expressions such as "Very Expensive." My subjective assessment of the experimental manipulation is that it moved beliefs about prices as follows. Coal: from Moderate to Very Cheap. Natural Gas: from Somewhat Expensive to Moderate. Oil: from Expensive to Somewhat Expensive. Dams: from Somewhat Cheap to Very Expensive. Solar: from Somewhat Cheap to Very Expensive. Wind: from Very Cheap to Very Expensive. In numerical terms, the experiment changed assessments of coal prices -2 units, gas prices -1 unit, oil prices -1 unit, nuclear –2 or –3 (if Treatment A or B), dams and solar + 3 units each, and wind + 4 units in cost.

Using this subjective interpretation allows a mapping of the experiment into the regression analysis. The analysis suggests that for most of the fuels, the regression model underestimates the effect of perceived prices. Consider coal. The slope coefficient on perceived cost is .11. A movement of two units would imply an increase in support for expansion of coal of +.2 on the scale from 0 to 5. However, the experiment produced a difference of +.4, which would imply a marginal effect of price information that is approximately twice as large as estimated.

Analysis of the other fuels reveals that the regression estimates are about right for the traditional fuels and for wind power, but too low for solar and too high for hydroelectricity. In the case of nuclear power, changes in perceived costs of 2 and 3 units, for Treatments A and B respectively, should have led to increases in support for this power source of approximately .3 and .4 points. That is approximately the value of the observed experimental effect. Oil prices should have led to a shift of a little more than one-tenth of one percent, and the observed experimental effect is .15. The regression coefficient for natural gas is .31 and the change in price information is approximately 1 unit; the observed experimental effect is .22, slightly below expectations. The experimental effect for wind was an increase in perceived prices from Very Cheap to Very Expensive, 4 units. The coefficient of .13 predicts an experimental effect of lower support for wind of .52. The experiment produced a decrease of .48 points.

Solar seems to be the bookend for coal in the study. Not only is solar viewed as the clean alternative, but the experiment also showed equally high price sensitivity. A move of 3 points in the cost schedule should have decreased support for solar by .33 points. Instead, the experiment produced a drop of fully .6 points. In one case, hydroelectricity, the experiment produced an effect smaller than expected. The regression estimates predict an effect of approximately .5, but the experiment lowered support for hydro by only .17 points. Some exceptions are to be expected, just by chance.

Overall, though, the experiment seems to have confirmed the regression analysis or suggests that the estimated effects of perceived costs are a bit too low.

As a matter of public policy, this analysis underscores the lesson from the earlier survey reported in the *Future of Nuclear Energy*. Public support for energy sources is highly dependent on perceived environmental harms and economic costs. Movements in costs of

oil and gas have lowered support for those energy sources. Efforts by government and industry to reduce environmental impacts of specific energy sources can have dramatic effects on support for power sources. This seems to be particularly true for nuclear power and coal. The public is highly responsive to cost information, either shaped by public education campaigns or by actual industrial performance. In this regard, support for solar, wind, and hydroelectricity seems especially soft and likely to erode quickly if there is a significant attempt to deploy any of these technologies without improvements that reduce the cost of providing electricity through these means.

# Nuclear Waste, Safety, and Proliferation

Nuclear energy production has many specific attributes that affect its deployment and public acceptance. The three most prominent are waste management and storage, safety, and proliferation. The survey asked about all three facets of nuclear energy in light of recent technology and policy developments. Most of the focus was on waste management as that, along with cost, is seen as the critical obstacle to further development of this technology, at least in the United States.

*Waste.* The design of the survey examined three facets of the waste problem – its prominence in the public's attitude toward nuclear power, views about current waste management policy, especially Yucca Mountain, and opinions about reprocessing.

A very large majority of the public would support an expansion of nuclear power if the waste problem were solved. [See Q20 in the appendix.] Fully a quarter of the sample said they would definitely support an expansion with the solution of the waste issue and another 40 percent would support but with reservations. The question, then, is what sorts of solutions the public would support.

The centerpiece of U.S. national policy regarding nuclear waste is the planned waste storage facility at Yucca Mountain, Nevada. Slightly fewer than one in five respondents felt that the nation should definitely use this facility. Another 25 percent would allow the project to proceed but "only if the state of Nevada agrees." A plurality of respondents (39 percent) thought we should not use the facility at all. There is still some room for debate on the issue, as 26 percent of respondents were not sure what they thought. However, the numbers do not look good.

Storage near nuclear plants may offer an interesting alternative. We asked about a particular proposal, storage in deep boreholes near existing nuclear facilities. Forty percent thought this idea is worth considering or definitely deserving support, compared with 35 percent opposing the idea. Again a quarter of the sample was unsure what they thought.

