Behavioral Assumptions Underlying Energy Efficiency Programs for Businesses

Prepared by
Michael J. Sullivan, Ph.D.
Freeman, Sullivan & Co.

Prepared for CIEE Behavior and Energy Program
Edward Vine, Program Manager

California Institute for Energy and Environment
1333 Broadway, Suite 240
Oakland, CA 94612-1918

January 2009

ciee

DISCLAIMER

This report was prepared as an account of work sponsored by the California Public Utilities Commission. It does not necessarily represent the views of the Commission or any of its employees except to the extent, if any, that it has formally been approved by the Commission at a public meeting. For information regarding any such action, communicate directly with the Commission at 505 Van Ness Avenue, San Francisco, California 94102. Neither the Commission nor the State of California, nor any officer, employee, or any of its subcontractors or Subcontractors makes any warranty, express or implied, or assumes any legal liability whatsoever for the contents of this document.

Table of Contents

Tables

Figures

Executive Summary

This white paper examines the behavioral assumptions underlying utility sponsored energy efficiency programs offered to businesses in California. It describes how assumptions about business decision making (that are built into the design of these programs) can affect the ability of these programs to foster increased investment in energy efficient technology.

Historically, most utility sponsored energy efficiency programs in California have been designed to cause businesses to make their buildings more energy efficient and purchase energy efficient equipment (e.g., lights, HVAC, motors, etc.). This has generally been accomplished by providing utility customers with information about the availability and cost of energy efficient alternatives and economic incentives designed to make these alternatives more economically attractive. The policy paradigm underlying these programs is what has been called the Physical Technical Economic Model (PTEM).

Within the PTEM paradigm, the only consumer behavior of interest is the consumer's decision to purchase energy efficient technology alternatives. Consumer behaviors that influence how often, when and for what purposes energy is used are not of interest except insofar as these behaviors may cause an offset in the savings that result when efficient alternatives are installed – for example, spillover effects.

In part, PTEM-type energy efficiency programs have flourished because they have been effective in causing increased investment in energy efficient technologies (e.g. lighting). They have also flourished because energy savings achieved through these programs are relatively easy to conclusively demonstrate – making it possible to closely tie utility energy efficiency program activities to reimbursement and incentive structures.

PTEM-type programs have been far from completely effective. Despite substantial efforts on the part of utilities to cause businesses to invest in energy efficient technology using these programs, a significant gap continues to exist between the level of energy efficiency investment that is economically justified and the level of such investment that is being achieved. An indication of the size of this gap is the fact that in 2007 it was estimated that only about 60 percent of economically justifiable energy efficiency investments were being made by residences and businesses in California. Moreover, there is a growing consensus among the energy policy planning community that PTEM-based programs are becoming increasing less effective in fostering energy efficiency investments as the easily achieved savings (i.e., the low hanging fruit) are being exhausted.

What Causes the Gap?

The existence of the above described gap is not news. For many years, energy efficiency program planners have been struggling with it. Several explanations for the gap have been offered. These explanations can be grouped into three broad categories as follows:

1. Neo-classical economic explanations for the gap – these explanations for the gap generally describe the gap as more apparent than real. They describe the gap as the consequence of a number of normal conditions that occur in efficient markets that can

cause adoption rates for new technology to lag behind the level of economically justifiable investment at any point in time.

2. Market barriers/failures explanations – these explanations argue that there exist significant institutional and other barriers in the market that prevent consumers from behaving rationally and prevent the market from performing efficiently. Several specific barriers and market failures have been identified. The most important among these are:

    a. Situations involving misplaced or split incentives (also called agency problems) – these are situations where investment costs are borne by one party in a transaction and the benefits from the investment are received by another.

    b. Limited availability of capital – the first cost of energy efficiency investments may exceed the availability of investment capital or borrowing power of potential investors.

    c. Market power – situations in which actions by powerful interests in supplier markets can inhibit the penetration of energy efficiency products into markets using predatory pricing and domination of supply channels.

    d. Regulatory distortions – situations in which regulatory practices (e.g., resource acquisition policies and rate designs) distort price signals shielding decision makers from the economic consequences of their actions.

    e. Transaction costs – consumers sometimes experience very high costs in finding, choosing and implementing energy efficiency investments.

    f. Inseparability of energy efficiency of decision alternatives from other product attributes – energy efficiency is only one among many product attributes, and the combination of energy efficiency with these other alternatives may greatly influence the attractiveness of these alternatives.

