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House Committee on Science and Technology

Hearing on:
The Contribution of the Social Sciences to the Energy Challenge

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Summary

This testimony is a response to an invitation to help members of the Subcommittee on Research and Science Education to explore the relevance of the social, behavioral and economic sciences in shaping a more productive energy use and set of energy policies. Any useful policy assessment clearly must include some form of economic analysis. Prices and incomes do matter in the evaluation of public policy; but they are not all that matter. Technological innovation and market dynamics are among those things that influence our demand for energy-related goods and services. Social norms and structures also play a role. These all, in turn, are shaped by culture, beliefs, values, preferences, habits, and the availability of alternatives.

For the most part, current economic policy models fail to adequately capture the ways in which individual energy consumption patterns change in response to both economic and noneconomic policies and programs. Therefore, policies based on these models have consistently overlooked the energy savings that can be achieved through changing social preferences, the accelerated adoption of energy-efficient technologies, and more energy-aware behaviors. As such, these models have tended to underestimate the energy savings that can be achieved while generally overestimating the costs of achieving increased levels of energy efficiency. The inaccuracy of these models has large and important implications for both energy policy and climate change mitigation policy. There is good news in all of this but, as we shall see, there is work ahead.

Given this circumstance, and based on the available evidence, the American Council for an Energy-Efficient Economy (ACEEE) believes three distinct recommendations are in order. First, and after further review, the Subcommittee should issue a set of findings that confirms our testimony. We think it will send a positive signal to the economics and social science communities that there is clear room for improvement. Second, support the development and funding of a National Energy Efficiency Data Center (NEEDC) which would be a national non-profit organization whose purpose will be to collect, organize, disseminate and archive energy efficiency and social science statistics, particularly those related to public policies and programs. Finally, more research and greater research funding will provide the means to expand our knowledge and understanding of how human behavior and choice can increase energy-efficiency, reduce our energy dependency, and reduce our impact on the global climate while still maintaining a robust economy.

Introduction

My name is John A. "Skip" Laitner and I am the Senior Economist for Technology Policy for the American Council for an Energy-Efficient Economy (ACEEE), a nonprofit organization dedicated to increasing energy efficiency as a means of promoting both economic prosperity and environmental protection. I am here today at the invitation of this Subcommittee to explore the relevance of the social, behavioral and economic sciences to energy use and policy. I thank you for the opportunity to testify today. Working with me in the preparation of this testimony here today is my ACEEE colleague, Karen Ehrhardt-Martinez. She holds a professional degree in sociology and works with me on a variety of economic and technology issues.

Any useful policy assessment must include some form of economic analysis. Prices and incomes do matter in the evaluation of public policy; but they are not all that matter. Indeed, the great English economist Joan Robinson wrote in 1947 that "economics science has not solved its first problem – namely what determines the price of a commodity?"[1] That remains true today, now 60 years later. But I might add, neither has economics determined exactly what magnitude of income is sufficient to satisfy either individual or household demands.

Among those things that influence our demand for goods, services, and amenities, and that also impact things like technological innovation, market dynamics, and personal choice are social norms and structures. These, in turn, are shaped by culture, beliefs, values, habits, alternatives, and basic human and social needs. In short, there is compelling evidence that an accurate economic analysis (of either energy use or the environmental impacts associated with the production and consumption of energy) requires a broader understanding of human behavior and choices. It also requires an understanding of the ways in which they are shaped by the institutional and social frameworks of our society. Recent studies of climate change policy have also stressed the importance of human choice and human behavior for the development of effective policies that reduce emissions and mitigate climate change.[2] However, current economic models fail to adequately capture the ways in which individual energy consumption changes in response to economic and noneconomic policies and programs.[3] Therefore, policies based on these models have consistently overlooked the energy savings that can be achieved through changing social preferences and the accelerated adoption of energy-efficient technologies and more energy-aware behaviors. As such, these models have tended to underestimate the energy savings that can be achieved while generally overestimating the costs

[1] Robinson, Joan. *An Essay on Marxian Economics*. London, England: MacMillan, 1947, page 79.
[2] Brewer, Garry D. and Paul C. Stern, Eds. 2005. *Decision Making for the Environment: Social and Behavior Science Research Priorities*. Committee on the Human Dimensions of Global Change, National Research Council, Washington, DC: National Academies Press; and also see, Stern, Paul C.; Oran R. Young; and Daniel Druckman, Eds. 1991. *Global Environmental Change: Understanding the Human Dimensions*. Committee on the Human Dimensions of Global Change, National Research Council, Washington, DC: National Academies Press.
[3] Laitner, John A. "Skip"; Stephen J. DeCanio; and Irene Peters. 2000. "Incorporating Behavioral, Social, and Organizational Phenomena in the Assessment of Climate Change Mitigation Options." in E. Jochem, J. Sathaye and D. Bouille, *Society, Behavior, and Climate Change Mitigation*. Dordrecht, The Netherlands: Kluwer Academic Press, pages 1-64; and Laitner, John A. "Skip"; Stephen J. DeCanio; Jonathan G. Koomey, and Alan H. Sanstad, "Room for Improvement: Increasing the Value of Energy Modeling for Policy Analysis." *Utilities Policy*, 2003, 11, pp. 87-94. Finally, see also, Worrell, Ernst; Stephan Ramesohl, and Gales Boyd. 2003. "Towards Increased Policy Relevance in Energy Modeling," *ACEEE 2003 Summer Study on Energy Efficiency in Industry.* Rye Brook, NY: American Council for an Energy-Efficient Economy, 2003.