It bears noting that on all three questions – expansion of nuclear power if the waste problem were solved, Yucca Mountain, and distributed storage – support increases with education. The lowest educated people are most likely to have no opinion and most likely

to oppose these proposals. A majority of those with at least a college education give at least provisional support to Yucca Mountain and favor the further consideration of the distributed storage ideas such as boreholes. The correlation between education and support for these policy proposals suggests some cause for optimism about the development of waste storage solutions, as these correlations may reflect a correlation between knowledge about the options and support for them.

Reprocessing represents an alternative path to the development of nuclear technology. The report *The Future of Nuclear Power* discusses a number of the drawbacks of the deployment of this technology in the United States and reflects unease among many experts in the U. S. about reprocessing. The American public, however, likes the idea.

We asked both about the current DOE proposals to introduce a large reprocessing facility in the United States and whether the respondent would support "a significant expansion of nuclear power" if waste were reprocessed. [Q23 and Q24 in the appendix.] Strong majorities offered their support in both cases. Fifty-two percent support the DOE program, with just 15 percent opposed; the remaining have no opinion. Fifty-three percent would favor or strongly favor a significant expansion of nuclear power if the country reprocessed its fuel, while only 21 percent opposed the idea.

One caution about these results is in order. Public support may not reflect the correct understanding of the technology, especially cost and toxicity of reprocessing facilities. Additional survey research is in order to probe those questions, but these results do suggest receptiveness to reprocessing at least in principle.

*Safety*. In the wake of accidents at Three Mile Island and Chernobyl, public opinion research has focused on the perceived risks associated with electricity production from nuclear power plants. Much of this research has documented the apparent exaggerated perception of the likelihood of a serious accident. The survey in 2002 and 2007 measured these perceptions with the following question.[1]

> *There are approximately 100 nuclear power plants in the United States. There was a serious accident at Three Mile Island in 1979. How likely do you think it is that in the next 10 years there will be a serious accident at a nuclear power plant?*

The public continues to view a serious accident as more likely than not. Slightly more than 30 percent of the sample felt that an accident was very likely or almost certain; 28 percent thought an accident somewhat likely; and 26 percent thought that an accident would be unlikely or almost certain not to occur. Fifteen percent were unsure or gave no answer.

Safety, however, is not nearly as important as waste storage, cost, and general environmental harm in explaining preferences about nuclear power. As is borne out in

[1] At the suggestion of Richard Lester the 2007 survey included the statement that there was a serious accident at TMI in 1979.

Table 6, perceived likelihood of an accident has no effect on preferences about the expansion or contraction of nuclear power, holding other perceptions and attitudes constant. Cost, general environmental harm, and waste management – and not safety— are first order factors in explaining public attitudes about nuclear power today.

*Technology Transfer and Proliferation.* Management of the fuel cycle presents a separate set of issues beyond questions of expansion or contraction of nuclear power. Without any further investment in nuclear power plants in the United States, American firms that develop nuclear power plants may still find a large and profitable market overseas. The U. S. government has a strong national security interest in restricting export of sensitive nuclear technology, especially to prevent the spread of weapons technology. Non-proliferation of weapons is a general objective of U. S. foreign policy, and the relevant concern for the public is whether specific sorts of agreements and activities are to be tolerated within that objective.

The year before the survey was conducted, the United States government announced a new agreement with India to allow American firms to sell nuclear power technology to that country. The agreement raises two separate issues. First, India has not agreed to the Nuclear Non-Proliferation Treaty, and the sale of technology to non-signators has been criticized as a violation of the spirit of the accord. Second, the agreement raised the general question of whether United States companies need to compete in markets, even where nuclear weapons technology has not yet been developed.

The survey asked about both facets of this issue. Specifically we asked the following two questions.

> *Recently the United States Government agreed to allow U. S. companies to sell nuclear power plant technology to India. India already has the knowledge to make nuclear bombs, but it has not signed the international agreement to prohibit the spread of nuclear bomb know-how. Do you support or oppose the sale of nuclear technology to India?*
>
> *Other countries allow their companies to sell nuclear power plants and technology to countries that do not yet have nuclear weapons. Should the United States government allow U. S. companies to do so as well?*

Americans overwhelmingly rejected both proposals. Seventy percent of respondents opposed (strongly or somewhat) the agreement with India. Sixty-three percent of respondents opposed sale of technology to countries that do not yet have nuclear technology. Beyond the specific aspects of the particular agreement, the overwhelming public objection to either sort of policy suggests that non-proliferation remains a deep concern of the American public and should remain a high priority in U. S. foreign policy.