    With the exception of transaction costs, the above described market barriers cannot be removed by changing the information or incentives that decision makers receive through energy efficiency programs. Instead of focusing on consumers per se, it is necessary to remove or reduce the apparent market barriers by means of market-level interventions targeted at government, regulatory agencies, manufacturers, distributers, retailers, service providers and then consumers.

3. Non-economic explanations for the gap – these explanations for the gap question the validity of the critical behavioral assumption underlying the PTEM model – namely, the assumption that consumers are making rational economic decisions taking into account the energy efficiency of the products and services that they are purchasing. Non-economic explanations for the gap conceive of energy use as a byproduct of human action (not an end in itself), and, as such, treat energy use as something that consumers may or may not consider in making decisions about the products or services they purchase. According to these explanations, the rational decision making model underlying PTEM-based programs oversimplifies consumer and business decision making leading to an overemphasis on information and price and subsequent ineffective marketing. Non-economic considerations that should be taken account in developing energy efficiency programs include:

a. Economic rationality is only one of several decision-making heuristics that may be applied by decision makers in evaluating alternatives in a given situation. Other decision-making heuristics include: bounded rationality, elimination by aspects, association, conformity, dissonance reduction and altruism. Any or all of these heuristics may become activated in a decision-making situation leading to outcomes that are decidedly not economically rational from the standpoint of energy efficiency.

b. Motivations other than economic gain can either encourage or discourage investment in energy efficient technologies. For example, while hybrid electric vehicles are sometimes dramatically more energy efficient than other vehicles powered solely by internal combustion engines, the evidence suggests that many early adopters of hybrid electric vehicles did not purchase them because they were fuel efficient. They purchased them because they allowed access to HOV lanes, they were "fun", they were less expensive than other cars they considered, and they projected the personal image the buyers wanted to present to others.

c. Purchase decisions are often made by groups, and the decision-making styles that groups use to arrive at decisions may or may not lead to economically rational outcomes. The important decision-making styles used by groups include: consensus seeking, autocracy, formulaic decision making, bureaucratic decision making and decisions by chaos. These are principally approaches used to resolve conflict among group members regarding their individual preferences. Resolution of conflict often results in decisions that are not economically rational.

d. Decisions about energy efficiency investments must pass through organizational hierarchies that may or may not authorize an economically rational decision seen from the point of view of its impact on energy efficiency. Decisions made by business organizations are heavily influenced by the attitudes, opinions and actions of their leaders. Moreover, decisions made by businesses about investments in energy efficiency often take place inside larger institutional contexts in which energy efficiency investment alternatives may be competing for resources with other alternatives that have lower or higher value to the organization. Decisions about investments in energy efficiency are often not made in isolation (i.e., either energy efficient or not): they are made in competition with other desirable alternatives that may have nothing to do with energy efficiency.

e. Decision-making about energy efficiency investments is <u>not</u> frictionless – the transaction costs associated with making these decisions may be relatively large for businesses that have little experience with such decisions and in many cases may be larger than any economic benefit they would obtain by improving energy efficiency.

This perspective on consumer and business decision-making departs strongly from the simple model of economic rationality contained within the PTEM model. While this new perspective offers tantalizing possibilities for reshaping programs to make them more

effective from the standpoint of marketing, this model has not been incorporated into the design of programs until very recently. It remains to be seen how much impact that this perspective will have on the effectiveness of energy efficiency programs, but it seems the time has come when we will find out.

All three of the above perspectives offer valuable insights into the causes of the gap. While there has been some tension between the adherents of these perspectives historically, it is a mistake to view these as competing perspectives. Indeed, the gap is undoubtedly caused to some extent by all of the above factors. That said this paper is principally concerned with identifying improvements that could be made to energy efficiency programs by expanding program designs to go beyond the simple assumptions underlying the PTEM model.

