UNIVERSITY OF MICHIGAN ENERGY SURVEY: YEAR ONE REPORT

PREPARED BY (ALL UNIVERSITY OF MICHIGAN):

John DeCicco
Research Professor
University of Michigan Energy Institute

Ting Yan
Research Assistant Professor, Program Methodology
Institute for Social Research

Florian Keusch
Postdoctoral Research Fellow, Program Methodology,
Institute for Social Research

Diego Horna Muñoz
Graduate Research Assistant
Institute for Social Research

Lisa Neidert
Senior Research Associate, Population Studies Center
Institute for Social Research
ACKNOWLEDGEMENTS

The University of Michigan Energy Survey is a joint project of the University of Michigan Energy Institute (UMEI) and Institute for Social Research (ISR). This report’s authors constitute the researcher team primarily responsible for developing the survey and analyzing the first year (four quarterly samples) of data. Special thanks go to Patrick Shields of ISR, who helped conceptualize the survey, played a crucial role in its development and execution, and provided invaluable input, guidance and encouragement throughout the process. Many other individuals contributed to the success of project, including Richard Curtin, Paul Gargaro, Yumi Kim, David Lampe, Jim Lepkowski, Amy Mast, Rebecca McBee, Jennifer Puckett, Michael Sadowsky, Gabriel Tabak, Bruno Vanzieleghem and Yuan Zhang. The survey team also wishes to thank the project’s faculty advisors and other individuals who provided input, reviewed the development and early results and otherwise assisted with the effort. For financial support, the U-M Energy Survey is grateful to UMEI director Mark Barteau and ISR director James Jackson, who provided the funding and in-kind contributions that made the project possible.

CITATION GUIDE

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ABSTRACT

An improved understanding of consumers’ basic attitudes regarding energy is important for informing public discussions of energy policy and related environmental strategies. It is also valuable for guiding decisions of energy-related businesses and public interest organizations as well as for serving the academic community involved in energy research and issues analysis. Launched in October 2013, the University of Michigan Energy Survey contributes to enhancing such understanding by probing U.S. consumer attitudes about the reliability, affordability and environmental impact of energy. Appended quarterly to the University of Michigan monthly Surveys of Consumers -- source of the widely reported Index of Consumer Sentiment -- the U-M Energy Survey inherits the sample design and methodological rigor of that household-level economic survey.

In addition to describing the survey’s development process, this report presents first-year results that reveal a number of notable findings. American consumers express at least as much concern about the environmental impact of energy as they do about its affordability, a result that shows some regional variation but which holds across income brackets. Reliability is of significantly less concern than affordability and the environment, and concerns about both reliability and affordability show an expected sensitivity to household income. Home energy bills are viewed as unaffordable if they were to double for consumers in the lower income tercile but only if they were to triple for consumers in the upper income tercile. Moreover, consumers report much greater sensitivity to higher gasoline prices than to higher home energy bills in terms of the degree of cost increase they view as unaffordable. Several other findings are of interest to the survey’s audiences are also presented here, and the unique data series generated by the U-M Energy Survey will enable deeper analyses of attitudinally related energy topics as time goes on.
**University of Michigan Energy Survey: Year One Report**

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Introduction

Public attitudes and concerns about energy have varied over the years and, as for any commodity that becomes one of life’s necessities, the subject evokes mixed feelings. Since the time of the Texas Railroad Commission’s attempts to regulate the oil market, tension has existed between consumers’ concerns about the affordability of fuel and energy suppliers’ needs to profit from their investments. Similar issues arose from the early days of electrification, leading to the establishment of state and municipal utility commissions, rural electric cooperatives and rate governance mechanisms for balancing the public’s concerns about price with the industry’s need to recoup its costs. As household energy use evolved from chopping wood and grazing ones’ own horses to near universal reliance on industrial-scale distribution systems, reliability became a worry, with personal comfort and quality of life being tied to vast systems beyond the control of individuals and their communities. The importance and value of energy also create economic opportunities. Mineral extraction, fuel production, power generation, infrastructure provision and energy distribution remain major sources of employment unto this day.

Like any extensive human activity, energy use has adverse side effects. Coal burning was a public nuisance in 13th century London. As the industrial revolution unfolded, chronic air pollution was associated with increased mortality and morbidity, and some areas experienced deadly episodes of severe pollution. The 1960s ushered in modern environmental policies, supported by public awareness of the health and other harms associated with major economic activities including energy production and use. In the 1970s, energy security became a watchword when the United States and Western Europe were confronted with an oil embargo and price spikes triggered by political strife in the Middle East. Such concerns wax and wane with regional and global events. These effects amplify the inherent volatility of energy markets, which entail investments that span decades and have complicated dynamics that preclude long-term price stability.

A policymaker addressing energy confronts a tangle of competing needs and economic complexities. He or she also faces public opinions about energy sources on which consumers intimately depend, about which they lack a deep understanding and for which they must pay with little day-to-day choice. Nevertheless, consumers do understand energy through the ways it affects their daily lives. In probing attitudes, it is important to respect respondents’ own level of
knowledge even though it may not align with that of policy analysts and energy professionals. Such an approach is taken in the University of Michigan Energy Survey, which is the subject of this report.

Stern & Aronson (1984) highlighted the need to inform energy policies by examining human factors through methods that go beyond those of traditional economic analysis. Indeed, the value of attitudinal research based on psycho-social models of behavior instead of classical economic models was established decades ago for studies of the general economy (Katona & Likert, 1946; Hosseini, 2011). Such methods do not presuppose economically rational consumer behavior, although it should be noted that psychological processes can be viewed as rational even though they are poorly explained by models rooted in utility maximization (Katona, 1953). An attitudinal approach for assessing U.S. consumers’ views about energy can build upon the foundation provided by the long-running University of Michigan Surveys of Consumers ("UMSC"), which pioneered methods now common in the field (Curtin 2004; ISR 2004).

Recent reviews have found that most energy-related surveys are designed to assess consumer and citizen (voter) understanding, opinions and behaviors about various forms of energy, types of energy-related development, conservation and efficiency, energy policies and related social concerns such as energy security and environmental impacts (NREL 2011; Kim et al., 2012; DOE 2013). Topics are often determined by issues of the day, and of course, public perception of energy is shaped by how the issues are portrayed in the media (Shanahan 2004). Many recent surveys examine public views of climate change, related energy technologies and policy options (e.g., Borick & Rabe 2010; Leiserowitz et al. 2014a; Pew 2014). Nevertheless, although a few polls have asked some questions for many years, there has been no long-running survey of basic consumer attitudes about energy.