# APPENDIX

QUESTIONNAIRE

Q1. How would you describe the community that you live in?

A large city ..... 1
A suburb of a large city ..... 2
A medium sized city ..... 3
A suburb or a medium sized city ..... 4
A small city ..... 5
A suburb of a small city ..... 6
A town ..... 7
A rural area ..... 8

Q2. What is the most important problem facing the United States today?

Immigration ..... 1
Crime ..... 2
Pollution of water and air ..... 3
Unemployment and Jobs ..... 4
Global Warming ..... 5
Low wages ..... 6
Poverty ..... 7
Corruption in Government ..... 8
Taxes ..... 9
Government Spending ..... 10
Federal Budget Deficit ..... 11
Inequality ..... 12
Family Values ..... 13
Energy ..... 14
Inflation ..... 15
Health care ..... 16
Social Security ..... 17
Drugs ..... 18
Racism ..... 19
Iraq ..... 20
Terrorism ..... 21
AIDS ..... 22
Inflation ..... 23
Abortion ..... 24
Other ..... 24

Q3. Which of the following captures your general opinion?

Environmental regulations in this country are …..

Are Much Too Strong ..... 1
Are Too Strong ..... 2
Are About Right ..... 3
Need to be Somewhat Stronger ..... 4
Need to be Much Stronger ..... 5

Q4. Which is the most important environmental problem facing the U. S. today?

Toxic waste ..... 1
Ozone depletion ..... 2
Endangered species ..... 3
Acid Rain ..... 4
Global Warming ..... 5
Smog ..... 6
Urban Sprawl ..... 7
Water pollution ..... 8
Overpopulation ..... 9
Destruction of ecosystems ..... 10

**[Q4=1..10; REMOVE ANSWER SELECTED IN Q4]**
Q4B. Of the remaining environmental problems below, which is the most important problem facing the US today?

Toxic waste ..... 1
Ozone depletion ..... 2
Endangered species ..... 3
Acid Rain ..... 4
Global Warming ..... 5
Smog ..... 6
Urban Sprawl ..... 7
Water pollution ..... 8
Overpopulation ..... 9
Destruction of ecosystems ..... 10

**[NUMBER BOX; RANGE 0-999999]**
**[TWO CHECK BOXES; ALLOW ONLY ONE RESPONSE]**
Q5. Approximately how many miles do you put on your vehicle each year? Please make your best guess

_____ Miles
__ I don't drive

__ I do not know

Q6. Approximately how much did you pay for electricity last month?

Under $25 ..... 1
$25 to $50 ..... 2
$50 to $75 ..... 3
$75 to $100 ..... 4
$100 to $125 ..... 5
$125 to $150 ..... 6
$150 to $200 ..... 7
Over $200 ..... 8
I do not know ..... 9

Q7. If it solved global warming would you be willing to pay $5 more a month on your electricity bill?

Yes ..... 1
No 2

Q7A. If yes, would you be willing to pay $10 more a month on your electricity bill?

Yes ..... 1
No 2

*Q7B. If yes, would you be willing to pay $15 more a month on your electricity bill?*

Yes ..... 1
No 2

*Q7C. If yes, would you be willing to pay $25 more a month on your electricity bill?*

Yes ..... 1
No 2

*Q7D. If yes, would you be willing to pay $50 more a month on your electricity bill?*

Yes ..... 1
No 2

*Q7E. If yes, would you be willing to pay $75 more a month on your electricity bill?*

Yes.....1
No 2

*Q7F. If yes, would you be willing to pay $100 more a month on your electricity bill?*

Yes.....1
No 2

Q5. There is a lot of talk about global warming caused by carbon dioxide emissions from human activities. Which of the following do you think best describes your view?

Immediate and drastic action is necessary. .....1
We should take some action now. .....2
More research is needed before action is taken. .....3
This is not a serious problem.....4

**[INTRO: DISPLAY]**
We'd like you to now consider different ways that we produce energy in the United States.

**[GRID]**
Q8. Some ways of generating electricity may be harmful to the environment we live in. How harmful do you think each of these power sources is?

| | Very Harmful | Moderately Harmful | Somewhat Harmful | Slightly Harmful | Not Harmful At All | Not Sure |
|---|---|---|---|---|---|---|
| Coal | o | o | o | o | o | o |
| Natural Gas | o | o | o | o | o | o |
| Nuclear | o | o | o | o | o | o |
| Dams | o | o | o | o | o | o |
| Oil | o | o | o | o | o | o |
| Solar | o | o | o | o | o | o |
| Wind | o | o | o | o | o | o |