Behavioral Assumptions Underlying Today's Energy Efficiency Programs

Energy efficiency programs have been evolving in the context of the debate about the usefulness and limitations of the PTEM paradigm for over 30 years in California. Therefore, it is reasonable to ask: to what extent does the current generation of these programs rely on the PTEM paradigm, and if so, how do they take account of the criticisms of this paradigm.

To answer these questions, a careful review of the behavioral assumptions underlying the current generation of energy efficiency programs offered to businesses in California was undertaken. This was done by analyzing the Program Implementation Plans and other testimony provided by the Pacific Gas & Electric (PG&E) Company in support of its recent request for funding for its proposed 2009-2011 energy efficiency program funding cycle. The analysis is focused on energy efficiency programs offered to non-residential customers.

PG&E was selected for the analysis because it is a combined gas and electric utility (so its programs are targeted at both gas and electric customers), and because it is the largest of the energy efficiency programs offered by California investor owned utilities (IOUs). While a more comprehensive review of programs in California and the US would be interesting and probably would reveal substantial variation in existing program designs, the resources available for this study were insufficient to support a broader review.

The scope and magnitude of the proposed next generation of energy efficiency programs proposed by PG&E are truly remarkable. Energy efficiency programs offered by PG&E have evolved since the mid-1970s from a few fairly simple and inexpensive information programs (costing only a few million dollars annually), to nearly 100 highly targeted programs providing a wide range of information and design services along with significant economic incentives. The cost of PG&E's proposed next generation of programs is projected to be more than $500 million per year.

The next generation of PG&E's proposed programs is expected to be delivered through three channels. These channels include:

1. Programs offered directly by PG&E to its customers (12 Core Programs).
2. Programs offered through Third Party Contractors (57 Third Party Programs).

3. Programs carried out by cooperating local and state government entities (19 Government Partnerships).

All of the Core Programs and Third Party programs are designed primarily to increase awareness of energy efficiency alternatives and provide economic incentives to make energy efficiency investment alternatives more attractive. In this respect, they have PTEM in their DNA. However, these programs also have been designed to overcome many of the limitations of the PTEM paradigm that have been discussed in the literature. Examples of these efforts include:

1. Continuing and new efforts to transform mass markets (to overcome market barriers) by intervening upstream in product supply chains for appliances and machines to encourage manufacturers, distributors, retailers and service providers to make customers aware of energy efficient products and encourage them to purchase them.
2. New efforts to segment utility customer markets to more effectively target energy efficiency programs to customers who may be receptive to them.
3. New efforts to identify alternative messages (beyond costs and energy savings) that may cause customers to adopt energy efficient alternatives.

In addition to the above efforts -- continuing an approach that began during the 2005-2008 funding cycle -- a significant amount of the resources dedicated to the Core Programs and virtually all of the resources dedicated to the Third Party programs are focused on highly targeted market segments where specialized offerings are being developed for specific customers and customer types. The targeted market segments are not defined by end uses (e.g., lighting, HVAC, refrigeration, etc.). They are defined by business types (e.g., wineries, canneries, oil extraction, grocery stores, big box chain stores, etc.). In these efforts, the utility is not marketing particular measures, but instead is offering custom combinations of measures designed to improve energy efficiency in particular kinds of businesses with high savings potential.

PG&E's third delivery channel -- the Government Partnerships -- are grants to government organizations to encourage them to undertake a wide variety of activities designed to improve energy efficiency at the community and statewide level. These activities include:

1. Direct installation of certain energy efficiency measures in low income households and small businesses.
2. Energy efficiency improvements in facilities under the control of government.
3. Enforcement of building codes.
4. Providing training for planners and other government administrators in writing and enforcing local ordinances that support energy efficiency and renewable resource development.
5. Encouraging citizens to make their own energy efficiency investments.

Grants under the Government Partnerships programs are primarily designed to accomplish market transformation objectives – to create social and political infrastructure

that fosters energy efficiency and renewable resource development. These programs are very unconventional in that they do not directly focus on changing the saturation of technical measures. They focus to a large extent on changing the social, political and cultural climate in which consumers use energy.