of achieving increased levels of energy efficiency. The inaccuracy of these models has large and important implications for both energy policy and climate change mitigation policy. In my testimony here today, I will expand on these notions a bit more as I try to answer three questions that this Subcommittee has posed for me:

1. How predictive is a purely economic approach to evaluating the impact of energy policy on individual and communal behavior? What other factors need to be considered to match economic theory to empirical data? To what extent are such data even available? That is, to what extent are relevant energy policies being evaluated for effectiveness?

2. To what extent are policies to influence individual and community energy use being shaped by what has been learned from research in the social sciences, including economics? As you aware of particular sectors of industry or government that make more of an effort to incorporate the results of such research into the design and evaluation of policy?

3. Please describe the purpose and scope of the first-ever Behavior, Energy and Climate Change Conference being organized by ACEEE. What do you hope to achieve through this conference? How much interest have you seen from industry, government officials, and others in a position to influence policy?

In responding as fully as I can to each of questions, let me divide up my testimony into five parts. The first section following this introduction provides an energy and economic context that I hope will be helpful in responding to the Subcommittee's request. The next three sections will deal specifically with each of the questions posed. The last section will provide recommendations and conclusions.

Energy Consumption in Context

As one of the richest and more technologically advanced regions of the world, the United States has expanded its economic output by three-fold since 1970. Per capita incomes are also twice as large today compared to incomes in 1970. Notably, however, the demand for energy and power resources grew by less than 50 percent during the same period.[4] This decoupling of economic growth and energy consumption is a function of increased energy productivity; in effect, the ability to do more with less consumption. In today's testimony I would like to accomplish three specific tasks as I try to answer your questions. First, I would like to note how this decoupling has been achieved; second, reaffirm the compelling evidence that already suggests greater energy productivity gains can be achieved – that there is, indeed, significant room for improvement; and third, suggest that social science research can provide policy makers with a more satisfying set of insights that can help our nation to capture those greater energy productivities while maintaining our economic prosperity and enhancing overall environmental quality. There is good news in all

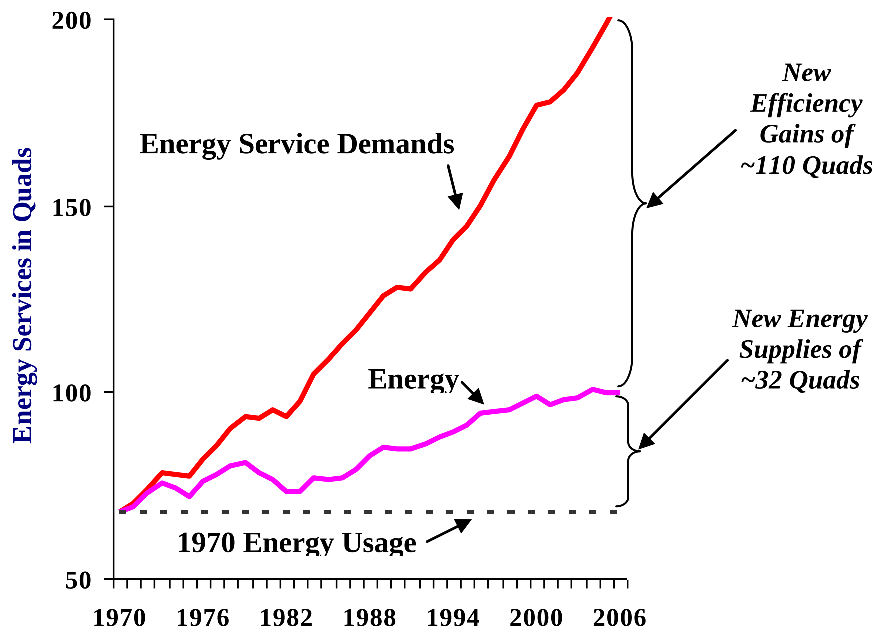
[4] These and other specific energy-related data cited in the testimony are the author's calculations as they are drawn from the Energy Information Administration's *Annual Energy Review 2006*, Report No. DOE/EIA-0384(2006), Washington, DC: U.S. Department of Energy, June 2007; and Energy Information Administration's *Short-Term Energy Outlook – August 2007*, Washington, DC: U.S. Department of Energy.

of this but, as we shall see, there is work ahead.