**[GRID]**
Q9. We would like you to think about the costs of producing electricity of different sources of electricity. How expensive do you think it is to produce electricity with each of the following fuels?

| | Very Expensive | Somewhat Expensive | Moderately Priced | Somewhat Cheap | Very Cheap | Not Sure |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Coal | o | o | o | o | o | o |
| Natural Gas | o | o | o | o | o | o |
| Nuclear | o | o | o | o | o | o |
| Dams | o | o | o | o | o | o |
| Oil | o | o | o | o | o | o |
| Solar | o | o | o | o | o | o |
| Wind | o | o | o | o | o | o |

**[STOP RESPONDENTS FROM GOING BACK AT THIS POINT]**

**Split Sample Version of intro before Question 10**:
**At this point the sample is randomly divided into 3 groups. Two groups are told the projected cost of electricity from different sources. One group is provided no information. Create variable:**

**GROUP**
**0 – ½ of sample**
**A – ¼ of sample**
**B – ¼ of sample**

**[GROUP A INTRO: DISPLAY]**
**[GROUP=A]**
The International Energy Agency, the world's leading source of information about energy resources, has estimated the cost of a typical month of electricity for a family of 4 in the US for different power sources.

From cheapest to most expensive their estimates are:

| | |
|---|---|
| Coal | $100 |
| Natural Gas | $125 |
| Nuclear | $150 |
| Oil | $200 |
| Wind | $250 |
| Dams | $300 |
| Solar | $400 |

**[GROUP B INTRO: DISPLAY]**
**[GROUP=B]**
The International Energy Agency, the world's leading source of information about energy resources, has estimated the cost of a typical month of electricity for a family of 4 in the US for different power sources.

From cheapest to most expensive their estimates are:

| | |
|---|---|
| Coal | $100 |
| Nuclear | $100 |
| Natural Gas | $125 |
| Oil | $200 |
| Wind | $250 |
| Dams | $300 |
| Solar | $400 |

**[GRID]**

Q10. Consumers, such as you, have more and more say in how electricity is produced in the United States.

To make more electricity to meet the country's needs over the next 25 years, new power plants will have to be built. Companies and government agencies need to start planning today. How should we meet this demand? For each power source indicate whether you feel the U.S should increase or reduce its use, or not use at all.

| | Reduce A Lot | Reduce Somewhat | Keep Same | Increase Somewhat | Increase A Lot | Not Use At All |
|---|---|---|---|---|---|---|
| Coal | o | o | o | o | o | o |
| Natural Gas | o | o | o | o | o | o |
| Nuclear | o | o | o | o | o | o |
| Dams | o | o | o | o | o | o |
| Oil | o | o | o | o | o | o |
| Solar | o | o | o | o | o | o |
| Wind | o | o | o | o | o | o |

**[GRID]**

Q11. Regardless of whether you want more of any particular fuel source, how much do you think the U. S. <u>will</u> rely on each of the following fuels for electricity over the next 10 years?

| | A Lot (More than 25% of electricity) | Some 10-25% | Not Much 5-10% | Very Little Less than 5% |
|---|---|---|---|---|
| Coal | o | o | o | o |
| Nuclear | o | o | o | o |
| Natural Gas | o | o | o | o |
| Oil | o | o | o | o |
| Dams | o | o | o | o |
| Renewables (Solar, Wind) | o | o | o | o |

Q12. To meet new electricity demand, utilities will have to build additional power plants. How would you feel if a new natural gas fired power plant were built within 25 miles of your home?

Strongly Oppose .....1
Somewhat Oppose.....2
Support .....3
Strongly Support .....4

Q13. How would you feel if a new coal-fired power plant were built within 25 miles of your home?

Strongly Oppose .....1
Somewhat Oppose.....2
Support .....3
Strongly Support .....4

Q14. How would you feel if a new nuclear power plant were built within 25 miles of your home?

Strongly Oppose .....1
Somewhat Oppose.....2
Support .....3
Strongly Support .....4

Q15. How would you feel if a large wind power facility (with 100 250-foot towers) were built within 25 miles of your home?

Strongly Oppose .....1
Somewhat Oppose.....2
Support .....3
Strongly Support .....4

**[RANDOMLY FLIP REPONSE LIST – ALWAYS KEEP NOT SURE LAST]**

Q16. There are approximately 100 nuclear power plants in the United States. There was a serious accident at Three Mile Island in 1979. How likely do you think it is that in the next 10 years there will be a serious accident at a nuclear power plant?