The next generation of energy efficiency programs proposed by PG&E departs dramatically from earlier efforts that relied primarily on the PTEM model. It is an extremely ambitious proposal for which the details have not been completely worked out. As they say, the devil is in the details. However, while implementation of the program portfolio proposed by PG&E will pose significant challenges, the need to improve these programs significantly is extremely urgent. The challenges will have to be overcome.

Conclusions

The influence of the PTEM model on the design and operation of energy efficiency programs is ebbing. In recent years, the utilities have come under increasing pressure from the California Energy Commission (CEC), the California Public Utilities Commission (CPUC) and the California Air Resources Board (CARB) to produce energy savings through energy efficiency programs. Consequently, the proposed next generation of energy efficiency programs is a far cry from the classical PTEM model. The proposed programs have been crafted to respond to the most critical market barriers and to take account of many of the behavioral factors that influence organizational decision making that have been discussed in this paper.

While these new programs have the potential to be dramatically more effective than conventional PTEM-based programs, their development poses significant challenges that should not be underestimated. One extremely important challenge is that many of the key concepts that are being advanced in the next generation of programs are still under development and are proposed to be under development as the next generation of programs rolls out. For example, as the next generation of programs is being implemented, it will be necessary to develop, test and roll out:

1. New marketing messages based on non-economic motivators.
2. A new market segmentation framework for energy efficiency marketing.
3. New marketing strategies.
4. Market transformation initiatives designed to change the social and political climate for energy use in communities in California.

Building this new generation of programs will require significant expansion of the research and development enterprise inside PG&E's energy efficiency department on the "front" end of program implementation. It will also require significant funding for program research and development focused not on technology but on changing consumer behavior and decision making.

In a significant departure from previous funding cycles, PG&E has requested that substantial funding ($42 million) be shifted from the measurement and evaluation budget (currently managed by the CPUC and carried out by third party evaluators) to research and development funds to be used by PG&E for program development. This proposal is

bound to encounter resistance, so its fate is highly uncertain. However, without the development of a significant research and development enterprise on the front end of the program development process, the success of the next generation of programs may be very limited.

An equally important challenge posed by the next generation of energy efficiency programs arises out of the difficulties that these new program designs pose for program evaluators charged with estimating the energy savings that they have achieved. This is important because evaluation is the mechanism that drives reimbursement and profit for the utilities. There are very serious evaluation research problems on the horizon. How, for example, does one estimate the energy savings that result from a community intervention like Energy Watch? How does one estimate the energy savings resulting from market transformation efforts designed to encourage installation and repair contractors to offer energy efficient alternatives in front of or before inefficient alternatives at the time of replacement or repair? Such initiatives contain the potential to produce a quantum leap in the productivity of energy efficiency programs. They also contain the potential to be a complete waste of money. There are real and serious questions that evaluators will be asked to answer concerning the efficacy of the proposed new generation of energy efficiency programs, and the current energy efficiency evaluation protocols for California may be inadequate to answer them.

While the next generation of energy efficiency programs offered to non-residential customers in California addresses many of the market barriers and incorrect assumptions about business decision making that plagued earlier generations of program design, one glaring defect in these programs continues to exist. In general, programs offered to businesses tend to be targeted at the bottom of the social hierarchies that they are designed to contact. That is, most programs targeted at businesses are designed to deliver information and services to the plant or facilities engineering staff – usually located near the bottom of the management hierarchy. These parties near the bottom of the hierarchy are then relied upon to carry the energy efficiency investment up through their organizations to the layers of management that can authorize action. The organizations within which these staff members operate are capable of being more or less receptive to energy efficiency investment alternatives depending on a variety of organizational considerations under the control of the management (e.g., hurdle rates, energy efficiency productivity targets, available budget for energy efficiency investment, etc.).

