Experts Meeting: Behavioral Economics as Applied to Energy Demand Analysis and Energy Efficiency Programs

EIA Office of Energy Consumption and Efficiency Analysis

July 17, 2013 | Washington, DC

Meeting Agenda

- **EIA WELCOME AND INTRODUCTION (15 minutes)**
- **ORIENTATION/PRESENTATION: OVERVIEW OF EIA RESIDENTIAL AND COMMERCIAL DEMAND MODELS AND CURRENT METHODS FOR INCORPORATING ENERGY EFFICIENCY/EFFICIENCY PROGRAMS (30 minutes)**
- **ORIENTATION/PRESENTATION: BEHAVIORAL ECONOMICS GENERAL OVERVIEW AND DISCUSSION (45 minutes)**
- **EXPERTS ROUNDTABLE DISCUSSION/BRAINSTROMING: HOW CAN EIA BENEFIT FROM APPLICATION OF BEHAVIORAL ECONOMICS TO RESIDENTIAL AND COMMERCIAL ENERGY DEMAND MODELING? (2 hours)**
- **MEETING SUMMARY AND CONLUSIONS (30 minutes)**

WELCOME AND INTRODUCTION BY EIA

- **EIA Staff Participants**
  - **Jim Turnure**, Director, Office of Energy Consumption and Efficiency Analysis
  - **Erin Boedecker**, Team Lead, Buildings Energy Consumption and Efficiency Analysis
  - **Mark Schipper**, Industrial Energy Consumption
  - **David Peterson**, Buildings Energy Consumption
  - **William Comstock**, Buildings Energy Consumption
  - **Kevin Jarzomski**, Buildings Energy Consumption
- **SAIC Facilitators**
  - **Jay Ratafia-Brown**, SAIC Task manager
  - **Jonathan Nunes**, SAIC – Electric Utility/Regulatory Economic Consultant
  - **Navid Nowakhtar**, SAIC Electric Utility Economic Consultant
- **Expert Participants**
  - Name, Affiliation, Area of Expertise

WELCOME AND INTRODUCTION BY EIA

- **Workshop Purpose and Objective**
  - Assess recent developments in the field of *behavioral economics as applied to energy demand analysis and energy efficiency programs*.
  - Supports the EIA goal of updating its analytic assumptions and methods associated with the modeling of changing energy markets for purposes of public information and policy analysis.
  - EIA uses the NEMS tool, a computer-based, energy-economy modeling system of U.S. through 2040, to project the production, imports, conversion, consumption, and prices of energy
  - Ultimate EIA objectives include:
    - Enhance the quality of EIA products through improved consumer behavior and policy representation
    - Maintain relevancy and consistency with developing best practices in energy economics
    - Enhanced capabilities will support the Residential Demand Module (RDM) and Commercial Demand Module (CDM), which are major components of NEMS that project energy consumption for marketed energy sources plus distributed solar and geothermal energy.
    - Both the RDM and CDM include projections of energy consumption by end-use service through 2040.

WELCOME AND INTRODUCTION BY EIA

- **Meeting Format and Facilitation Approach**
  - Meeting seeks a free exchange of information
  - Defined agenda and schedule will be maintained
  - SAIC facilitators will help maintain the schedule and take notes
  - **Participants - Always state your name** so that everyone in the room and on the teleconference know who is speaking
    - **Be patient:** Don't want participants speaking over each other
  - **Teleconference participants** should speak up if room comments cannot be clearly understood
  - **WebEX participants** can "raise your hand" when you want to speak and we'll call on you
  - Meeting discussion and recommendations are not for attribution

OVERVIEW OF EIA RESIDENTIAL AND COMMERCIAL DEMAND MODELS AND CURRENT METHODS FOR INCORPORATING ENERGY EFFICIENCY/EFFICIENCY PROGRAMS

- Description of how EIA currently incorporates consumer decision-making in NEMS' residential and commercial demand models. EIA will discuss the current plans to update and enhance these models to account for the growing number of energy efficiency programs throughout the country.
  - Model Framework Description and Model Inputs and Outputs
  - Equipment Retirement / Replacement and Technology Choice Methodologies
  - Implementation of Incentives and Credits to Promote Energy Efficient Choices
  - Use of Price Elasticity Functions and "Rebound Effect" Factors for Behavior Modification
  - Need to Account for Proliferating Energy Efficiency Programs
  - Description of EIA's Need for Enhanced Approach to Account for potential "Deviations" from the Existing Economic Methodology used in the NEMS Demand Models
  - Questions/Answers/Discussion Focused on EIA's Modeling Requirements