For example, nearly all the questions in Gallup’s energy-related polling explore beliefs about specific energy issues, policy trade-offs and policymaker performance (Gallup 2014). Many questions run only when an issue is in the news. Recent surveys examine views of the Keystone XL pipeline; some earlier surveys explored views of opening the Arctic National Wildlife Refuge for oil drilling; and over the years (but not consistently) questions were asked about nuclear energy. In Gallup (2014), only one question -- about how much respondents personally worry about energy affordability -- probes a general attitude.

Because most existing energy surveys have been designed to inform energy policies or programs for which decision makers must weigh competing interests, questions are often posed
accordingly. Event-driven effects are also evident, e.g., as seen in 2010, the year of the BP Macondo oil spill when the share of respondents who said they would prioritize protecting the environment spiked upward (Polling Report, 2014). Such results align with the findings of Bolsen et al. (2008), who examined trends in energy policy-related public opinion since 1974 and found that support for energy resource development, such as oil and gas production in environmentally sensitive locations, correlated with energy prices.

Farhar (1994) reviewed energy-related surveys from the mid-1970s through early 1990s and found an increasing concern for environmental protection after the 1973-80 “energy crisis” period had passed. This trend coincided with greater support for energy efficiency and renewable energy. Farhar also found that while consumers expressed little interest in personal changes in behavior, they did express support for energy policy changes aligned with environmental concerns. Nevertheless, other research has shown an association between environmental attitudes and energy saving behaviors (Gadenne et al., 2011). Moreover, supplementing attitudinal variables with social context variables (such as household characteristics and income) improves explanatory power for environmental behaviors (Poortinga et al., 2004).

Many surveys are designed to elicit opposing viewpoints and such results are readily highlighted by news media in ways that may accentuate the significance of opposing views in the public mind. Nevertheless, Rosen et al. (1981) found that, even at a time of spiking energy prices, respondents who clearly prioritized development over the environment or vice versa were a significantly smaller share of the population that those who were simultaneously concerned about both issues. Thus, from a psychological perspective, there is no reason a priori for consumers’ attitudes to be highly polarized.

**Methods**

Petty et al. (1981) characterize attitudes as enduring positive or negative feeling about a person, object or issue. The attitudes that consumers report in surveys are based on what is momentarilily salient to the respondents and can differ according to how questions are asked. Schwartz (2007) notes that attitudes are best “conceptualized as evaluative judgments formed on the spot rather than a trait-like disposition.” In this regard, surveys can be seen as measuring specific responses to specific questions asked at a particular time, i.e., attitude expressions, rather than attitudes per se (Tourangeau et al., 2000). However, not every attitude expression is made up on the spot. Many are retrieved from memory and so respondents can express views
that are fairly stable over time. Moreover, respondents are most comfortable and provide more reliable answers when talking about things they know – including everyday behaviors – unless these touch on sensitive topics.

To design an instrument to stand the test of time, it is necessary to ask questions of ongoing relevance to consumers rather than focusing on issues of the day or the ever evolving concerns of energy businesses, policymakers and interest groups. Although we reviewed existing surveys that addressed energy and compiled a question bank of over 250 entries, our development process kept the foregoing considerations in mind. Based on the review and discussions with colleagues in several energy-related disciplines, we created a straw list of topics that covered attitudinal issues in a manner independent from specific energy sources, technologies, market developments and policy options. Shown in Table 1, this list was narrowed through focus groups and cognitive interviews, and then used to formulate questions for pre-testing and further refinement prior to launching the survey in October 2013 (DeCicco et al. 2014).

**Focus groups**
The proposed topics were tested with focus groups to understand how consumers think about energy issues and to learn the language they use to express their thoughts. Focus groups involve a small number of participants interviewed together by a moderator who leads semi-structured discussions on topics of interest for the survey (Krueger & Casey, 2000). The findings enable us to draft questions that consumers could readily understand and answer.

Three focus groups were convened in March and April 2013 with a total of 22 participants recruited from communities in Southeastern Michigan. Volunteers were screened so that each group had a reasonably balanced mix of in terms of gender, age, residency and home rental or

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The items in boldface were the topics ultimately selected for the survey.
ownership, characteristics likely to be related to individual perspectives on energy. The sessions were held in rooms designed for focus groups at the Institute for Social Research (ISR), University of Michigan, Ann Arbor. The discussions lasted about two hours each and group members were paid $35 for their participation.

Focus group participants were clearly knowledgeable and concerned about the cost of energy. They proved able to track energy costs and bills and were well aware of gasoline prices. However, they could not answer questions about the price of home energy, such as the per kilowatt-hour price of electricity. This led us to develop questions about the dollar amounts of home energy bills rather than unit prices.

Focus group participants had a fairly strong understanding of reliability, readily relating it to whether or not the power was on in their homes. They thought of reliability exclusively in terms of electricity; when the moderator raised reliability in the context of gasoline, participants tended to confuse reliability with energy security. These observations led us to develop survey questions that asked about reliability in terms of individual household energy use and then ask respondents what form of energy they have in mind when evaluating reliability.

During the focus groups, participants struggled with what was meant by the economic impacts of energy. When asked how energy might affect the economy, participants often failed to grasp what the topic was about. Regarding energy security, some participants tied the issue to gasoline and oil but many confused it with reliability. These findings echo the Demski et al. (2014) finding that the term “energy security” was unfamiliar and, when the concept was explained, that the responses were very susceptible to framing. Thus, although energy professionals can be successfully polled on such topics (Manley et al., 2014), lay respondents cannot be expected to adequately understand them. We opted to exclude questions on energy security and economic impacts.

Focus group participants all felt that energy affected the environment or personal health in some way. However, they lacked a clear understanding of the impacts or how impacts were tied to various forms of energy. Therefore, we developed questions that asked for general impressions of the impact of energy on the environment and about broad types of impact that the participants understood. The participants did not clearly distinguish energy efficiency and conservation, and so we composed questions to simply ask how often consumers reduce their energy use without trying to elicit how they did so.
Overall, focus group participants demonstrated limited knowledge of energy. They did not know where it comes from, how it is delivered or exactly how it affects the environment. But they were quite able to talk about their direct experiences with energy and general feelings about it, and so the survey was designed to probe those perceptions accordingly.

