Dollars or Sense: Economic versus Social Rationality in Residential Energy Consumption

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ABSTRACT

Residential energy consumption is often conceived of as a social problem in need of a technological solution that would allow consumers to use energy more efficiently and thus use less energy. Nevertheless policy makers and researchers are increasingly recognizing the importance of also addressing behavioral change in efforts to reduce energy consumption and carbon emissions as most energy-efficient technologies require proper human interaction to achieve their promised savings. One recent example of the growing interest in the topic of behavior change is the large turnout at the Behavior, Energy and Climate Change Conference[1].

Although the renewed interest in behavior is decidedly needed, there remains a tendency to frame behavioral change almost exclusively as a matter of individual choice, and predominantly in terms of rational economic actors. Unfortunately, there is much evidence to suggest that people often do not act on economic or rational self-interest alone. In fact, people often find it difficult to do so. Instead, some studies suggest that individual behavior is also shaped in important ways by the social context within which people operate. In many instances, individuals are likely to behave as rational *social* actors who determine what is and isn't "appropriate" behavior by gleaning information from their own observations and interactions within their sphere of social influence.

This paper explores the ways in which social rules, resources and context shape individual patterns of energy consumption. More specifically, the paper will consider the ways in which social norms, social networks, social status and social context all influence individual behavior and residential energy consumption. In broadening this perspective, our hope is to improve program design and assessment as well as policy analysis based on such assessments.

Introduction

A variety of emerging constraints on current patterns of energy production and consumption are likely to limit the breadth of opportunities available for improving our social and economic well-being in the future. Whether we are discussing the mounting impact of climate change, the worries associated with volatile energy prices, or the very deep concerns about the long-term availability of reliable and environmentally-smart energy resources, concerns over energy resources and the implications of energy use are expected to continue to expand. Indeed, current evidence suggests that worldwide policy debates will be increasingly dominated by attempts to implement more effective energy programs and policies. For the immediate future, policymakers acknowledge that energy efficiency is the "energy resource of first choice" (Chandler 2008), a solution into which billions of

[1] November 7-9, 2007. Sacramento California. Convened by ACEEE, CIEE and PIEE.

dollars will be turned over to U.S. utilities and others over the next few years for program implementation. (Hoffman et al. 2008)

In order to be successful, these efforts will need to move beyond the current paradigm that technology alone will meet the ever-growing energy and greenhouse gas reduction goals. They will need to acknowledge the human dimension of energy use and technology interaction, and strategically integrate a socio-behavioral model to better meet their aggressive savings targets. In both the residential and commercial sectors, it has been shown that products, homes and buildings built to perform to a set level of energy efficiency often fall short due to operator behavior. For example, only 40 percent of commercial buildings today are delivering the energy performance for which they were designed, a number attributed to occupant behavior.

In this paper, we attempt to identify key social drivers that shape our energy use patterns and suggest an alternative framework for understanding energy consumption and designing program approaches that integrate this understanding. We use residential energy consumption as the focus of our analysis. Although most programs and policies concerned with residential energy consumption have approached the problem from a techno-economic framework focusing on the development and deployment of new technologies and the provision of economic incentives and disincentives, we suggest that other approaches are possible and may be more effective in driving immediate and long-term savings.

Moreover, the current tendency is to frame behavioral change almost exclusively as a matter of conscious individual choice, and predominantly in terms of rational actors. What these approaches often ignore is that people seldom act in response to economic or rational self-interest alone. In fact, people often find it difficult to do so (Turrentine and Kurani 2006). We argue that individual behavior is often shaped by the *social* context within which people operate and compare themselves. Instead of purely rational *economic* actors, individuals are likely to behave and make decisions as rational *social* actors who determine what is and isn't an "appropriate" behavior by gleaning cues from their observations and interactions within their sphere of social influence.

This paper explores the ways in which social rules, resources and context shape individual patterns of energy consumption. We begin with a discussion of residential energy use trends and patterns, and then present a discussion of the common assumptions and approaches used to interpret current consumption trends and patterns. Finally, we present what we call a "social rationality framework" and conclude with a discussion of the intersection between social and economic rationality and its implications for energy programs and policy.

We begin with a look at current residential energy consumption patterns compared to the past and explore opportunities for potential savings.