The Success of Energy Efficiency to Date

The members of this Subcommittee may be surprised to learn how big a role that energy efficiency has already played supporting the growth of our economy over time. Figure 1, below, provides the historical context of efficiency gains estimated through 2007 as they might compare to the development of new energy supplies since 1970. In effect, Figure 1 compares the projected level of energy consumption in 2007 to that which might have been necessary had the economy continued to rely on 1970 technologies and market structure.

Figure 1. U.S. Energy Service Demands, Energy Efficiency Gains, and Energy Supplies



Source: Author calculations based on EIA data referenced in footnote 4.

In 1970 Americans consumed an estimated 68 quadrillion Btus (quads) for all uses of energy – whether heating and cooling our homes, schools, and businesses, powering our many industrial processes, or transporting both people and freight to the various places they needed to go. If we converted all forms of energy consumed in 1970 to an equivalent gallon of gasoline per capita, it turns out that the U.S. economy required about 2,670 gallons of gasoline equivalent for each man, woman, and child living in the U.S. at that time. Had the United States continued to rely on 1970 market structure and technologies to maintain its economic growth we would today be consuming an estimated 210 quads of energy. That would have been about 5,550 gallons of gasoline per person equivalent. But in fact, the consumption estimated for 2007 appears to be only slightly more than 100 quads of energy (in rounded numbers). Again on a per capita equivalent, this means that the United States economy requires about 2,660 gallons of gasoline per resident.

In examining these numbers more closely, several insights might pop into mind. First, energy efficiency has allowed us to decrease the per capita energy use, at least somewhat, compared to what we used in 1970. Second, instead of doubling our energy use the gains in energy efficiency, in effect, have allowed us to reduce total energy use by the equivalent of 110 quadrillion Btus in 2007. As such, energy efficiency has "fueled" roughly 77 percent of the new growth demands in the United States since 1970. The new energy resources, on the other hand, have provided less than one-third of the demands (or about 32 Quads as shown in the figure).

Technology Drivers Behind Our Energy Efficiency Gains

Among the reasons for the increased energy productivity during the past 35-40 years has been the emergence and widespread adoption of advanced technologies, including substantial improvements in standard consumer products, new high-tech electronics, improvements in fuel economy, and the emergence of a variety of information and communication technologies (ICT). A refrigerator in 1970, for example, would have consumed on average 1,600 to 1,800 kilowatt-hours (kWh) of electricity per year. Today, new refrigerators might require only 450 to 600 kWh – even as their volume has more than doubled in size. In 1970 cogeneration units which might have achieved efficiencies on the order of 50-60 percent (still more favorable than the 32 percent system efficiencies of our electricity grid back then, and with a level of inefficiency that persists still today) were seldom part of a company's long-term energy plans. Their more productive cousins – what today we call combined heat and power plants that can achieve overall efficiencies of 90 percent and beyond – have become a critical resource in the strategic plans of many energy-intensive industries. In 1970 I was driving a 1957 Chevy which may have gotten all of 20-21 miles per gallon – if that. Today I own a Toyota Prius which perhaps averages 45 miles per gallon. And today I do more online banking and shopping, and businesses conduct more of their transactions electronically – especially in the last two decades. These and many other advanced technologies have added up to a significant increase in overall energy efficiency.

The Social Drivers Behind Our Energy Efficiency Gains

The impressive gains in energy efficiency since 1970 are the result of the numerous innovations and choices made by both businesses and consumers. But what are the drivers behind these innovations in efficiency? What spurs people to choose energy-efficient technologies and behaviors? And how much variation is there in the decision-making process?

Among the drivers of innovation and efficiency is the increasing level of concern about rising energy prices. However, while energy prices comprise an important motivating factor, innovation and efficiency have also been driven by concerns about environmental degradation, global climate change, international energy security, and even the lack of adequate energy and water supplies within developing countries.

In other words, it is a varied backdrop of concerns that has motivated action by individuals, households and companies that are interested in solving problems. In addition to their concerns over energy and the environment, individuals and groups also regularly contend with concerns over earning a decent income, as well as developing a highly profitable enterprise. But the complexity of the process doesn't end there. A thorough understanding of motivating factors is further complicated by the diversity of interests, backgrounds, skills, and personalities held by would-be agents of change. In fact, these individuals and organizations bring with them both shared and divergent sets of interests, backgrounds and skills, creating a kaleidoscope of shifting concerns and behavioral outcomes. In other words, there is a wide range of corporate, group, and individual characteristics that shape one's propensity toward energy-saving, or energy-efficient behaviors and those characteristics often change over time; yet none of these attributes or concerns are adequately captured in the energy prices signals and changes in incomes that economic models typically rely on to evaluate the impacts of energy programs or policies. Moreover, by relying on energy prices as the primary driver of behavioral change, economic models fail to measure and incorporate the impact of other important elements such as consumer information pertaining to the availability of more energy-efficient products on the market, the variety of ways of shipping a product while generating net energy savings, or traveling to new places for work or leisure in ways that use less energy. In short, energy choices are not simply a function of energy prices but involve a more complex mix of motivating factors that vary across individuals and organizations and that shape their propensity to act.