**Questionnaire development**

Guided by the focus group findings and the question bank derived from the literature review, we compiled an initial draft questionnaire, that was then tested and iteratively revised. The first such step used cognitive interviews, which involve posing draft questions to collect “verbal information about the survey responses, which is used to evaluate the quality of the response or to help determine whether the question is generating the information that its author intends” (Beatty & Willis, 2007). Two rounds of cognitive interviews were conducted with 24 individuals in May and June 2013. After each round, the questionnaire was revised to address the problems respondents had comprehending, mentally processing and responding to the questions.

The next step involved expert review by UMSC researchers and professional interviewers, followed by phone interview pretesting in early September 2013. Pre-testing resulted in a need to trim the number of questions to fit within the desired seven-minute time allotment for the energy rider. The resulting questionnaire is provided here in Appendix A and was implemented to collect the first survey sample in October 2013; the sequence of questions was not varied.

**Data collection and analysis**

As a quarterly rider on the UMSC, the energy survey inherits that established survey’s sample design and statistical characteristics. The UMSC is a monthly telephone survey that interviews approximately 500 adult men and women from households in the coterminous United States (48 states plus the District of Columbia) using a nationally representative sample that gives each household an equal probability of being selected (Curtin, 2002). To maximize its ability to detect attitudinal change, the UMSC uses a rotating panel design; for each monthly sample, an independent cross-sectional sample of households is drawn and a subset of the respondents is re-interviewed six months later.

The results reported here are based on the first year of energy survey data, using samples from October 2013 and January, April, and July 2014. Responses were analyzed according to household demographic and geographic data gathered as part of the core UMSC. The classification variables used include:
• Three levels (terciles) of self-reported income;
• Four categories of home status: renters plus owner terciles by self-reported property value;
• Four regions: Northeast, Midwest, South and West.

The survey also includes a question about respondents’ self-reported knowledge of energy, enabling us to classify the population into respondents who said they knew a lot or a fair amount and those who said they knew a little or nothing about energy issues. Responses were weighted so that the results are representative of the U.S. household population and, unless otherwise noted, all results are based on the pooled sample that combines responses from the four quarterly samples.

Findings
The first few questions addressed reliability; the second set addressed the environmental impacts of energy; the third set addressed affordability; then came three questions probing the respondents’ overall degree of concern by topic; the final question asked how knowledgeable the respondents felt they were about energy. Previously published reports summarize results from the early samples (UMEI, 2014). Here, findings on consumers’ overall degrees of concern about the three main topics are summarized first, before delving into the specific results for each topic.

Overall concern about energy-related topics
The questions used to probe respondents’ overall degrees of concern about each of the three energy topics were posed near the end of the interview so that the respondents had already become familiar with the issues; these questions took the form:

*How much do you personally worry about the [affordability / reliability / environmental impact] of energy? Would you say a great deal, a fair amount, only a little, or not at all?*
As shown in Figure 1, respondents expressed a degree of concern about the environmental impact of energy somewhat, but not quite significantly, greater than their concern about energy affordability. Concern about reliability was significantly lower overall.

For the combined sample, 59 (±2) percent of respondents said they worry a fair amount or a great deal about the environmental impact of energy. This fraction was just shy of differing at a 95% confidence level from the 55 (±2) percent of respondents who said they worry at least a fair amount about affordability. The fraction of respondents who worry at least a fair amount about the reliability of energy averaged 32 (±2) percent. For all three topics, respondents with a higher self-reported knowledge of energy issues expressed higher levels of concern than those who said they knew little or nothing about energy.

The degrees of concern about reliability and affordability varied by income, home status and self-reported knowledge of energy. For reliability, we did not find significant differences in concern by region. Regarding affordability, the fraction of respondents expressing higher degrees of concern was significantly greater in the Northeast than it was in the West, while respondents in the South and Midwest did not differ significantly from the national average. As would be expected, concern about both reliability and affordability varied inversely to household income and to home status.
Concern about the environmental impact of energy varied by neither income nor home status. Although regional differences were not statistically significant in data for any individual quarter, the combined sample using four quarters of data revealed a regional variation. Roughly 68 (±5) percent of respondents from the Northeast say they worry a fair amount or a great deal about energy’s environmental impact while only 56 (±4) percent of respondents in the South and West express that level of concern. The 59 (±4) percent of Midwestern respondents concerned at least a fair amount about energy’s impact on the environment is similar to the national average. These findings about the strong and relatively uniform degree of concern that U.S. consumers express about the environmental impact of energy echo the findings of many surveys that probe environmental views, and certainly appear to reflect the Kempton et al. (1995) thesis about the extent to which environmental values are a deeply embedded part of the American psyche.

**Views on reliability**

To examine perceptions of reliability, we first asked:

*Considering all sources of energy you usually use in everyday life, how reliable would you say they are -- not at all reliable, slightly reliable, moderately reliable, or very reliable?*

If respondents asked for clarification, an interviewer told them that reliability refers to getting the energy they need when they need it.

Overall, 72 (±2) percent of consumers perceive the energy they use as very reliable. Differences were found according to income and home status, with the number of consumers who consider energy to be very reliable increasing as the bracket increases. The “very reliable” answer was given by 61 (±4) percent of consumers in the bottom income tercile, 74 (±4) percent in the middle tercile and 82 (±3) percent in the top tercile (Figure 2).

The pattern was similar for home tenure and terciles of property value, with the top and middle terciles reporting significantly higher perceived reliability than homeowners in the lower property value tercile and renters. We did not find significant differences in perceived reliability by region or by self-reported knowledge of energy.
The interviewers next asked:

*What specific source of energy were you mostly thinking about when you said that the energy you use is [not at all / slightly / moderately / very] reliable?*

They did not present a list of energy sources or otherwise prompt the respondents for answers. Electricity was the dominant response, given by 61 (±2) percent of respondents, followed by natural gas at 22 (±2) percent while gasoline, oil and petroleum ranked third with 11 (±2) percent of responses (answers involving any petroleum fuels being coded the same). No significant differences in response were found by income, by home status or by self-reported knowledge of energy.