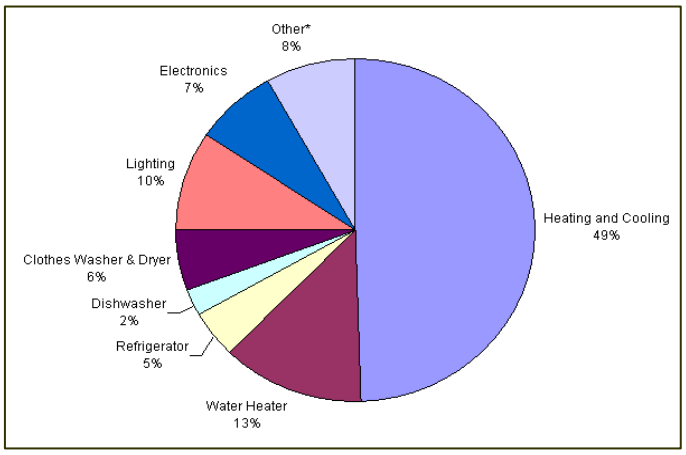
Residential Energy Consumption Behaviors and Potential Savings

Homes are responsible for approximately 21 percent of the nation's energy demand or roughly 21 quads of energy in 2006. While total residential energy demand has grown by roughly 30 percent since 1978, energy consumption per household actually declined between 1978 and 1982 and has remained relatively stable since that time despite growth in the prevalence and use of energy consuming technologies. During the past 30 years, efficiency-oriented, technology-focused efforts have been the primary driver of the majority of energy savings. Nevertheless, many of the recent efficiency gains have been offset by three

countervailing trends: an increase in the number of households, larger residences, and an increase in energy service demand associated with changing behaviors and lifestyles.

At the household level, heating and cooling currently account for about half of total residential energy consumption (see Figure 1); somewhat less than in 1978 when heating and cooling were responsible for nearly 70 percent of household energy use. Conversely, the proportion of energy used by appliances and electronics has experienced a notable increase during the same period. Most recently, consumer electronics have come to represent one of the fastest-growing segments of residential energy use, accounting for as much as 25 percent of the average household's electricity use (EIA 2008).

Figure 1. Residential Energy Bill Pie Chart



Source: www.energystar.gov, based on Residential Energy Consumption Survey (2001)

In addition to the overall trends, it is equally important to take note of the variation that exists in residential energy use across households. This variation is not simply the result of differences in design or technology but is also a function of socio-demographic differences (household size, member's ages, income, ethnicity and race) as well as differences in values, beliefs, norms and habits. In fact, non-physical factors have resulted in variations of as much as 3 to 1 in homes with similar construction (Hackett and Lutzenhiser 1991). So where do we turn for additional energy savings? Technology? Or, behavior? Which holds the larger energy saving potential? According to Stern (2008), readily available technologies provide the opportunity to reduce current residential sector energy demand by more than 25 percent:

Potential Technology-Based Efficiency Gains:

- Upgrading attic insulation (up to 7% of total)
- More efficient Heating, Ventilation, and Cooling systems (up to 5%)
- Use of Compact Fluorescent Lamps (up to 4%)
- Caulking/weatherstripping (2.5%)
- Efficient refrigeration (1.9%)
- Efficient water heater (1.5%)
- Projection versus plasma TV (1.3%)
- Efficient clothes washer (1.1%)

However, it is also important to recognize that technology adoption doesn't occur in a social vacuum. Among the reasons to address social and behavioral issues stems from the need to recognize the ways in which they are important enablers of technology adoption and proper use. In addition, behavioral approaches can also reduce energy consumption more directly by changing habits and lifestyles. In terms of technology adoption, consumers must choose whether or not to buy a new technology (such as an HVAC system, lighting, refrigerator, water heater, TV or clothes washer) and which technology to buy. Proper use includes decisions and choices associated with the installation, maintenance, and use of equipment while habits and lifestyles include choices about how we live, where we live, how much we consume, how much we travel, and how we spend our time.

In summary, total residential energy consumption has increased over the past 30 years but at a much slower rate than might otherwise be the case due to significant efficiency gains achieved through new, more efficient technologies. These gains have allowed residential energy use per household, per capita, and per square foot to decline significantly. Despite these significant increases in energy efficiency, however, an even greater level of energy savings is possible by addressing behavioral issues so as to enable the expanded adoption of more efficient technologies, smart energy use choices, and less energy-intensive lifestyles and energy use habits.