OVERVIEW OF EIA RESIDENTIAL AND COMMERCIAL DEMAND MODELS AND CURRENT METHODS FOR INCORPORATING ENERGY EFFICIENCY/EFFICIENCY PROGRAMS

- EIA staff will discuss how EIA currently incorporates consumer decision-making in NEMS' residential and commercial demand models

- **Slides presented here**

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Behavioral Economics Background Information

- Consumers generally don't behave optimally with respect to the costs and benefits of energy conservation
  - They don't place the same life-cycle value on energy efficient products as do policymakers or investors looking to subsidize or fund them
- Behavioral economics suggests a set of reasons beyond costs and benefit:[1]
  - Preference orders are not invariant among consumers (differentiation)
  - Energy efficiency is rarely an idea or intention at the "top of the mind"
  - Other important financial matters related to work, family, and education are likely more important
  - Decisions are complex, with many options and difficult mathematical calculations
  - People tend to procrastinate - *for a long time*

1 ***Ideas42 – the Social Problems – Energy***

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Behavioral Economics Background Information

- Differences in human behavior can significantly affect energy consumption, suggesting that intervention strategies to promote sustainable behaviors should result in significant energy savings in the future.
- If the previous statement is true, the following questions need to be answered to assist EIA analytical capabilities:
  - What are the most effective strategies in motivating energy efficient behavior via programs and technology?
  - Can behavioral economics help predict the impacts of future wide-scale behavioral interventions across the country, results of which will be highly useful for updating EIA's residential and commercial demand modules?
  - How can we successfully incorporate theories of human behavior from environmental psychology, behavioral economics, decision-theory, goal-setting theory, etc. into EIA demand-side models?

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

What is Behavioral Economics (Comparison with Neoclassical Economic Models of Choice Behavior – Maximization, Equilibrium, and Efficiency)?

- Neo-classical economics assumes consumers are rational with full information and transitive preferences.
- Neo-classical economics has been criticized for lacking *psychological realism* in its conception of individual behavior from numerous sub-disciplines and specialties across the social sciences.
- In particular, behavioral economists and decision psychologists have demonstrated consistent and widespread departures from the predictions of rational choice theory through the careful design of laboratory experiments.[2]
- *Behavioral Economics is about formalizing and demonstrating consistent deviations from the rational economic model.*

2 Bull, Joe, "Loads of green washing—can behavioral economics increase willingness-to-pay for efficient washing machines in the UK?" Science and Technology Policy Research Unit (SPRU), Freeman Centre, University of Sussex, Falmer, Brighton, East Sussex BN1 9QE, August 2012.

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

What is Behavioral Economics (Comparison with Neoclassical Economic Models of Choice Behavior – Maximization, Equilibrium, and Efficiency)?

- **Russell Sage Foundation definition of Behavioral Economics:**[3]
  - "Building on research in cognitive and social psychology and sociology, *behavioral economists* have shown that there are persistent, systematic departures from rationality in economic decision making, which are not purged by market forces, and which may well shape the way markets operate, rendering them less efficient than textbook market models.
  - *Behavioral economics* has taken up the difficult task of working out how cognitive biases, mental rules of thumb, interpersonal relationships and social networks and norms can cause real-life economic decisions to deviate from the standards of rational, self-interested maximization.
  - While the results fall far short of a fully worked out theoretical alternative to standard micro-economics, *behavioral economic principles* have become increasingly useful in suggesting explanations of aspects of market behavior that defy standard explanations, and they are beginning to prove to be valuable guides to formulating economic policy."