The fraction of consumers who identified natural gas when responding about reliability was smaller in the South and West, 16 (±3) and 19 (±4) percent, respectively, than it was in the Northeast and Midwest, where it averaged 28 (±4) percent. Southern and Western respondents were more likely to focus on electricity, results that partly align with the geographic pattern of residential energy supply. Less than half of households in the South use natural gas while roughly three-quarters do in other regions (EIA 2009). Though we can only speculate, the relatively elevated mention of natural gas in the West might be related to the 2010 pipeline explosion in San Bruno, California (NTSB 2011).

![Figure 2. Perception of energy reliability by tercile of self-reported household income.](image)
Views on energy affordability

The two main household energy expenditures are home energy bills and motor fuel. To probe views on affordability, we crafted questions about the increases in cost that consumers would find unaffordable. Methodologically, this indirect approach is more reliable for assessing such beliefs than directly asking “how much can you afford to pay for energy?”

Home energy

The first set of questions examined home energy bills, starting with a query to establish each respondent’s baseline, i.e., how much they have recently been paying:

*Now thinking about the last time you (or someone else in your household) paid a household energy bill of any kind, how much did that bill cost you? Please do not include your water bill.*

If clarification was needed, respondents were told that expenses include whatever they might pay for electricity, natural gas, propane, heating oil or other fuels use at home. If they could not remember a recent energy bill, they were asked to provide their best estimate. We next asked:

*What sources or types of energy did that bill cover?*

That question was then followed by:

*At what dollar amount would that [type of energy stated by respondent] bill become unaffordable to you (and your family)? By unaffordable we mean that you (and your family) would be forced to make significant changes in the way you live your life.*

If respondents were unable to provide a dollar value, we asked how much their bill would have to increase in percentage terms to become unaffordable. Respondents who said that their current bill was already unaffordable were asked the dollar amount at which it became unaffordable.

Analyzing the responses to these three questions yields the percent increase over recent energy bills that consumers consider unaffordable. Responses averaged to a 140 (±10) percent increase (i.e., a factor of 2.4), but varied by region, income and home status.

Western consumers view a home energy bill increase of 173 (±25) percent as unaffordable, a level notably higher than the 108 (±22) percent increase found unaffordable by Northeasterners. The South and Midwest fell in between, with bill increases averaging about 135% being seen as unaffordable.

Consumers in bottom income tercile believe that home energy would become unaffordable if their bills were to roughly double, reporting an average unaffordability threshold of 102 (±15) percent. The average response of the middle income tercile was 129 (±14) percent. The level was significantly higher for top income tercile consumers, who reported that a 185 (±22)
percent increase would be unaffordable. A similarly stepped pattern is found according to home ownership status, with increases of 104 (±14) percent, 130 (±19) and 170 (±22) percent seen as unaffordable by bottom, middle and top terciles, respectively, of property value. On average, renters reported that a home energy bill increase 148 (±22) percent would be unaffordable.

Motor fuel
The vast majority of American consumers use gasoline for motor fuel, so for this issue we inquired only about gasoline. In this case, fuel price (rather than cost of refueling) is salient given how widely gasoline prices are known. The U.S. Energy Information Administration (EIA) reports such prices weekly, providing a baseline, and since 1993 the UMSC has included a question about the gasoline price expected in five years. Therefore, the energy rider needed only to add one new question on the affordability of gasoline:

*At what price per gallon would gasoline get so high that it becomes unaffordable to you (and your family)?*

If a clarifications were needed, interviewers stated that “unaffordable” meant the price at which the respondents’ households would have to make significant changes in the way they get around. When respondents replied that they felt the current gasoline price was already unaffordable, we asked them to name the price at which they felt it had become unaffordable. Respondents unable to provide a dollar amount were asked to provide an estimate in percentage terms, which we converted to a dollar value based on the U.S. average all-grade gasoline price during the month when the interview occurred.

On average over the one-year span of the survey to date, consumers believed that gasoline would become unaffordable at a price of $5.93 (±0.14) per gallon. That represents 66 (±4) percent increase above the average price over the year. Responses again varied by income, home status and region.

Top income tercile consumers reported on average that they would view gasoline to be unaffordable if it reached $6.61 (±0.26) per gallon (an increase of 86%). This price is a dollar per gallon more than that seen as unaffordable by middle and bottom income consumers, whose respective average responses of $5.62 (±0.21) and $5.58 (±0.26) per gallon were statistically identical. A similar pattern was found when viewing these results by home status. By region, the West again appears to be the most tolerant of higher prices, responding on average that gasoline would become unaffordable at $6.40 (±0.32) per gallon. That price is significantly greater than the $5.70 (±0.30) per gallon average from the Northeast. Responses from the South and Midwest
averaged $5.85 (±0.24) and $5.81 (±0.25) per gallon, respectively, values not statistically higher than the price considered unaffordable by respondents in the Northeast.

**Affordability today**
The foregoing sequence of questions enables us to calculate the implicit fraction of the population that already views their energy costs as unaffordable. For home energy, the estimate is 7 (±1) percent of consumers. This fraction varies predictably by income; the 13 (±3) percent of bottom-income tercile consumers whose responses implied that they currently consider home energy to be unaffordable is significantly greater than the corresponding 5 (±2) percent and 4 (±1) percent of middle and top income consumers, respectively. For motor fuel, similar calculations imply that 5 (±1) percent of consumers view gasoline as already being unaffordable, a result that did not vary significantly across any of the classifications.

Based on this approach, we estimate that 93% of Americans currently view home energy as affordable and 95% view gasoline as affordable. These estimates are derived from responses obtained over the first full year of our survey; note also that, because this perspective was inferred rather than solicited directly, different estimates might result from posing the questions differently.

Regarding seasonality, Figure 3 shows the “current” cost levels (average responses to “how much did that bill cost you?”) along with the average energy bills respondents said would be unaffordable by month of survey. Although quarter-to-quarter differences are generally not significant, the pattern is seasonally consistent and so there is relatively little variability in the percent increase viewed as unaffordable. As previously noted, the increase in home energy bills deemed unaffordable averages 140 (±10) percent, and that estimate has only a 7% coefficient of variation for its 95% confidence interval.
Affordability expected in the future

To examine how consumers believe their home energy bills will evolve, we asked:

*About how much do you expect that [type of energy stated by respondent] bill to cost you five years from now?*

Respondents were asked to report this figure in whole dollars; if unable to provide a dollar value, they were asked to provide an estimate in percentage terms. Combining the responses to this question with respondents’ self-reported baseline home energy costs enables us to compute the increase expected in five years, which averages 31 (±2) percent across the population.