Table 1: Residential Energy Consumption

	1978	1982	1987	1997	2001	2006	2007	Sources
Total Delivered Energy Consumption (quads)	10.57	9.64	9.84	10.71	10.54	11.02	11.45	1
Consumption per Household (million Btu)	138	102	101	101	92	98	101	2
Population (000)	222,585	232,188	242,804	272,912	285,454	298,755	301,621	3
Consumption per capita (million Btu)	47.51	41.53	40.54	39.25	36.92	36.89	37.96	4
Total Square Feet (billion)	n.a.	142.3	156.8	168.8	221.1	204.2	207.1	5
Consumption per square foot (000 Btu)	n.a.	67.8	62.8	63.5	47.7	54.0	55.3	4
Sources: 1) AEO 2007 & 2008; 2) AEO 2006; 3) Census Bureau; 4) Authors Calculations; 5) RECS								

Economic versus Social Rationality: Understanding and Intervening

Though it is clear that more energy-efficient technologies will be needed to reduce residential energy consumption, programs to ensure a more optimal mix of technologies would be enhanced by integrating elements of social rationality into their design. The following section begins by defining the techno-economic platform under which most efficiency programs have operated in the past, then characterizes the social-rationality approach that an increasing number

of programs are beginning to use. We then explore the use of social rationality to (1) increase the diffusion and/or adoption of more energy-efficient technologies, and (2) change habits and behaviors that contribute to high levels of energy consumption.

The Techno-Economic Framework

Most efforts to date have approached the challenge of maximizing potential energy savings exclusively through a techno-economic framework of change (Parnell and Popovic Larsen 2005). Since 1970, both theoretical and practical models of energy-related behavior have focused on reducing energy use as a function of developing the right technologies, making them available at the right price and then promoting them to consumers by espousing their "rational" benefits. Underlying the techno-economic model are the assumptions that growth in energy consumption is best solved through the application of new technologies and that energy consumption and technology adoption behaviors are best understood in terms of a set of economic calculations involving the price of energy, the cost of technologies, and the level of disposable income. In this context, people are portrayed as rational decision makers who will behave differently when confronted with changes in energy prices within a given market setting. Moreover, the model suggests that the prevalence of energy-efficient behaviors and choices may be enhanced through the introduction of carefully crafted economic incentives and disincentives (Archer et al 1987). Finally, the model suggests that consumers, when presented with information about the economically-desirable package, will act to increase their net benefit.

According to the techno-economic model, the primary barriers to the transfer of energy-efficient technologies are 1) the lack of more efficient technologies, 2) the lack of sufficient economic incentives, and/or 3) the lack of timely, sufficient, or even accurate and complete information. A cursory evaluation suggests that although these programs have achieved some success, their success has been limited as a result of the narrow focus of the techno-economic model and the flawed assumptions on which it is based (Parnell and Popovic Larsen 2005).

Shortcomings of the techno-economic model. The assumption that individuals are economically-rational actors has been regularly called into question. For example, in a study of solar technology adoption, Archer et al. (1987:78) found that, "information indispensable to even gross cost calculations was, in fact, absent" in people's assessments. Similarly, in a study of vehicle purchase decisions, Turentine and Kurani (2006) found that "even the most financially skilled" consumers did not use payback calculations as part of their vehicle purchase decision-making. Archer et al. (1987) concluded that "this result appears to *contradict* a central tenet of the rational model" - namely, the rationality of the decision-making process. Similarly, in a study of consumer intentions to conserve energy, Feldman (1987:39) finds that, "avoided costs and implicit discount rates are probably not useful concepts for describing the behavior of the general public..." and concludes that it is dangerous to assume that energy consumers operate as rational investors. Moreover, Stern and Aronson (1984:61) argue that "there is a problem with the very notion of users as investors" because people don't conceptualize energy and energy-using equipment only as investments. For example, when people purchase a car, they are concerned with a variety of characteristics including performance, reliability, safety, styling, status, resale value and fuel-efficiency, but the primary emphasis may be on any one of these factors. Stern and Aronson's assessment indicates that even when people attempt to calculate the economic rationality of purchases, they often fail to do so successfully. Despite this large body

of evidence that the actions of firms and individuals are far from rational, most economic policy models of energy consumption and climate change continue to be based on the assumption of rationality (Laitner et al. 2001).

Second, the overly narrow focus on economic considerations often results in the oversimplification of the decision making process and the exclusion of social-psychological variables that are often essential in understanding individual behaviors. Individuals are both overtly and subconsciously influenced by a variety of non-economic variables including their values, beliefs, and attitudes, as well as prevailing social norms, group norms and interpersonal dynamics. For example, in a recent study of hotel guest behaviors, social psychologist Robert Cialdini sought to increase the number of guests that were willing to reuse their towels for more than one night. The study left cards bearing four different messages in hotel rooms asking guests to reuse their towels: three used variations of the 'help preserve the environment' message, and the 4th appealed to social norms by noting that 75 percent of people staying in the hotel had, at some point in their stay, reused their towels. Compared to the first three messages, the final (social norm) message increased towel reuse by an average of 34% (Goldstein, Cialdini, & Griskevicius, 2007). One more change to the normative appeal was tried and achieved an additional 7 percent participation. The message was changed to say that 75 percent of the guests who stayed in the same room reused their towels. Rather than providing guests with a financial incentive or providing a general knowledge appeal, the message that was the most effective in changing guest behavior was "people just like you are doing it."