3 Russel Sage Foundation, "Advances in Behavioral Economics," Edited by Colin Camerer, George Lowenstein, and Matthew Rabin

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Current Applications of Behavioral Economics to Energy Demand/Efficiency Programs and Decision-Making

- *Current modeling* of energy efficiency and efficiency programs focuses on equipment costs, energy prices, and personal consumption information derived from traditional neo-classical economic models of rational choice.
- *Behavioral economics* research shows that a much more complex process takes place. Many studies indicate that consumers fail to adopt existing technologies, such as *better insulation, fuel efficient vehicles, and efficient appliances and lighting*, that would ultimately save them money by using less energy over a prescribed timeframe.
  - Energy efficiency tends to be overlooked during the evaluation of purchase options.
  - Product selection involves a trade-off between many heterogeneous factors (e.g., multiple aspects of functionality, aesthetics, performance and price) and is likely to focus on salient product characteristics rather than uncertain and intangible factors, such as expected future energy costs.
  - Energy efficiency is often a ***"shrouded attribute***" that is overshadowed by other more prominent considerations during the purchasing process.[2]
  - Presumably this takes place in the absence of Energy Efficiency programs and to a *lesser extent* when EE programs are implemented.

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Current Applications of Behavioral Economics to Energy Demand/Efficiency Programs and Decision-Making

- Current BE study results imply a need to account for *non–price-based behaviors* when accounting for widespread EE programs that further encourage energy conservation.
- A variety of methods have been studied in a large body of ongoing research on social approval, consumption feedback, goal setting, commitment, and other mechanisms.[4]
- The goal is to understand the benefits of these methods and programs to scale them to millions of consumers.
- *If understood, the theory can then be confidently incorporated in energy demand models*.

4 Allcott and Mullainathan – "Behavioral Economics and Energy Policy"

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Key Principals of Behavioral Economics as Applied to Energy Efficiency Programs[5]

- **Framing and Psychological Cues –** framing of information can bias choice in systematic and predictable ways
  - **Labeling schemes, such as the EPA energy labeling and Energy STAR ratings**, have been effective at narrowing the energy efficiency gap for electrical appliances in many markets.
  - **Supplementary information about running costs and emissions -** Findings from psychology and behavioral economics suggest that providing consumers with such information can increase willingness-to-pay for energy efficiency further by reducing the cognitive effort of cost-benefit analysis and appealing to environmental motives. Responsiveness to this information can be increased by using framing techniques to make information more salient and induce loss aversion.
  - **Loss Aversion:** Consumers tend to focus on losses rather than gains; Behavioral Economics has shown that people tend to be 'loss averse', meaning that they can be encouraged to take a risk or make a particular choice by framing the consequences as a means of avoiding losses rather than making gains. *One study found that the adoption of home insulation could be increased by presenting bill reductions as avoided extra costs rather than savings*
  - **Monetizing efficiency:** highlighting the financial implications of efficiency increases the impact of efficiency information conveyed to the consumer.
  - **Sunk Costs:** People become psychologically invested in costs that they've already paid for, regardless of the current costs and benefits – hard for people to disregard non-efficient items (e.g., incandescent bulbs, old refrigerators)
  - **Energy Program Defaults:** If the default is opt-out, then expected participation rates are lower than an opt-in default (e.g., program enrollment with opt-in default will see higher participation; appliances with energy conservation set to default settings will see greater energy savings)
  - **Temporal framing** - providing running cost information for the operational life of the product rather than for a shorter time horizon (e.g., a year) encourages consumers to value energy-efficiency more highly. *Some recent studies have shown that providing consumers with lifetime cost information can marginally increase willingness to pay for energy efficient appliances.*

5 Todd, Annika and Sebastien Houde, List of Behavioral Economics Principles that can Inform Energy Policy

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Key Principals of Behavioral Economics as Applied to Energy Efficiency Programs[5]

- **Bounded Rationality, Choice Architecture and Heuristics** – refers to the organization of options, attributes and information constituting a choice set.
  - **Consumer choices:** Too many consumer choices exacerbate the program opt-out effect
  - **Extremeness aversion and compromise effect:** Consumers tend to choose an option that represents a compromise (people won't buy the cheapest or the most expensive appliance)
  - **Information feedback effect:** Consumer behavior is likely to change with appropriate feedback (e.g., in-home energy consumption displays provide consumers with data that can yield selection of choices to lower energy consumption)

5 Todd, Annika and Sebastien Houde, List of Behavioral Economics Principles that can Inform Energy Policy

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Key Principals of Behavioral Economics as Applied to Energy Efficiency Programs[5]