The good news is that studies by ACEEE and others have repeatedly shown that the United States can cost-effectively reduce energy use 25-30 percent or more over the next 15-20 years in ways that *increase* overall productivity.[5] Moreover, given the right choices and investments in the many cost-effective but underutilized energy-efficient technologies, these gains in energy productivity could provide much needed slack in now overly stressed energy supply markets.[6] This, in turn, can lessen energy price volatilities, and minimize greenhouse gas emissions – all in ways that save additional money for businesses and consumers. While this information is readily available, it has not been included in most of the economic models used to evaluate energy policies. As a result, policies based on these models have consistently overlooked the cost-effective energy savings that can be achieved through changing social preferences and the accelerated adoption of energy-efficient technologies and behaviors.

Economic Models, Social Preferences and Energy Policy

The Subcommittee has asked how predictive is a purely economic approach to evaluating the impact of energy policy? To answer this question it might be helpful to first put this into a context. For that purpose, let me take you back to 2003 when both U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy's Energy Information Administration (EIA) received a Congressional request to evaluate a proposed climate policy that would reduce energy-related carbon dioxide emissions by about one-third compared to levels forecasted for the year 2025. The resulting EIA modeling analysis, using its National Energy Modeling System (NEMS) suggested that if that policy were adopted there would be a negative impact on investment and household consumption, and that energy prices would rise

[5] Nadel, Steven; R. Neal Elliott, and Therese Langer. 2005. "A Choice of Two Paths: Energy Savings from Pending Federal Energy Legislation, Washington, DC: American Council for an Energy-Efficiency Economy. See also, McKinsey Global Institute, "Curbing the Global Energy Demand Growth: The Energy Productivity Opportunity, McKinsey & Company, San Francisco, CA, May 2007; and finally, "Closing the Efficiency Gap: Strategic Plan for energy Efficiency Improvement in the G8 Countries," United Nations Foundation, Washington, DC, July 2007.
[6] Elliott, R. Neal. 2006. "America's Energy Straightjacket," Washington, DC: American Council for an Energy-Efficient Economy.

significantly compared to the reference case.[7] Conversely, the EPA relied on the Argonne National Laboratory's AMIGA Modeling System and found the impacts to be somewhat more positive; indeed, the analysis (which unfortunately was never publicly released) showed that there could be small but positive increases to both investment and consumption over time.[8]

Three key differences perhaps explain this sharp contrast in modeling results. First, the AMIGA modeling system tends to use a more dynamic characterization of technology cost and performance over time. This means that as price signals increase (for example, through a cap and trade mechanism), and as non-price policies are implemented (for example, by expanding voluntary initiatives such as the Energy Star programs, increasing performance-based standards such as the Energy Efficiency Resource Standard, or appropriating additional funds for energy-related R&D efforts), the AMIGA modeling system tends to show a greater improvement in technology performance which reduces the costs and generates a higher energy bill savings. Second, the model tracks the substitution of productive capital as it displaces less energy-efficient technologies over time. It then translates this into a more appropriate GDP accounting framework than the NEMS model is able to do.[9] Finally, AMIGA allows consumer and business preferences to shift over time in response to various programs. For example, consumers today might purchase a new appliance only if it pays for itself in three years. However, an expanded set of voluntary programs might encourage the adoption of technologies that might pay for themselves in, say, four or five years. That greater willingness to adopt technologies means a greater level of net energy savings for the economy.[10]

There are two critical points to be made in answering the Subcommittees question in this regard. First, since the EIA report was the only analysis that was publicly released, the persistent storyline of negative economic impacts tended to erode public and Congressional support for any meaningful action on either energy or climate policy in the United States. Therefore, the most direct effect of poorly developed economic modeling exercises on behavior has been to limit the range of perceived opportunities for action and therefore to limit action itself. In other words, the publication of a set of modeling runs that rely on an inappropriate characterization of energy productivity benefits has limited the public sense of opportunity to act. Second, the exclusion of appropriate social variables and technology characterizations from these models also tends to make these options invisible during debates of possible remedies and solutions. In other words, poorly specified models have also tended to limit policy options to a narrow set of potential

[7] Energy Information Administration, *Analysis of S. 139, the Climate Stewardship Act of 2003*, U.S. Department of Energy, Washington, DC, June 2003.

[8] U.S. Environmental Protection Agency, "Preliminary Analysis of the Climate Stewardship Act," Unpublished results, May 23, 2007. The witness has direct knowledge of this analysis as he was the EPA project officer that undertook this analysis in cooperation with the Argonne National Laboratory's AMIGA modeler, Donald A. Hanson.