Third, context matters. While there is no doubt that the social, political and economic context in which behaviors take place plays an important role in shaping the decision-making environment in ways that influence individual decisions, these factors have not played a prominent role in assessments to date. Contextual variables are important because they provide individuals with clues regarding potential risks and rewards, validate or discredit issues of concern, and often structure the opportunities and constraints within which choices are made. A variety of national-level, state-level, and municipal-level factors may influence investments and behaviors, including characteristics of the housing market and transportation infrastructure, government policy, and media coverage of relevant issues such as global climate change.

Finally, technologies do not generally act alone; there are people operating and otherwise interacting with them. From programmable thermostats used as 'on/off switches,' to refrigerators 'replaced' by a more efficient model but still operating in the house, to disenabled power management features on ENERGY STAR qualified computer monitors, operator interface with energy-efficient technologies has often been overlooked and has contributed to a reduction in the energy-savings potential from those technologies.

A Social-Rationality Approach

Recently, policy makers and researchers have placed increased emphasis on the critical role that behavior plays in defining the relationship between society and the environment, and have made efforts to broaden their understanding of human behavior (NRC reports, Wilson 2007, Ehrhardt-Martinez 2008, 2007 Congressional Hearing: *The Contribution of the Social Sciences to the Energy Challenge*). Some of these efforts build on knowledge from sociology, psychology, and anthropology which suggests that individual choices and behavior are less likely to be shaped through the rational evaluation of economic information and rational economic self-

interest than by means of the social context within which individuals operate. The relatively recent concept of community-based social marketing has its roots in this understanding.

With the advent of the Internet and many other new sources of information, most people today are faced with an overabundance of information. For those interested in efficiency and conservation, the challenge is no longer to find topical information but to determine which sources are valid, reliable and personally relevant. People routinely turn to a variety of socially-rooted shortcuts to get information and determine (both consciously and subconsciously) their own course of action. Social networks, social norms, social status and social context each play an important role:

Social networks refer to individuals or an infrastructure of individuals with whom we interact on a regular basis, such as family members, friends, colleagues, members of a club or organization, and/or online communities. These are the groups who help us solve problems, manage organizations, and better achieve our goals.

Some recent efforts to facilitate energy conservation behavior have employed social networks. Of particular interest are efforts to use existing social networks to disseminate information and technologies through trusted contacts and to achieve higher levels of commitment among individuals interested in effecting social or behavioral change. Efforts by non-profit and political organizations that encourage individuals to take a specific action and then ask their friends to follow suit are using this understanding.

Whether they act as trusted advisors or simply provide information by means of modeling their own actions, people within our social networks suggest to us what are "acceptable" and "appropriate" behaviors and technologies/products to buy. In other words, we learn from the research and experiences of trusted others.

Social norms. In sociology and social psychology, a social norm is generally defined as a shared expectation of behavior that indicates what is considered culturally desirable and appropriate. In many ways norms are similar to rules or regulations in that they are prescriptive, however norms lack the formality of rules. Norms can be of two types: injunctive and descriptive. Injunctive norms convey information regarding which behaviors are and aren't socially approved. Descriptive norms convey information regarding which behaviors are and aren't typically performed (i.e. socially popular). When actual behaviors differ from what is considered to be normative, those behaviors may be considered deviant and are often subject to acts of social regulation or social control.

People use norms to guide their own behavior. As such, norms provide people with socially-based short cuts for determining how they should respond in a particular situation, which behaviors they should and shouldn't adopt, and which technologies they should and shouldn't accept. Norms are particularly relevant with regard to public behaviors and technologies such as recycling, and transportation choices because they are more readily observed. One way of applying social norms and controls to change behavior is to find mechanisms that make otherwise private behaviors such as one's home energy use more public and observable. It has been found that when people conform to a norm that has been modeled to them, the behavior change can be long-lasting (McKenzie-Mohr and Smith 1999).

Social status and identity. According to the Weberian approach[2], status refers to an individual's position in society relative to others. It involves a ranked system of organization or

[2] Max Weber was one of the founders of the modern discipline of sociology. Weber was a German political economist and sociologist who established some of the foundational thinking with regard to the impact of culture and status on social and economic systems.

stratification among status groups. Status is generally associated with a special life-style that is maintained through exclusionary practices and involves both positive and negative privileges. Importantly, status conveys a level of "social esteem" or prestige as well as access to limited resources. Interestingly, there are specific markers of status and the esteem and prestige associated with status positions. The markers include products and behaviors that communicate aspects of our status and identity to others. In other words, what we wear and drive and how we act conveys information about who we are relative to others in society. These factors often supersede economic factors when individuals make decisions regarding purchases and behaviors.