- **Prosocial Behavior –** Prosocial and environmental behaviors can be important motivational factors for consumers and compliment monetary-based motivations
  - **Appealing to environmental motives**: Behavioral economics has demonstrated that consumers are often motivated by non-financial considerations.
  - **Contingent valuation surveys** in a number of countries have shown that consumers are willing to pay for public goods, including reducing carbon emissions, but no studies have yet investigated the impact of disclosing running emissions on demand for energy-efficient equipment.
  - Utility customers reduce energy consumption when they know that **their entire community is saving**
  - Consumers typically care more about their **levels of performance and participation relative to others** in their community, rather than absolute levels of performance
- **Commitment Mechanisms, Goal Setting, Time Inconsistency**
  - **Commitment Mechanisms:** Procrastination with respect to investment in expensive equipment or products (e.g., insulation) is typical. Programs that gain consumer commitment to an action can be effective in overcoming procrastination. Small actions may lead to larger actions in the future.
  - **Immediate versus Long-Term Rewards:** People value immediate rewards much more than they value future rewards
    - Consumers are unlikely to pay the higher cost of an energy efficient appliance today to save greater amounts over the long haul.

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GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Key Principals of Behavioral Economics as Applied to Energy Efficiency Programs[5]

- **Incentives**
  - **Monetary Incentives:** These types of incentives can have substantial impact on behavior
    - Results can disappointing since the reward may crowd out more intrinsic motivations (e.g., Prosocial motivations) – non-monetary incentives may be more effective (e.g., competition and cooperation)
  - **Utility Approach:** Match emissions reductions of customers by purchasing pollution offsets
  - **Competition and Rewards:** People are more motivated by competition and rewards given to top performers rather than piece-rate rewards to all – rewards to people who save the most energy
  - **Lotteries and Certainty Effect:** consumers overestimate small opportunities to gain larger rewards (lottery tickets rather than rebates for appliances)
  - **Endowment Effect:** Take away rewards if consumers fail to sustain behavior (e.g., energy savings)
  - **Nudge-Inducing Policies:** These policies take the form of particular taxes, subsidies, or other regulations specifically structured to encourage businesses to nudge. The nudges have two benefits.
    - Improves the choices of consumers who don't have the patience to sort through energy efficient choices and they also do not affect or subsidize the behavior of those already attuned to the benefits of going "green."

5 Todd, Annika and Sebastien Houde, List of Behavioral Economics Principles that can Inform Energy Policy

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Key Principals of Behavioral Economics as Applied to Energy Efficiency Programs[5]

- **Implementation Intentions**
  - Maps out how to convert the intention to save energy with an actual plan to save energy:
  - Organizations interact with consumers in many ways in addition to pricing. Utilities, for example, can give consumers clear or opaque information about energy efficient goods, can make it easy or difficult to find out about energy-efficiency promotions, and can otherwise nudge consumers in ways that cause them either to increase or decrease consumption.
  - Regulatory changes such as utility "decoupling," which separate electricity retailers' profits from quantities sold, are one mechanism that can encourage firms to "nudge" consumers toward reducing energy use.

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GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Behavioral Economics Case Study Examples

- Study evaluating the energy consumption of 10 identical Habitat for Humanity all-electric homes outfitted with the same appliances and equipment[6]
  - Homes were found to exhibit a large range of energy consumption
  - Most energy intensive home consumed 2.6 times more energy than the least
- Energy use consistently differs by 2 to 3 times in identical homes, occupied by people with similar demographics[7]
- A study found that space heating usage in winter months was affected more by individual factors, such as country and climate of origin and childhood experiences, than environmental factors such as outside temperature.[8]

6 Parker, D., Hoak, D., Meier, A., Brown, R. (2006), How Much Energy Are We Using? Potential of Residential Energy Demand Feedback Devices, Proceedings of the 2006 Summer Study on Energy Efficiency in Buildings, American Council for an Energy Efficient Economy, Asilomar, CA., August 2006.

7 Socolow, R. H., (1978). The Twin Rivers program on energy conservation in housing: Highlights and conclusions. In Socolow, R. H. (Ed.), Saving Energy in the Home: Princeton's Experiments at Twin Rivers (pp. 2-62). Cambridge, MA: Ballinger Publishing Company.