These expectations differ according to socioeconomic variables, with respondents in lower categories by either income or home value expecting greater increases than respondents in middle and upper categories. Renters expected greater home energy bill increases than homeowners of any category. No significant differences in expectations were found by region or self-reported knowledge of energy.

The responses to this question plus responses about unaffordability enable us to calculate how many consumers implicitly expect home energy to become unaffordable in five years, a fraction representing about one-fifth of the population overall. Consumers who expect energy bills to reach levels they consider unaffordable comprise 32 (±5) percent for the bottom income, 18 (±3) percent of the middle income tercile and 10 (±3) percent of the top income.

Figure 3. Average self-reported home energy bills and the bill levels that respondents said they would find unaffordable, by month of survey.
terciles. The corresponding shares are 25 (±5) percent for renters and homeowners in the bottom property value tercile, compared to 11 (±3) percent for those in the top property value tercile.

Gasoline price expectations have been probed by the UMSC for many years through the questions:

- Do you think that the price of gasoline will go up during the next five years, will gasoline go down, or will they stay about the same as they are now?
- About how many cents per gallon do you think gasoline prices will (increase/decrease) during the next five years compared to now?

On average over the first year of the energy survey, respondents said that they expect gasoline to cost $4.12 (±0.03) per gallon in five years, an increase of 15 (±1) percent over the national average for all grades of gasoline reported by EIA during the interview period. This response did not exhibit any significant variation by region, income, home status or self-reported knowledge of energy. Previous research has found that consumer gasoline price expectations are generally consistent with a forecast of no change in the real price (Anderson et al., 2011). Although not within the scope of this analysis, it may be interesting to compare these consumer expectations with expert price projections such as those of EIA’s Annual Energy Outlook.

Combining these responses with those on gasoline affordability yields an estimate that 18 (±2) percent of consumers implicitly expect gasoline to become unaffordable in five years. These responses did vary by the classification variables. For example, the fraction of top income tercile respondents who expect gasoline to be unaffordable in five years is 10 (±3) percent, compared to 20 (±3) percent for the middle income and 24 (±4) percent for the bottom income terciles.

**Home energy vs. motor fuel**

Comparing the responses about affordability for home energy to those for gasoline reveals a striking difference in the degree of cost increase that consumers view as unaffordable (in the sense of consumers feeling that they would have make changes in their daily lives due to the higher costs). Consistently over the samples analyzed to date, respondents express much less tolerance for gasoline price hikes than they do for higher home energy bills. Consumers on average view a 140% increase, i.e., a factor of 2.39 (±0.10), as unaffordable for home energy bills. In contrast, they view a 66% price rise, i.e., an increase by a factor of 1.66 (±0.04), as unaffordable for gasoline.
Variability in the responses on this issue were observed by income and by region. The income breakdowns are shown in Figure 4. For both home energy and gasoline, the degree of increase considered unaffordable by consumers in the top income tercile is much greater than that for consumers in the middle and bottom terciles. However, the patterns for the two lower terciles differ for home energy and gasoline.

For home energy the responses look fairly stepwise, ranging from the 102 (±15) percent increase (i.e., doubling) of home energy bills deemed unaffordable by the bottom tercile on average to the 185 (±22) percent increase (near tripling) that it would take before bills were seen as unaffordable by consumers in the top income tercile. Differences between the lower and middle terciles are apparent though not significant at a 95% confidence level.

For gasoline, however, the bottom and middle income respondents have identical views, both considering a 57 (±7) percent fuel price increase to be unaffordable on average. In contrast, consumers in the top income tercile say that a price increase of 86 (±7) percent on average would be unaffordable for gasoline.

Figure 5 shows the breakdown for the level of cost increases considered unaffordable by region. It appears that Western consumers have a significantly higher tolerance for increases in either home energy or gasoline costs than consumers from the Northeast, with responses from the Midwest and South falling in between.
Views on the environmental impact of energy

As noted earlier, our overall results show that consumers are at least as concerned about the impact of energy on the environment as they are about its affordability. The environmental dimension was also explored through five specific questions, the first of which was:

_Thinking about all sources of energy people use in everyday life, to what extent would you say they affect the environment? Would you say a lot, a fair amount, a little, or not at all?_

About three-quarters of respondents stated that they think energy affects the environment a fair amount or a lot. This level of belief was steady across the four quarterly samples and did not vary by income. Statistically significant variations were found by region, home status and self-reported knowledge of energy.

In the South, 70% of respondents believe energy affects the environment by at least a fair amount, a fraction somewhat less than the 79% average of the other regions (which did not vary significantly from each other). As shown in Figure 6, the pattern of belief differs from the pattern of concern. The Northeast has a larger fraction of consumers who express higher degrees of concern about the environmental impact of energy. But in terms of beliefs about the extent to which energy affects the environment, the Northeast is similar to the West and Midwest.

Examining the responses by home tenure, approximately 83% of renters believe that energy affects the environment at least a fair amount, compared to 73% percent of homeowners.
This result may be due to the association of age and home ownership. On average, the mean age of renters is 45 (±2) while the mean age of homeowners is 57 (±1). At the same time, 87 (±4) percent of our respondents younger than 35 believe that energy affects the environment at least a fair amount, versus 73 (±3) percent of respondents 55 or older. Other research has shown that younger adults are more concerned with global warming than older adults (Kellstedt et al., 2008; Malka et al., 2009), which also lends credence to such an association.