The above aspects of organizations are taken as given by existing programs and they should not be. Business organizations are malleable, and the receptiveness of business organizations to energy efficiency initiatives is almost completely under the control of company management. Company management determines whether an organization is receptive to energy efficiency improvements or not by establishing policies that govern how the organization will react when it is presented with energy efficiency investment decisions. It is almost certain that significant improvements in the uptake of energy efficiency investments could be achieved by focusing resources and effort on convincing management in companies operating in California to adopt policies that make their firms more receptive to energy efficiency investments. This is a critical missing element in the current effort to cause businesses to make energy efficient decisions.

From the standpoint of improving the efficiency of energy use by businesses, perhaps the biggest drawback arising from the current focus on buildings, machines and other energy using devices (from the old PTEM model) is that business organizations cause a dramatic amount of energy use that has little to do with the devices and machines they are using. If one views the business as a whole (as opposed to the buildings and production processes under its control), it can be seen that the actual energy use associated with many businesses goes far beyond what is used in the buildings and manufacturing processes. For example:

1. Businesses make choices that affect the amount of energy that is used by their customers.
2. They make choices about products contained in their supply chains that can be more or less energy efficient – depending on a variety of considerations.
3. They make decisions that have consequences for the energy that their employees use traveling to and from work (e.g., where they locate in relation to transit stops and whether on-site free parking is provided).
4. They make choices that affect how much energy is used transporting products and employees to and from customer sites.

Buildings and production processes are just part of the opportunity that businesses have to make energy efficiency improvements. Moreover, because improvements in the energy efficiency of buildings and production processes usually involve capital expenditures, improving the energy efficiency of buildings and other capital equipment may be the hardest thing to convince businesses to do to lower their energy use. In essence, there is low hanging fruit right before our eyes, but our current regulatory and policy framework is concentrating our attention on the fruit on the top of the tree.

The limitations of the PTEM model for achieving significant *further* improvements in energy efficiency are becoming increasingly apparent. In response to this situation, new programs have been proposed by PG&E (and the other California IOUs) that incorporate a wide range of efforts to transform markets and take advantage of marketing strategies that do not rely solely on the assumption that consumers are making rational decisions about the costs and benefits of energy efficiency.

Unfortunately, these new programs do not fit well within the existing regulatory framework that treats savings obtained from energy efficiency improvements as an energy supply resource. They do not fit well within the existing framework for evaluating the efficacy of energy efficiency programs which is focused on documenting direct energy savings. Lastly, because the proposed next generation of programs is still under development, it remains to be seen how well they will work. These are all considerations that stand in the way of the next generation of more effective energy efficiency programs.

It seems as though we are on the horns of the proverbial dilemma. We can force the utilities back to the drawing board to bring forth programs that are more in line with the PTEM model (which will impede the progress of the development of more effective energy efficiency programs). Alternatively, we can modify the current regulatory framework (resource acquisition policies and evaluation practices) to make it more

compatible with the proposed direction of development of the next generation of energy efficiency programs. Either way forward will be challenging.

.

1. Introduction

In the first decade of the new millennium, the negative consequences of increasing greenhouse gas (GHG) emissions and dependence of the US economy on sources of energy supply under the control of foreign governments have become increasingly apparent. Improving the efficiency of energy use in US homes and businesses is a vital linchpin in the policy apparatus needed to solve these problems. However, from the earliest efforts to improve the efficiency of energy use in the US economy (starting in the early 1970s) until the present, there has existed a significant gap between the level of energy efficiency investment undertaken by businesses and consumers and the level that is judged to be economically cost justified at any point in time.