People often choose to pay more for designer clothing, high performance cars, and large houses not because they "need" these items or because these items provide additional functional benefits but because they are markers of social status and social esteem. Nevertheless, many of these readily observable choices confer important energy implications.

Similarly, individuals also use products to express their self-concept and identity. In this sense, individuals use possessions as tools in defining, redefining, and expressing who they are as individuals. As explained in a recent paper on the topic (Heffner et al. 2006), individuals adopt products and lifestyles "not because such practices fulfill utilitarian needs, but because they give material form to a particular narrative of self-identity." This need is particularly important in modern society where "culture no longer provides a well-defined prescription for how to live one's life (Heffner et al. 2006). Instead, in modern, industrialized, capitalist systems "consumer goods (and the meanings attached to them) are an important element in the process of self-definition. The question of "who am I?" is answered 'in day-to-day decisions about how to behave, what to wear and what to eat – and many other things'" (Giddens 1991 as cited in Heffner et al. 2006).

Compared to the traditional techno-economic approach, an approach based on identity and status infers a completely different set of behavioral determinants that can be applied to shape individual behaviors and achieve desired outcomes. Interestingly these two approaches may suggest conflicting incentives. For example, while a traditional techno-economic approach to increase the adoption of fuel-efficient cars might focus on financial incentives such as rebates that lower the sales price of the car making it more affordable, an approach concerned with status and identity would focus on the symbolic value of the car as a marker of status and identity. In the latter scheme, a high price would confer more prestige and social esteem making the car more attractive to many would-be buyers. An incentive might, in this case, actually *deter* a would-be buyer.

Social context. In discussing the critical elements of social change, Gladwell (2002:140) argues that individuals are "exquisitely sensitive" to the power of context. According to Gladwell, the conditions and the circumstances in which everyday life occurs not only provide the backdrop to events, but they also influence those events and the actions of individuals in critical ways. Gladwell's assessment is partially rooted in Broken Windows Theory (Kelling and Coles 1996) which argues that crime is the inevitable result of disorder. Gladwell describes it this way:

> *If a window is broken and left unrepaired, people walking by will conclude that no one cares and no one is in charge. Soon, more windows will be broken, and the sense of anarchy will spread from the building to the street on which it faces, sending a signal that anything goes.* (p141)

The argument is based on the notion that the impetus behind behavioral change is rooted in particular features of the environment (visual or otherwise) and not based on particular characteristics of the individuals involved. In the case of energy efficiency, contextual variables are important because they have the power to shape behavioral change by providing individuals with clues regarding potential risks and rewards, by validating or discrediting issues of concern, and by structuring the opportunities and constraints within which choices are made. For example, the unwillingness of the current Presidential administration to pass any type of significant national legislation to address climate change sends a message to individuals, business leaders and others that there are reasons to doubt that humans are having an impact on the climate and that no changes in behavior are necessary. As a result of the continued inattention to the issue, the carbon-based motivation for adopting energy-efficient behaviors remains invalidated in the national social context. At the same time, continued international action and commitment to the issue has sent opposing signals. The outcome has been an environment of uncertainty, resulting in mixed responses (action on the part of some and inaction on the part of others) but no overwhelming change in behavior.

Of course the national political context, while extremely important, is simply one of the contextual variables that shape behavior. A variety of national-level, state-level, and municipal-level factors may also influence investments and behaviors. Actions taken by state and municipal level governments to reduce energy consumption and carbon dioxide emissions also send powerful signals to consumers and businesses regarding the priority placed on conservation issues. The messages are likely to influence the priority placement of businesses and consumers when making choices regarding investments and purchases.

Social Rationality and Technology Adoption/Diffusion

A variety of existing programs have incorporated elements of social rationality into their efforts to increase technology adoption and diffusion. Some examples include Project Porchlight which uses several different aspects of social rationality to encourage the adoption of compact fluorescent light bulbs in Canada, and the ENERGY STAR program's Change a Light Campaign. Interestingly, both of these programs use social networks, commitment, norms, and feedback to promote the adoption of energy-efficient light bulbs. Both have been structured using the principles of community-based social marketing which readily overlap with elements of social rationality.