The next question on this topic was:

*Which one of the following is affected the most by the energy people use in everyday life -- air, water, global warming, or personal health?*

These four types of impact were selected based on findings from the focus groups and cognitive interviews. We observed that respondents may not understand environmental impact mechanisms enough to realize that personal health effects might be linked to air pollution, for example. Therefore, we did not assume such a cognitive link when crafting questions even though experts might hold that health impacts are caused by air or water pollution. Participants in both the focus groups and cognitive interviews clearly viewed global warming as a distinct environmental impact. They did not appear to distinguish “global warming” and “climate change,” and we opted to use the former term in our questionnaire. Leiserowitz et al. (2014b) found some distinctions when they examined reactions to the words, finding that the term “global warming” was more emotive.
As to which aspect of the environment is most affected by energy use, 43% of respondents said air, 27% said global warming, 16% said water and 15% said personal health (the 95% confidence interval is ±2 percentage points for each of these values). No significant differences were found across home status or self-reported knowledge of energy, but we did find differences by region and by income. A smaller share of respondents in the Northeast region (11 ±4%) reported that water was the environmental domain mostly affected by energy than in the South region (18 ±3%). On the other hand, a larger share of respondents in the Northeast (33 ±6%) believe that global warming is the domain mostly affected by energy than in the South (24 ±3%). The Midwest and West did not differ significantly from the other two regions in this matter.

In terms of self-reported income, respondents in the bottom tercile were more likely to refer to personal health and less likely to refer to air as the aspect of the environment most affected by energy. Figure 7 compares this finding to the income-related patterns of response on the degree of concern (worry) about the impact of energy on the environment and beliefs about the extent to which energy affects the environment. Responses on these two topics did not vary significantly by income even though income-related differences appear for the aspect of the environment that respondents believe is most affected by energy.

Figure 7. Income-related patterns of response on:
(1) concern about the impact of energy on the environment;
(2) belief that energy affects the environment;
(3) air as the aspect of the environment most affected by energy use;
(4) personal health as aspect of environment most affected by energy.
Depending on their answer to the previous question, respondents were then asked:

What particular source of energy would you say affects [the air / water / global warming / personal health / (other) the most?

If a respondent gave more than one answer, they were asked to pick the choice they thought had the greatest effect. If a respondent said “gas,” the interviewer clarified whether they meant gasoline or natural gas. Interviewers coded the replies into the broad but not necessarily mutually exclusive categories listed in Table 2.

Petroleum-related forms of energy such as gasoline and oil itself were identified by 35% of the respondents as the source of energy that most affects the environment. Coal was second at 20% followed by electricity with 12%. The response “fossil fuels” (unspecified) ranked fourth (8%); we did not try to clarify which particular fossil fuel respondents had in mind when they gave that answer. Natural gas was stated by 6% of respondents. Combining the generic fossil fuel response with those of petroleum fuels, coal and natural gas, plus the 0.6% that identified fracking, sums to roughly 70% of the population. An oil and gas category (petroleum related plus natural gas) tallies to about 42% of the responses.

When cross-tabulating by self-reported household income, respondents in the top tercile are more likely than those in the bottom tercile to believe that fossil fuels are the form of energy

<p>| Table 2. Sources of energy that U.S. consumers believe to affect the environment the most |
|-----------------|------------------|-----------------|------------------|------------------|</p>
<table>
<thead>
<tr>
<th>Responses</th>
<th>percent</th>
<th>Responses</th>
<th>percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline, oil or petroleum</td>
<td>35</td>
<td>Pollution</td>
<td>1.0</td>
</tr>
<tr>
<td>Coal</td>
<td>20</td>
<td>Power plants</td>
<td>1.0</td>
</tr>
<tr>
<td>Electricity</td>
<td>12</td>
<td>People, cities</td>
<td>0.9</td>
</tr>
<tr>
<td>Fossil fuels</td>
<td>8</td>
<td>Fracking</td>
<td>0.6</td>
</tr>
<tr>
<td>Natural gas</td>
<td>6</td>
<td>All</td>
<td>0.2</td>
</tr>
<tr>
<td>Emissions</td>
<td>3</td>
<td>Chemicals</td>
<td>0.2</td>
</tr>
<tr>
<td>Biofuels, wood</td>
<td>2</td>
<td>None</td>
<td>0.2</td>
</tr>
<tr>
<td>Water pollution</td>
<td>1.9</td>
<td>Solar/wind</td>
<td>0.2</td>
</tr>
<tr>
<td>Automobile exhaust</td>
<td>1.7</td>
<td>Electromagnetic fields</td>
<td>0.1</td>
</tr>
<tr>
<td>Factories</td>
<td>1.3</td>
<td>Hydroelectric dams</td>
<td>0.1</td>
</tr>
<tr>
<td>Nuclear</td>
<td>1.2</td>
<td>Don’t know / no answer</td>
<td>4</td>
</tr>
</tbody>
</table>

having the greatest impact on the environment. Bottom income tercile respondents were somewhat more likely to view electricity as affecting the environment the most. No significant variation was found on this issue by region, home status or self-reported knowledge of energy.

The next question asked respondents how they felt the impact of energy on the environment is trending:

Thinking about the next five years, do you think the energy people use in everyday life will affect the environment more, affect the environment less, or will the environment impact of energy stay about the same?

The responses tallied as 14% saying less, 49% saying about the same and 38% saying more in terms of how energy use will affect the environment in five years. These results did not vary significantly across any of our classification variables.

Energy conservation behavior

The questionnaire also asked about respondents’ own actions to conserve energy. We explored self-reported behavior undertaken for either cost or environmental reasons, first asking:

How often do you reduce the energy you use for your home or vehicle for cost reasons -- always, often, sometimes, or never?

On average, half of respondents reported to save energy for cost reasons always or often. Responses differed significantly by self-reported income, with 42 (±4) percent of the top income tercile responding “always or often” compared to 52 (±4) and 57 (±4) percent of the middle and bottom terciles, respectively. Figure 8 compares these results with the extent to which consumers worry about the affordability of energy, which follows a similar pattern by income. Consumer actions to reduce energy use are very diverse and can be classified in ways that link certain types of behavior to various attitudinal variables [Karlin et al. 2014]. While unsurprising, the income-related correlation between self-reported action to reduce energy use for cost reasons and concern about affordability may be helpful for researchers who seek to unravel the psychological factors related to energy conservation behavior.
We also found that respondents who say they are more knowledgeable about energy are more likely to reduce energy use for cost reasons: 54 (± 3) percent vs. 44 (±3) percent, and they also worry more about affordability, 59 (±3) percent vs. 50 (±4) percent, than respondents who say they are less knowledgeable. On the other hand, consumers who consider themselves to be relatively knowledgeable about energy also tend to be in the top terciles by income and home value. Although we did not attempt a formal bivariate analysis, these results suggest that self-reported knowledge of energy might counterbalance the otherwise lesser degrees of concern and less common conservation behavior of higher income consumers.