[9] In fact, AMIGA generally follows the accounting framework of the Bureau of Economic Analysis as it estimates quarterly GDP for the United States. As BEA tracks changes in GDP for any given period of time, it accounts for total household consumption, total investment, overall government spending, and total net imports. AMIGA follows this same accounting procedure. Hence, if there are programs and policies which stimulate increases in more productive investment in the economy that saves money for households and businesses, and reduces imports of oil and natural gas, AMIGA would show that to provide net benefits to the U.S. economy.

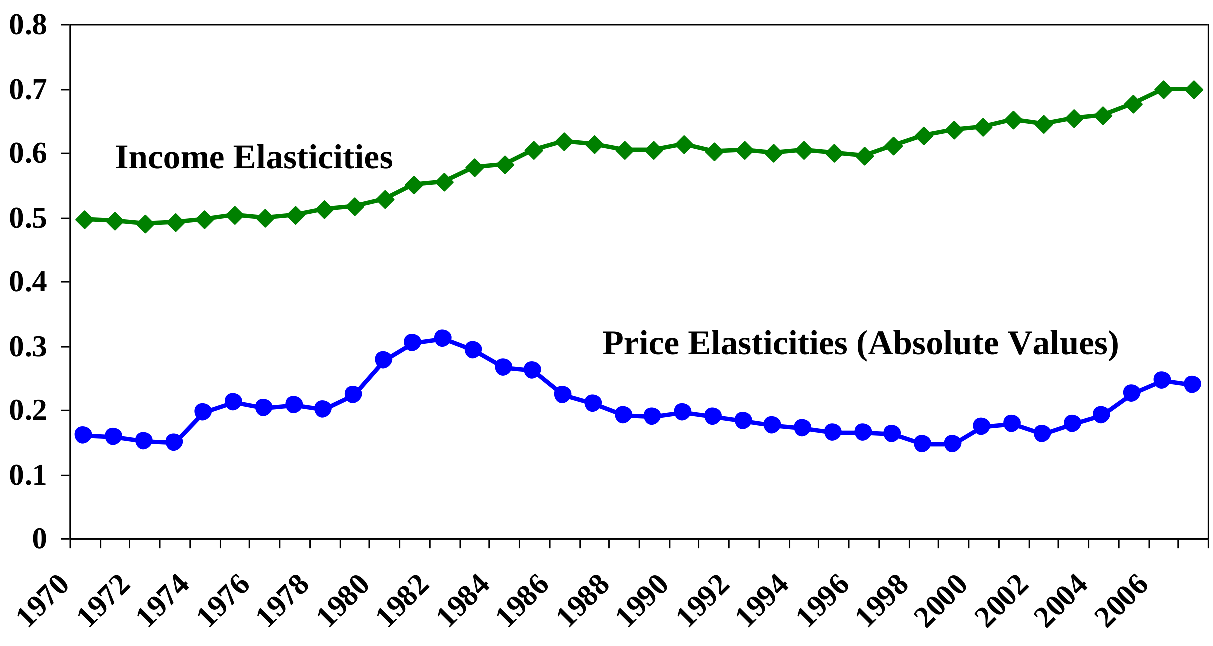
[10] Perhaps of interest to the Subcommittee, there is more information on this topic as a result of a November 2006 national workshop that ACEEE convened to explore a number of these critical insights. The workshop title was, "Energy and Economic Policy Models: A Re-examination of Some Fundamental Issues." For a full list of participants and access to the papers presented there, see: http://www.aceee.org/conf/06modeling/.

solutions predominantly focused on increasing energy supply as opposed to policies that could increase efficiency using social and behavioral science and existing technologies. Integrating these important social and technological measures into economic models can provide us with a more satisfying and thorough review of energy and climate policy options, thereby significantly broadening the options from which to choose.

Currently, the primary method for integrating behavior into economic models is through what economist call "elasticities." When derived from time series data for prices and incomes as they compare to changes in energy use over time, these values provide economists with a measure of how energy use responds to changes in prices and incomes. 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 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).

These and other forms of elasticities are used directly or indirectly in economic models to estimate future energy consumption based on different policy scenarios that inevitably result in increased energy prices whether induced by fuel taxes, cap and trade systems, or otherwise. In short, the elasticity is a constant that is used by economists to estimate the level of energy consumption at a variety of different energy prices or to estimate the cost of inducing specified amounts of energy/carbon savings. Unfortunately, this method fails to account for non-economic programs and policies and changing preferences among consumers and the important impact that they can have on elasticities and consumption patterns. In other words, elasticities and preferences are not fixed. They change over time. Figure 2 highlights this point.

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



Source: Author calculations based on EIA data referenced in footnote 4

The data in Figure 2 provide annual estimates for what economists call long-run elasticities over the period 1970 through 2007. As opposed to monthly or quarterly changes, the so-called long-run in this case covers 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 but highly useful for our purposes here today. In that regard, the intent is to highlight that these values change over time, they are not at all constant as most economic models assume them to be.