The ENERGY STAR Change a Light Campaign, led by the US EPA, requires participants to pledge to change at least one light bulb in their house with one that has earned the ENERGY STAR. Individuals and organizations can participate by logging on to the ENERGY STAR website[3] and specifying how many light bulbs they plan to change. Individuals can also become "pledge drivers" by committing to get their community or organization involved in the campaign and committing to promoting the change of at least 100 light bulbs. Participants provide their name, zip code and organizational affiliation, allowing pledge drivers and EPA staff to track their progress and access established social networks to promote change and establish new social norms. The progress of each organization is tracked online –observable for all to see. The public tracking prompts passive competition among pledge drivers and presents an opportunity to recognize top performers. Moreover, the website offers special resources for teachers, retailers and government leaders to work with students, consumers, and communities.

[3] http://www.energystar.gov/index.cfm?fuseaction=cal.showPledge

Project Porchlight is a similar initiative run by a Canadian non-profit organization called One Change based in Ottawa, Ontario. The campaign works with Hydro Ottawa, the City of Ottawa, volunteers and other partners to effect social and environmental change. The original goal of the campaign was to get 200,000 households in Ottawa to change at least one inefficient incandescent light bulb to one energy-efficient CFL by providing residents with a free light bulb. By using existing networks, the project encourages local action in neighborhoods and within groups by working with group members who deliver light bulbs door to door. Light bulb recipients make a commitment to their neighbors that they will install the light bulb (preferably in a prominent place) as a symbol of their commitment to the effort; an action which also provides a first step in shaping their identity as someone who is willing to take action to reduce their environmental impact (One Change 2008).

Not only has Project Porchlight been successful in exceeding their initial goal by more than 20,000 light bulbs, they recently expanded their efforts to other parts of Canada. The project is currently active in more than 150 communities in Ontario and Alberta and works with more than 3000 volunteers. Early in 2008, the project successfully surpassed their new goal of delivering more than one million energy-efficient bulbs.

According to Douglas McKenzie-Mohr, direct appeals that ask people to commit to take a specific action are more effective. If a person agrees to take a specific action, they are likely to follow through on it, especially if the commitment has been made publicly. Because human beings have a need to appear consistent, we are likely to agree to future similar requests for our commitment as well. This holds true even if the next request is larger, occurs after much time has passed, and comes from a different group than that of the initial request. Agreeing to the first request is actually thought to alter how one sees oneself, and in an enduring way.

Social Rationality and Behavioral Change: Effects of Social Norms on Habits and Lifestyles

Social factors can also be used to change behaviors associated with habits and lifestyles. For example, several studies have explored the role of social norms in determining environmentally responsible behaviors. In 1990, Cialdini et al. investigated the effect of norms on individuals' decisions to despoil the environment. In the study, "participants were given the opportunity to litter in either a previously clean or fully littered environment after first witnessing a confederate who either dropped trash into the environment or simply walked through it." Cialdini et al. hypothesized that: 1) participants would be more likely to litter in the already littered environment than into a clean one; 2) participants who witnessed the confederate drop trash into a fully littered environment would be the most likely to litter there themselves because their attention would be drawn to the pro-littering descriptive norm; and 3) participants who saw the confederate drop trash into a clean environment would be least likely to litter there, because their attention would be drawn to evidence of an anti-littering descriptive norm. In fact, the study found that 32 percent of the participants littered in the littered environment without the confederate while 54 percent of participants littered in the same environment when the confederate did litter. The third hypothesis was also supported by the finding that only 14 percent of participants littered in the clean environment when the confederate did not litter, while a mere 6 percent of participants littered in the same environment when the confederate littered.

In a more recent study of energy conservation, Schultz et al. (2007) investigated "respondents' views of their reasons for conserving energy at home as well as reports of their

actual residential energy saving activities such as installing energy-efficient appliances and light bulbs, adjusting thermostats, and turning off lights." When surveyed, respondents were asked to rate the importance of four potential reasons behind their energy conservation: its environmental benefits, its social benefits, its monetary benefits, or because other people are doing it. Respondents reported that their primary reason for conserving energy was "because it will help save the environment." However, a study of the relationship between participants' beliefs in these reasons and their attempts to save energy indicated that conservation behaviors were most strongly correlated with the perception that other people were doing it. According to Schultz, "this belief that others were conserving correlated twice as highly with reported energy saving efforts than did any of the reasons that had been rated as more important personal motivators."