We then asked about saving energy for environmental reasons:

*How often do you reduce the energy you use for your home or vehicle for environmental reasons -- always, often, sometimes, or never?*

On average, 44 (±2) percent of respondents said they reduce their energy use for environmental reasons always or often. These responses also varied according to self-reported knowledge of energy; 47 (±3) percent of knowledgeable respondents (those who say they know at least a fair amount about energy) reporting that they reduce their energy use always or often. That figure is significantly greater than the 38 (±4) percent of less energy-knowledgeable respondents who say they reduce their energy use for environmental reasons. Figure 9 compares these results to the
responses on concern about the impact of energy on the environment, also shown according to self-stated knowledge of energy. This chart again shows a correspondence between consumers’ expressed attitudes and their self-reported behavior, corroborating other research such as that by Gadenne et al. (2011). We observe, however, that even though consumers say they are at least as concerned about the impact of energy on the environment as they are about its affordability, affordability appears to be stronger than concern for the environment as a motivator for self-professed conservation behavior.

**Discussion**

Although public views on energy have been widely investigated, new insights were obtained by surveying attitudes about aspects of energy that are personally meaningful to ordinary consumers. Three topics -- reliability, affordability and impact on the environment -- were understood well enough for lay respondents to meaningfully address in a brief 18-question rider appended to the University of Michigan Surveys of Consumers. Several notable findings emerged from the four quarterly samples of the survey’s first year.

On average, U.S. consumers are much less concerned about the reliability of energy than they are about its affordability and impact on the environment. This finding runs counter to the...
expectations of many energy professionals, particularly those in the utility industry who are highly sensitized to the public outcries that ensue during major power outages. Moreover, consumers say that they are at least as concerned about the impact of energy on the environment as they are about affordability. This finding appeared in the first sample and held up as each new quarterly sample came in; it did not vary across income-related classifications. Regional differences were not significant in single samples but emerged as the cumulative sample grew. Four quarters of data revealed that respondents in the Northeast express greater concern about the impact of energy on the environment than those in the South and West, with the Midwest falling in between. A somewhat different regional pattern emerged in response to a separate question about the extent to which energy impacts the environment. Respondents in the South are somewhat less likely to believe that energy affects the environment by at least a fair amount, whereas the other three regions did not differ significantly from one another in that regard.

The survey probed consumer perceptions of affordability by asking how much energy costs would have to rise before they became unaffordable (in the sense of respondents feeling that they would have to change their home lifestyle or travel habits). This line of questioning reveals that consumers are much less tolerant of higher gasoline prices than of higher home energy bills. Measured as a percentage increases from costs during the time of the survey, respondents said that their home energy bills would have to go up about twice as much as gasoline prices would have to rise before being considered unaffordable. This section of the survey also implies that, over the October 2013 through July 2014 period examined to date, 93% of Americans view home energy as affordable and 95% view gasoline as affordable.

The sensitivities on energy affordability did not vary significantly by region but did vary by income as would be expected. For gasoline, the price increase considered unaffordable was the same for the bottom and middle income terciles, for which it averaged $5.60 per gallon. That is $1.00 per gallon less than the price considered unaffordable by the top income tercile. For home energy, the bottom income tercile reported that home energy would be unaffordable if bills were to roughly double on average, while for the top tercile that threshold would not be reached until their bills nearly triple. The views of middle income tercile consumers were in between and similar to the overall average, which is that a 140% (factor of 2.4) increase in home energy bills would be viewed as unaffordable. Broadly similar patterns were also seen when analyzing the responses according to home tenure and status.
In addition to other findings (reported above but not recapped here), the results have bearing on energy policy in a number of ways. Debates about energy and the environment are often framed economically, e.g., with questions that might probe consumers’ willingness to pay higher energy costs (or to make up-front investments) for pollution control, efficiency improvements, renewable energy or other environmentally protective measures. Such questions invite respondents to make a tradeoff between affordability and the environment and typically yield findings accordingly. By not invoking an economic frame, we found that consumers are equally concerned about those two facets of energy. Policymakers should therefore be aware that consumers on their own (i.e., without prompting) may want energy to be both affordable and “clean,” without perceiving these two goals as entailing a tradeoff.

The finding that the threshold of unaffordability for higher gasoline prices is substantially lower than that for higher home energy bills serves to reinforce the political wariness of higher motor fuel taxes. Nevertheless, the degrees of increase -- 66% for gasoline prices and 140% for home energy -- that consumers say they would find unaffordable are much larger than the projected impacts of many energy policy proposals that provoke cost debates. Thus, although consumers may in fact have a greater tolerance for energy price increases than is commonly assumed, that is not to say that as concerned citizens, many would not be aroused when such proposals are called to their attention. Moreover, the sensitivity of the affordability results to income suggests that consumers are likely to perceive policy-related price increases as regressive even though some economic analyses indicate that the regressivity is not that strong because lower income correlates with lower levels of consumption.

Although reliability did not rate as nearly as high a concern as affordability, that could change if a major power outage affected large portions of the country, as happened in August 2003. If this survey were underway then, we suspect that views about reliability might be different from the current findings. Therefore our results should not be interpreted to mean that policymakers need not be vigilant on reliability. The income sensitivity for perceived reliability suggests that there might be value in policies to better assure reliability for all customers. Policies such as the Low Income Home Energy Assistance Program (LIHEAP) already exist for addressing energy-related affordability concerns.

Although we cannot quantitatively link the relatively high thresholds we estimated for energy cost unaffordability to published estimates of energy demand elasticity, our findings are in line with demand being rather price inelastic. Thus, the results are broadly consistent with
policies that seek to motivate technology change in energy-related products and services and which affect costs indirectly rather than through energy pricing policies that consumers would perceive more directly.

Conclusions
Even after just one year of results, the U-M Energy Survey is yielding new and eye-opening insights into consumers' basic attitudes regarding energy. Its design and execution build on the robust methodology and sample design of the University of Michigan’s long-running Surveys of Consumers. As a new instrument contributing to energy-related social science, its results will be valuable for informing public discussions of energy policy, guiding energy-related business and public interest strategies, and enriching knowledge within the broader energy research community.