Using one approach a modeler might determine that the income elasticity over this period of time might be 0.60. But, in fact, the value changes annually. In 1970 the income elasticity appears to be on the order of 0.50, generally rising over time. By 2007 it approaches a value of 0.70. On the other hand, the price elasticity (in absolute terms meaning that we've dropped the negative sign) might be estimated as 0.20 over the period of analysis shown in Figure 2. However, there is a significantly different pattern of annual changes in price elasticities than is shown for income elasticities. First the pattern is much more volatile. It starts at about 0.16 (again as an absolute value). It then bumps up and dips before reaching a peak of about 0.31 in 1982. It then slides back down to 0.17 in the year 2000. The pattern finally closes at a significantly higher 0.24 by the end of the period.

Given the set of data highlighted in Figure 2, three points quickly emerge. First, we've clearly confirmed that elasticities are not at all constant. Any analysis that makes that assumption may generate biased results. Second, the data show policymakers that, yes, these changes are occurring but they provide little insight into what drives these changes; more critically, they provide little insight as to what mix of programs and policies might provide a more reasoned or balanced response to concerns about energy and climate change issues. Finally, most economic models start with the presumption that prices are the critical determinant of behavior. But the data in Figure 2 suggest that, for the United States over this time horizon, income levels are a greater determinant of energy use than are energy prices. This seems to suggest that policymakers may want to explore income-based policy initiatives as a complement to the price signal. In other words they might want to evaluate the extent to which incentives may induce a more appropriate public response; or they might want to explore policies that encourage innovations which increase energy productivity and generate savings for the economy.[11]

The social sciences can and should contribute in at least three ways:
1. Recognizing and Understanding Changes in Elasticities
2. Documenting and Modeling Socially-Induced Changes in Energy Consumption
3. Documenting and Modeling the Variation in Energy Consumption Patterns across Social Groups/ Segments

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[11] In fact, one recent journal article provided evidence that a combination of programs and policies which complemented a mild price signal actually generated a more cost-effective result than a policy which depended on price signals alone to drive changes in total energy consumption. Hanson, Donald A. and John A. "Skip"Laitner. 2004. "An Integrated Analysis of Policies That Increase Investments in Advanced Energy-Efficient/Low-Carbon Technologies." *Energy Economics*, 2004, 26(4), pp. 739-55. See especially the discussion surrounding price and non-pricing policies as highlighted by the results in Table 4 of that article.

1. Recognizing and Understanding Changes in Elasticities:

As we've just highlighted, most economic models now portray elasticities as fixed. However, both Figure 2 and other research on elasticities shows 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 1/3 in response to non-financial incentives, disincentives and other programs. Two examples highlight this point. First, in a recent study of hotel guest behaviors, Robert Cialdini (also a witness at this hearing) sought to increase the number of guests that were willing to reuse their towels instead of having them laundered on a daily basis. The study left cards in each hotel room asking guests to reuse their towels and noted that 75 percent of people staying in the hotel had, at some point in their stay, reused their towels. By emphasizing the behavior as normative, Cialdini was able to lift reuse rates from 35 percent to 58 percent, saving both water and energy.[12]

In another study, Schultz et al. (2007) used a social norms approach to help homeowners to conserve energy. The study involved delivering notices to household doorsteps, telling homeowners how their energy consumption compared to the neighborhood average. Homeowners who were consuming more electricity than their neighbors reduced their consumption.[13]

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 to 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.

[12] Cialdini, R.B. 2005. "Basic Social Influence is Underestimated." *Psychological Inquiry* 16(4): 158-161.

[13] Schultz P.W., J.M. Nolan, R.B. Cialdini, N.J. Goldstein, and V. Griskevicius. 2007. "The Constructive, Destructive, and Reconstructive Power of Social Norms." *Psychological Science* (May).

For example, recent studies on the relationship between gasoline prices and consumption levels indicate that elasticities associated with transportation fuel costs have been declining.[14] These studies create the perception that increasing gasoline prices have little impact on consumption. 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.[15]

The Role of Social Science Research on Energy Policy

When applied correctly, both non-economic and economic social science research can provide critical insights into the most effective, viable, and sustainable energy policies. When correctly specified, economic models can provide policy makers with a range of policy scenarios and likely outcomes. When used in conjunction with economic insights, non-economic social science research can help by: 1) ensuring the development of *appropriate* technologies, 2) increasing the adoption of existing technologies, 3) improving the effectiveness of economic policies and forecasts, and 4) identifying non-economic mechanisms for catalyzing the types of social change required to reduce CO2 emissions and moderate climate change.

Since the 1980s, funding for non-economic social science research on energy consumption has declined dramatically. More funding is clearly needed in order to expand our understanding of the social dynamics of energy consumption, energy conservation and energy efficiency. By expanding this knowledge base, we could significantly improve our capacity to reduce energy consumption via mechanisms that are currently less well understood.