The Intersection between Economic and Social Rationality

Although research suggests that individual decision making (particularly in the residential sector) is unlikely to conform to existing models of economic rationality, prices and incomes clearly do matter, and some form of economic analysis should be included in any useful technology, policy, or program assessment. Importantly, a social rationality approach offers a means of providing a more robust assessment of policy and program options so as to ensure their maximum effectiveness and our ability to manage problems on the scale of climate change. In this section we briefly highlight the standard approach to policy analysis and then suggest how a more integrated and dynamic framework is likely to enable the emergence of more "cost-effective" or "socially-acceptable" solutions.

Currently, most economic policy models fail to adequately capture the ways in which individual energy consumption patterns change in response to both economic and non-economic policies and programs. Therefore, any policies based on these models consistently overlook the energy savings that could be achieved through the accelerated adoption of energy-efficient technologies, changing social preferences, and more energy-aware behaviors. As a result, these models tend to underestimate potential energy savings while overestimating the costs of achieving increased levels of energy efficiency. The inaccuracies often result in uninformed and ineffective energy and climate change mitigation policies.

Economists typically use elasticities to integrate behavior into their economic models. In effect, elasticities are nothing more than a measure of response to a given influence or incentive. When derived from time series data for prices and incomes, for example (as they compare to changes in energy use over time), elasticities provide economists with a measure of how businesses and consumers change their energy use given a change in prices and incomes[4].

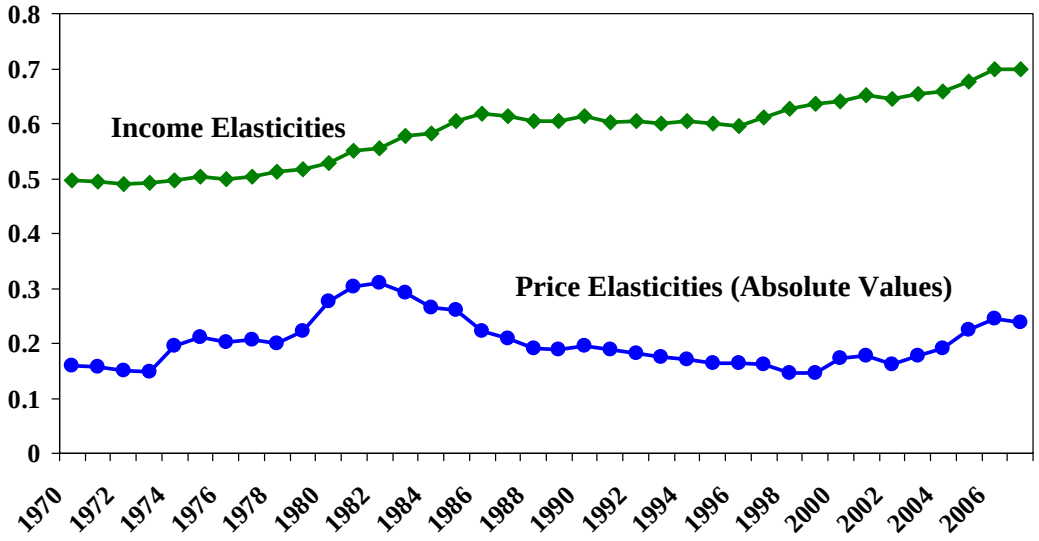
Elasticities are often used (directly or indirectly) in economic models to estimate future levels of energy consumption based on specific policy scenarios that inevitably result in increased energy prices (whether induced by fuel taxes, cap and trade systems, or otherwise). In short, an elasticity represents a fixed relationship between energy prices and energy consumption or between income and energy consumption that is used by economists to estimate how consumption levels will change in response to changing prices or to estimate the cost of inducing

[4] As an example, economists may determine that a 10 percent increase in price has in the past resulted in a 1 percent decrease in the demand for energy. In that case we say that the energy price elasticity is -10 percent (sometimes expressed as -0.1). On the other hand, if we determine that a 10 percent increase in income has in the past resulted in a 3 percent increase in the demand for energy, here we would say that the energy income elasticity is +30 percent (or expressed as +0.3).

a specified amount of energy/carbon savings. Unfortunately, in the real world, elasticities and preferences are not fixed. They change over time. Figure 2 highlights this point.

The data in Figure 2 provide annual estimates for what economists call long-run elasticities over the period 1970 through preliminary estimates for 2007. The figure illustrates the year to year changes in total U.S. energy consumption given changing prices and per capita incomes. The intent is not to suggest that these are actual estimates to be used in economic policy models (the data are much too aggregate in that regard) but to highlight the point that elasticities do change over time.