Among the survey’s notable findings are that American consumers say that they are at least as concerned about energy’s impact on the environment as they are about its affordability. Reliability was found to be of substantially less concern than either of those two issues. Concern about energy affordability and reliability and show the expected sensitivity to household income, but concern about the environmental impact of energy cuts uniformly across income terciles. However, both beliefs about the extent of energy’s impact on the environment and concern about such impact show some regional variation.

Other original results pertain to how much more expensive energy would have to be before consumers find it unaffordable in the sense of believing that it would require them to make significant changes in their household behavior as it relates to home energy or motor fuel. In general, consumers report a strikingly lower threshold of unaffordability [i.e., much greater sensitivity] for gasoline price increases than they do for higher home energy bills. Expressed tolerance for energy cost increases depends on income, of course, and there is a notable difference in this regard between consumers the upper tercile and those in the middle and lower terciles. On average, lower income tercile consumers believe that their home energy bills would be unaffordable if they were to double, but upper income tercile consumers say that a tripling of home energy bills would be unaffordable. Middle-income consumers express an intermediate level of tolerance for home energy bill increases, but are closer in this regard to their lower income tercile counterparts than they are to consumers in the upper tercile. For gasoline, however, we found no difference between the middle and lower income terciles regarding the
price increase that they feel would make gasoline unaffordable, while upper income tercile consumers expressed a tolerance for a much higher price increase.

The survey also produced a number of other findings as summarized above. The results reported here reflect only the first year of data gathering that is planned to continue indefinitely into the future. Some data not discussed here hint at seasonal effects, the prospect of greater resolution for several issues and additional findings with respect to classification variables, for which significant results can only come as data accumulate. The potential exists to use the data to develop indices (e.g., regarding perceived energy affordability, for example) as well as to analyze our attitudinal data in combination with energy consumption, price, behavioral and policy preference data from other sources.

This survey will also enable observation of how attitudes change in response to events. By steering clear of issues of the day, which are well covered in other polls, this survey’s topics of reliability, affordability and environmental impact will be of timeless resonance for consumers yet sensitive to changes in energy-related conditions. By the time of the last sample analyzed here (from July 2014), for example, gasoline prices had not fallen as much as they did by late 2014, and it will be interesting to see how views change in response. The energy world is inevitably buffeted by occurrences that are impossible to predict but likely to affect consumers’ views as measured here, yielding data that will be increasingly valuable for energy researchers and policymakers in the years ahead.
APPENDIX:
Energy Survey Questionnaire

The next questions are about energy. By energy, we mean electricity, gasoline, natural gas, propane, wood, and other fuels that you might use in your everyday life, as well as the natural resources from which these sources of energy are obtained.

Q1. Considering all sources of energy you usually use in everyday life, how reliable would you say they are -- not at all reliable, slightly reliable, moderately reliable, or very reliable?

Q2. What specific source of energy were you mostly thinking about when you said that the energy you use is [not at all / slightly / moderately / very] reliable?

Next are some questions about energy and the environment.

Q3. Thinking about all sources of energy people use in everyday life, to what extent would you say they affect the environment? Would you say a lot, a fair amount, a little, or not at all?

Q4. Which one of the following is affected the most by the energy people use in everyday life -- air, water, global warming, or personal health?

Q5. What particular source of energy would you say affects [the air / water / global warming / personal health] the most?

Q6. Thinking about the next five years, do you think the energy people use in everyday life will affect the environment more, affect the environment less, or will the environmental impact of energy stay about the same?

Q7. How often do you reduce the energy you use for your home or vehicle for environmental reasons -- always, often, sometimes, or never?

The next few questions are about your household’s energy expenses.

Q8. Now thinking about the last time you (or someone else in your household) paid a household energy bill of any kind, how much did that bill cost you? Please do not include your water bill.

*If clarification is needed:* In this study, household energy expenses include whatever you might pay for electricity, natural gas, propane, heating oil or other fuels you might use in your home for household chores, lights, electronics and entertainment, appliances, and heating and air conditioning.

[If you cannot remember the exact amount, please give us your best estimate.]

Q9. What sources or types of energy did that bill cover?

Q10. About how much do you expect that [heating oil / kerosene / (natural) gas / electricity / propane / energy] bill to cost you five years from now?

*If respondent says they don’t know, probe:* About what percent do you expect that [respondent’s type of energy] bill to increase in five years from now?

Q11. At what dollar amount would that [respondent’s type of energy] bill become unaffordable to you (and your family)? By unaffordable we mean that you (and your family) would be forced to make significant changes in the way you live your life.
If respondent replies that bill is already unaffordable, probe: At what dollar amount did that [respondent’s type of energy] bill become unaffordable?

If respondent says they don’t know, probe: What percent would that [respondent’s type of energy] bill have to increase by to become unaffordable?

Q12. At what price per gallon would gasoline get so high that it becomes unaffordable to you [and your family]? [By unaffordable we mean that you [and your family] would be forced to make significant changes in the way you get around.]

If respondent replies that bill is already unaffordable, probe: At what price per gallon did gasoline get so high that it became unaffordable?

If respondent says they don’t know, probe: What percent would the price per gallon of gasoline have to increase by to become unaffordable?

Q13. How would you [and your family] change the way you get around if gasoline prices reached that level?

If already unaffordable, ask: How did you [and your family] change the way you got around when gasoline prices reached that level?

Q14. How often do you reduce the energy you use for your home or vehicle for cost reasons -- always, often, sometimes, or never?

I’m going to read you a list of energy problems. As I read each one, please tell me how much you personally worry about this problem.

Q15. First, how much do you personally worry about the affordability of energy? Would you say a great deal, a fair amount, only a little, or not at all?

Q16. How much do you personally worry about the reliability of energy? [Would you say a great deal, a fair amount, only a little, or not at all?]

Q17. How much do you personally worry about the environmental impact of energy? [Would you say a great deal, a fair amount, only a little, or not at all?]

Q18. People tell us they know a lot about some issues, but not so much about others. How much do you feel you know about energy issues, including the sources of energy, the production of energy, and the delivery of energy? Would you say a lot, a fair amount, a little, or nothing?

END
References