Past research on non-economic mechanisms, performed primarily in the 1970's and 1980's, is being currently being applied in some programs. At the national-level, the Energy Star program is using research on information dissemination and labeling to improve their information campaigns. They are also using research on the effectiveness of social marketing strategies in their design of campaigns to increase the adoption of energy-efficient technologies. A variety of electric utilities have also used social science research to inform demand-side management programs to effectively reduce energy consumption and reduce peak load demand.

[14] Hughes, Jonathan E.; Christopher R. Knittel; and Daniel Sperling. 2006. "Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand," Center for the Study of Energy Markets (CSEM) Working Paper 159. Berkeley, CA: California Energy Institute, University of California. September.

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

The Behavior, Energy and Climate Change Conference

Finally, the Subcommittee has asked about the upcoming Behavior, Energy and Climate Change (BECC) Conference – scheduled for November of this year in Sacramento, CA. This event has been organized in response to the needs of policy makers to better understand the energy behavior and energy-related choices made by consumers at all levels, whether residential, commercial, industrial, governmental, or non-profit. The routine activities of these energy users are the key drivers of greenhouse gas emissions. Therefore, efforts to reduce climate impacts necessitate a clear understanding of the social and behavioral factors that shape choices to conserve energy or to purchase more efficient appliances, buildings and vehicles.

Conference planning began early in 2007, when the California Institute for Energy and Environment (CIEE), under the auspices of the University of California System's Office of the President, brought together a small planning group to begin to think about how to engage policy makers and researchers in a dialogue about the importance of behavioral research in accelerating the pace and impacts of new climate policies in California (and California's partner states and provinces). Subsequent discussions led to a Behavior, Energy and Climate Change Summit meeting in Sacramento in May of this year. At the BECC summit, policy staff of state legislature, energy and environmental agencies, private and public utilities, academic researchers, and private sector representatives (50 in all) met to discuss common interests, concerns and information needs in this area. There was broad agreement of the importance of behavior and choice in understanding and affecting climate change, and a willingness to continue the conversation and to engage a larger group in finding ways to improve policy, enhance program impacts, and increase the quantity of scientific research needed to support these efforts.

An important outcome of the summit is the upcoming Behavior, Energy and Climate Change Conference to be held November 7-9, 2007 in Sacramento, California. CIEE has partnered with the American Council for an Energy Efficient Economy (ACEEE) and Stanford University's Precourt Institute for Energy Efficiency (PIEE) in sponsoring this meeting, which has now gained national attention and participation from across the United States and Canada. (ACEEE has consistently provided a venue to report behavior research related to energy use for 25 years at its biennial Summer Study conference. PIEE is a newly funded institute. It has behavior research as one of six focal areas and is compiling a database of the literature.)

The BECC conference program includes more than 60 speakers and will cover a broad range of topics. But a common theme is linking knowledge—whether from scientific literatures, ongoing academic research, energy evaluation, or program experience—to policy development and implementation. (A preliminary conference agenda is included in this testimony.) The hoped-for results will include increased awareness, new collaborations between researchers and decision-makers in industry and government, a more effective mix of policies (voluntary and regulatory), greater support for behavior-focused research and an acceleration of the rate and impacts of efforts to reduce climate change in California and elsewhere. More of the conference details, including the preliminary program agenda can be found on the ACEEE website (see: http://www.aceee.org/conf/07becc/07beccindex.htm). The final conference agenda, the full set of presentations and a conference summary document will also be available on the website following the conclusion of the conference.

In addition to the conference, the initial discussions also identified the need to compile the diverse and dispersed literature on behavior, energy and climate change to facilitate research and encourage collaborations among policy makers, academic researchers and others. Precourt Institute at Stanford is undertaking this project and has recently developed a searchable bibliographic database of relevant literature as well as lists of foundational readings and other resources. The initial set of references will be available on their website on September 25 at http://piee.stanford.edu. The database will expand over time as other researchers contribute additional literature and information and professional profiles of researchers involved in the area will also be added.

Conclusions and Recommendations

Based on more than 25 years of research on energy efficiency, ACEEE believes the evidence indicates a generally less-than-satisfying performance of economic models as they have been used to assess a variety of energy and climate-related energy policies. By definition, national energy policy decisions, based on erroneous or incomplete information, will lead to suboptimal economic and environmental outcomes. The good news in all of this is that, despite the generally pessimistic outcomes published by many of the conventional models, there has been a resurgence of interest of how economics and the social sciences can inform policy, increase energy efficiency, and reduce energy consumption. One indication of this renewed interest is the planned Behavior, Energy and Climate Change Conference to be held November 7-9, 2007 in Sacramento, California.

On the other hand, renewed interest does not guarantee real results. Any real advancements in the capacity of the economics and social science communities to contribute to more meaningful policy insights will require targeted support from policymakers to overcome the current lack of research funding as well as the paucity of existing data.