Almost certainly will happen, .....1
Very likely, .....2
Somewhat likely, .....3
Somewhat unlikely, .....4
Very unlikely, .....5
Almost certainly will not happen .....6

Not sure .....7

**[Q17PRE: DISPLAY]**
Coal is a major source of carbon dioxide emissions, which scientists have concluded contribute to global warming. One technology, called carbon capture and sequestration, takes the carbon dioxide out of coal and pumps this gas under ground caverns. This technology would increase the price of electricity by approximately $50 per month but it would cut almost all greenhouse gas emissions from coal.

Q17. Would you support use of this technology to cut greenhouse gas emissions even if electricity prices went up?

Strongly Support .....1
Support Somewhat.....2
Oppose Somewhat.....3
Oppose Strongly .....4
Neither Support Nor Oppose.....5

Q18. If carbon dioxide were pumped deep under ground within 25 miles of your home would you support or oppose such a facility?

Strongly support.....1
Support somewhat .....2
Oppose somewhat .....3
Strongly oppose .....4
Neither Support Nor Oppose.....5
Not Sure.....6

**[INTRO: DISPLAY]**
Nuclear power plants produce no greenhouse gases. Nuclear power plants do produce a small amount of highly dangerous radioactive waste. This waste slowly loses its toxicity over a span of 100,000 years.

Q19. Do you agree or disagree with the following: Nuclear waste can be stored safely for many years.

Strongly Agree .....1
Agree .....2
Disagree.....3
Disagree Strongly.....4
Not Sure.....5

Q20. If there were a safe and effective way to deal with nuclear waste would you support a significant expansion of nuclear power to meet future energy needs?

Yes, Definitely ..... 1
Yes, but with reservations ..... 2
Probably Not ..... 3
Definitely Not ..... 4
Not Sure ..... 5

**[Q21PRE; DISPLAY]**
Currently spent nuclear waste is stored above ground at nuclear facilities, until the U. S. has a long-term storage plan. The United States Department of Energy has prepared a long-term underground storage facility in Yucca Mountain, Nevada. Objections from the state of Nevada and some experts have slowed down the development of this facility.

Q21. Do you think the United States should complete and use this facility to store spent nuclear waste underground?

Yes, definitely ..... 1
Yes, but only if the state of Nevada agrees ..... 2
No, the federal government needs to find another site ..... 3
No, because we shouldn't have such a facility ..... 4
Not Sure ..... 5

Q22. A recent proposal from nuclear scientists is to bury waste permanently in holes drilled deeply into the Earth's crust, where no water flows. The pressure of the earth would keep the waste locked in place. Do you think such dispersed storage is a good idea?

Yes, Definitely ..... 1
Worth Considering ..... 2
Probably Should Not Do ..... 3
Definitely Not ..... 4
Not sure ..... 5

**[Q23PRE; INTRO]**
France and Japan recycle their nuclear fuel using a method called reprocessing. Reprocessing makes electricity from nuclear power a little more expensive but it reduces the time it takes waste to become harmless from 100,000 years to as little as 1,000 years.

Q23. The Department of Energy is considering a large effort to introduce reprocessing in the United States. Do you support or oppose such an effort?

Support strongly ..... 1
Support somewhat ..... 2
Oppose somewhat ..... 3
Oppose strongly ..... 4

Not Sure.....5

Q24. Would you support a significant expansion of nuclear power if the United States reprocessed all of its nuclear fuel?

Support strongly.....1
Support somewhat.....2
Oppose somewhat.....3
Oppose strongly.....4
Not Sure.....5

Q25. There is a lot of talk about global warming caused by carbon dioxide emissions from human activities. Which of the following do you think best describes your view?

Immediate and drastic action is necessary.....1
We should take some action now.....2
More research is needed before action is taken.....3
This is not a serious problem.....4

Q26. Recently the United States Government agreed to allow U. S. companies to sell nuclear power plant technology to India. India already has the knowledge to make nuclear bombs, but it has not signed the international agreement to prohibit the spread of nuclear bomb know-how.

Do you support or oppose the sale of nuclear technology to India?

Strongly oppose.....1
Oppose somewhat.....2
Support somewhat.....3
Strongly Support.....4
Not Sure.....5

Q27. Other countries allow their companies to sell nuclear power plants and technology to countries that do not yet have nuclear weapons. Should the United States government allow U. S. companies to do so as well?

Yes, definitely.....1
Yes, but with reservations.....2
Probably not.....3
No, definitely not.....4
Not sure.....5

Q28. In politics do you consider yourself to be a Democrat, Republican, another partisan, or a non-partisan?

| | |
|---|---|
| Republican | 1 |
| Democrat | 2 |
| Green | 3 |
| Reform | 4 |
| Other (please specify) | 5 |
| No Party | 6 |