Figure 2. Annual Changes in Energy-Related Income and Price Elasticities



Source: Authors' calculations based on data referenced in EIA 2008

In general, elasticities focus on observed relationships but fail to explain underlying causal relationships and how those relationships change over time. To that extent, then, economic assessments can benefit from integrating the broader insights within the social science disciplines in at least three ways: 1) recognizing and understanding changes in elasticities; 2) documenting and modeling socially-induced changes in energy consumption; and 3) documenting and modeling the variation in energy consumption patterns across social groups/segments:

1. *Recognizing and Understanding Changes in Elasticities.* As we've highlighted, most economic models incorrectly portray elasticities as fixed. However, both Figure 2 and other research on elasticities show that these values change significantly over time. The available evidence suggests that such changes are the result of changing social structures, preferences, values, social norms, feedback, commitment, etc. Moreover, complex systems and patterns typically arise out of a multiplicity of relatively simple interactions that cannot be explained by the use of constant elasticities. But, the time series data necessary to support these kinds of assessments are generally not available to draw precise conclusions.
2. *Documenting and Modeling Socially-Induced Changes in Energy Consumption.* People respond to more than just energy prices. There is a large body of research and literature

that shows that people may reduce their energy consumption by as much as *one-third* in response to non-financial incentives, disincentives, and other programs. A variety of examples of socially-induced change are provided earlier in this paper.

3. *Documenting and Modeling the Variation in Energy Consumption Patterns across Social Groups/Segments.* Understanding variations in energy consumption patterns across social groups and segments is critical to creating effective policies and understanding the effect of social dynamics on energy consumption and carbon emissions. For example, the use of price elasticities of demand that are based on the average consumer fail to take into account the effect of income inequality on demand and fail to capture the ways in which price elasticities vary across different segments of the population over time. People are social animals. We act in accordance with the norms and values of the groups to which we belong. Therefore, understanding behavioral change requires an understanding of the ways in which membership in particular demographic groups shape and constrain individuals' conscious and subconscious decisions regarding energy consumption.

   A variety of demographic characteristics can offer important insights into energy consumption behavior, including those linked to age, education, income, household status, religion, gender, ethnicity, occupation, political affiliation, etc. For example, recent studies on the relationship between gasoline prices and consumption levels indicate that elasticities associated with transportation fuel costs have been declining (Hughes et al. 2006). These studies create the perception that increasing gasoline prices have little impact on consumption.[5] However, a study of the same relationship across different income categories is likely to reveal a curvilinear relationship such that both lower and higher income groups experience low price elasticities, while middle income groups display higher price elasticities. Low income groups that have limited discretionary income have already reduced their consumption to the minimum and therefore cannot respond to price signals by reducing their consumption further, while high income groups that have large amounts of discretionary spending are better able to absorb the price increases without changing consumption patterns. It is the middle income groups that are most likely to change their consumption in response to increasing prices of gasoline.

Summary and Conclusions

In this paper we attempt to identify some oft overlooked social drivers of residential energy use patterns as a basis for designing more effective energy efficiency programs. While technological innovation and economic incentives will continue to have an impact on individual behavior and energy consumption, we seek to recognize the important ways that individuals respond to social cues and behave in ways that might be called "socially rational." We provide evidence that individual behavior is often shaped by the social context within which people operate. Instead of purely rational economic actors, we argue that individuals are likely to behave and make decisions as rational social actors who determine what is and isn't an "appropriate" behavior by gleaning cues from their observations and interactions within their sphere of social

[5] For a thorough review of the literature on elasticities, see Dahl, Carol. 2006. *Survey of Econometric Energy Demand Elasticities Progress Report,* Golden, CO: Division of Economics and Business, Colorado School of Mines, August.

influence. As such, this paper explores some of the ways in which social rules, resources and context shape individual patterns of energy consumption.

Social networks, social norms, social status, and social context all play an important role in shaping individual behavior. Understanding how individuals are connected through social networks and how those networks shape individual behavior can provide us with special insights into strategies for shaping energy consumption behavior. Similarly, social norms frequently distinguish "appropriate" from "inappropriate" behavior. The shaping and application of social norms to energy consumption behaviors provides non-economic means of changing individual and household behavior. Social status and markers of social status can also provide compelling sources of motivation in efforts to reinforce or change individual behaviors. Finally, social context provides an important backdrop in everyday decision making activities that provide individuals with clues regarding potential risks and rewards that validate or discredit issues of concern, and that structure the opportunities and constraints within which choices are made.

In addition, we argue that energy policy modeling efforts could also benefit substantially from acknowledging and incorporating the range of non-economic but socially rational means of stimulating or enhancing energy efficiency behaviors. By recognizing the non-economic, social forces that shape behavior, the scope of policy options becomes broader, providing the means to dramatically redefine our approach to addressing energy and climate change challenges and augmenting the likelihood of successful outcomes.

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