Given current circumstances, and based on the available evidence regarding the contribution of social sciences to energy policy, ACEEE believes three distinct recommendations are in order. First, and after further review by this Subcommittee, we believe it appropriate for the Subcommittee to issue a set of findings that confirms our testimony. We think it will send a positive signal to the economics and social science communities – that there is clear room for improvement. Second, support the development and funding of National Energy Efficiency Data Center (NEEDC), a national non-profit organization whose purpose will be to collect, organize, disseminate and archive energy efficiency and social science statistics, particularly those related to public policies and programs.[16]

[16] For more details on this proposal, see: Horowitz, Marvin J. 2006. "It's Time for a National Energy Efficiency Data Center," Arlington, VA: Demand Research; as presented to the ACEEE workshop, "Energy and Economic Policy Models: A Re-examination of Some Fundamental Issues, Washington, DC. The Horowitz paper and others from this workshop can be downloaded from: http://www.aceee.org/conf/06modeling/.

Finally, and more critically, more research and greater research funding are needed in order to expand our knowledge and understanding of how human behavior and choice can increase energy-efficiency, reduce our energy dependency, and reduce our impact on the global climate.

Energy consumption is an integral part of our daily lives. Individuals, households, businesses, industries, and organizations consume energy in work and in leisure, 24/7. Energy heats and cools our homes; harvests, processes and cooks our food; provides us with transportation; powers our computers; and powers our industrial machinery.

Energy consumption is rooted in human behavior. What is less widely recognized is that the solutions to energy shortfalls are also rooted in human behavior. Instead, the first and most common response is to look to *technology* to provide the answers. And, when available technologies aren't adopted, we look to the field of *economics* to explain why not. Unfortunately this approach is unable to adequately identify and address the behavioral roots of our energy problems that extend beyond the realm of economics. Effective solutions must draw on a broader understanding of social systems and human behavior.

The need for a better understanding of human behavior and choice has been repeatedly noted by the National Research Council's Panel on Human Dimensions of Global Change, emphasizing the need for behavioral research for effective policies that reduce emissions and mitigate climate change.[17] Most recently, the National Academies have reported that behavioral science has been significantly under-supported in the U.S. Climate Change Science Program.[18] In fact, most of the social science work in this area has either been undertaken by lone academic investigators or supported by progressive state government and utility companies, particularly in California, the Pacific Northwest, and parts of the upper Midwest and New England. The resulting academic social science literature is scattered across the disciplines of sociology, psychology, anthropology, and economics. It is not coherent or well-organized. And it is difficult for policy makers and researchers to access—although there have been several efforts to bring these literatures together in comprehensive reviews.[19] The non-scientific literatures are mainly from energy program evaluations and market studies. They are of uneven quality. Although some of

[17] Garry D. Brewer and Paul C. Stern, Eds. 2005. *Decision Making for the Environment: Social and Behavioral Science Research Priorities.* Committee on the Human Dimensions of Global Change, National Research Council. Washington DC: National Academies Press.

Paul C. Stern, Oran R. Young and Daniel Druckman, Eds. 1991. *Global Environmental Change: Understanding the Human Dimensions.* Committee on the Human Dimensions of Global Change, National Research Council. Washington DC: National Academies Press.

Paul C. Stern and Elliot Aronson, Eds. 1984. *Energy Use: The Human Dimension.* New York: Freeman.

[18] Committee on Strategic Advice on the U.S. Climate Change Science Program. 2007. *Evaluating Progress of the U.S. Climate Change Science Program: Methods and Preliminary Results.* Washington DC: National Academies Press.

[19] For example: Schipper, Lee, Sarita Bartlett, Dianne Hawk, and Ed Vine. 1989. "Linking Lifestyles to Energy Use: A Matter of Time?" *Annual Review of Energy.* 14:273-318.

Loren Lutzenhiser. 1993. "Social and Behavioral Aspects of Energy Use" *Annual Review of Energy and the Environment.* 18:247-89.

Charlie Wilson and Hadi Dowlatabadi. 2007. "Models of Decision Making and Residential Energy Use." *Annual Review of Environment and Resources.* 32:2.1-2.35.

this work can be found in public data bases,[20] much is a "gray literature" that is not known to policy makers and, in fact, not readily accessible.

More research and greater research funding will provide the means to expand our knowledge and understanding of how human behavior and choice can increase energy-efficiency, reduce our energy dependency, and reduce our impact on the global climate while still maintaining a robust economy.

This concludes my testimony. Thank you for the opportunity to present these views. I will be happy to respond to further questions and, of course, to provide any additional material the Subcommittee believes will be helpful in examining this critical topic.

[20] California Measurement Advisory Council searchable database. http://www.calmac.org/search.asp
Consortium for Energy Efficiency, Market Assessment and Program Evaluation Clearinghouse searchable database http://www.cee1.org/search/search.php