8 Schweiker and Shukuya , Comparison of theoretical and statistical models of air-conditioning-unit usage behavior in a residential setting under Japanese climatic conditions. Building and Environment, 44(10), 2137-2149.

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

Behavioral Economics Case Study Examples

- 2007 UK marketing firm survey of 10,048 Europeans across 10 countries about consumer energy awareness and consumption practices[8]
  - 80% of the respondents claimed that they were concerned about climate change and 75% felt that their personal actions had an impact
  - 45% reported that they were unaware of how much energy they used at any one moment (over 60% in France and Spain)
  - More than half (~55%) felt that they already done enough to limit their energy consumption
  - However, there appears to be an "attitude-behavior gap," as an objective measure of *energy efficient behavior* showed that the survey respondents engaged in an average of only 1.4 out of 6 key energy efficiency behaviors

8 Logica Survey (2007), Turning Concern Into Action: Energy Efficiency and the European Consumer.

GENERAL OVERVIEW AND DISCUSSION OF BEHAVIORAL ECONOMICS AS APPLIED TO ENERGY DEMAND AND EFFICIENCY

- **Current Overall Status of this Discipline (Focus on Consumer Decision-Making)**
  - Is there a general consensus regarding the status of Behavioral Economics as applied to various disciplines?
  - Is human behavior similar across disciplines – health, finances, energy?
  - *Households, people … are all so different with regard to their decision-making* – can behavioral economics meaningfully contribute to modeling this behavior at scale?

EXPERTS ROUNDTABLE DISCUSSION/BRAINSTROMING: HOW CAN EIA BENEFIT FROM APPLICATION OF BEHAVIORAL ECONOMICS TO RESIDENTIAL AND COMMERCIAL ENERGY DEMAND MODELING?

- Efficacy of Utilizing Behavioral Economics to Satisfy EIA Modeling Requirements
  - How can Behavioral Economics theory, empirical experience and lessons-learned be used by EIA to further enhance its modeling capabilities with respect to accounting for non-price-based consumer choice behavior modification.
  - A key question is whether the discipline and its application to EE programs has advanced far enough to be considered by EIA or whether more research and data gathering and analysis needs to be undertaken and supported by EIA.
- Application of Behavioral Economics Theory and Experience to Energy Demand Modeling
  - Lessons-Learned from EE Program Designs and Outcomes
  - Lessons-Learned from Ex-Post Modeling of EE Programs
  - Insights from EE Program Results Interpretation
- Methods for Adding Behavioral Assumptions to the Existing Demand Models
  - Behavioral Economics suggests that the adoption of efficient equipment could be accelerated further by: (i) monetizing efficiency, (ii) directly communicating the link between efficiency and carbon emissions, (iii) communicating the long-term (e.g., operational life) financial and environmental impact of product choices, and, (iv) framing the information as avoided losses ('extra') rather than gains ('savings').5
  - These impacts need to be quantified and appropriate methods developed to effectively incorporate into demand models.

EXPERTS ROUNDTABLE DISCUSSION/BRAINSTROMING: HOW CAN EIA BENEFIT FROM APPLICATION OF BEHAVIORAL ECONOMICS TO RESIDENTIAL AND COMMERCIAL ENERGY DEMAND MODELING?

- Future Behavioral Research and Empirical Data Required to Support EIA's Needs
- Existing Research Groups or Networks on Behavioral Economics
- Methods for Adding Behavioral Assumptions to the Existing Demand Models?
- Future Behavioral Research and Empirical Data Required to Support EIA's Needs?
  - Based on the current status of Behavioral Economics as applied to the energy demand markets, what are the discipline's future needs?
  - Future research could quantify the impact of EE programs on discount rates or willingness-to-pay for efficiency in real world contexts to develop robust inputs for economic models based on 'modified' rational economic choice.
  - This probably requires a deeper understanding of the empirical relationship between environmental attitudes and willingness-to-pay and the relationship between the absolute size of financial incentives and the impact of other program behavioral techniques (e.g., framing).
- Existing Research Groups or Networks on Behavioral Economics?

MEETING SUMMARY AND CONLUSIONS

- **Summary of Salient Discussion Items**
- **Conclusions**
- **Recommendations for EIA**

For More EIA Modeling Information

U.S. Energy Information Administration home page | www.eia.gov

Annual Energy Outlook | www.eia.gov/forecasts/aeo

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