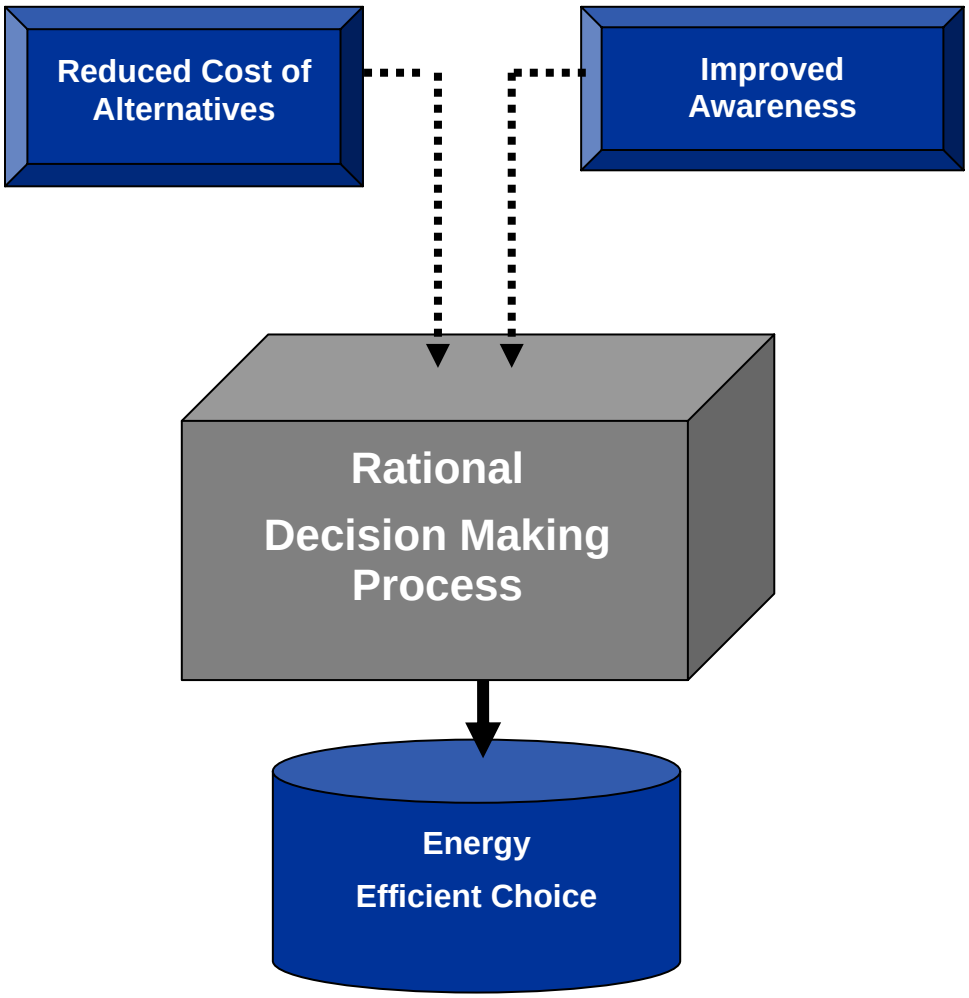
In essence, significantly less investment in energy efficient technology is being realized than is possible given reasonable assumptions about the costs of energy efficiency improvements and the energy costs that they are designed to avoid. This situation continues in the presence of significant efforts by government-sponsored energy efficiency programs offered by electric and gas utilities. In California, at least, it is believed that these programs have significantly improved the market share of certain energy efficient technologies. However, even in the California energy efficiency market, it is generally agreed that providing information about energy efficient alternatives alongside significant economic incentives has caused much less investment in energy efficient technology alternatives than would be expected based on the apparent cost effectiveness of these technologies.

To understand why this is occurring and how new approaches to energy efficiency program design might close this gap, this paper examines the behavioral assumptions underlying energy efficiency programs offered to businesses by electric and gas utilities. Most of the discussion in the paper centers on energy efficiency program efforts that have been developed in California. In part, this decision was based on the desire to make the analysis as relevant as possible to the development of future energy efficiency programs sponsored by the California Public Utilities Commission (CPUC) – the entity that sponsored the development of this paper. It was also based on the desire to focus the analysis on energy efficiency programs that have been aggressively supported by both the regulatory environment and utility management -- that is, on programs that have been allowed to flourish. Finally, the decision was based on the need to limit the scope of the analysis to a manageable size. Regardless of the tight geographical and institutional focus of this work, most of the discussion in the paper about the effects of behavioral assumptions on consumer and business decision making concerning energy efficiency investment applies generally to the design of utility sponsored energy efficiency programs outside of California. This is because the behavioral factors that influence these decision making processes are more or less universal.

Utility-based energy efficiency programs have been evolving for about three decades in California. From the very beginning, these programs have been derived from a potent policy paradigm that has been called the Physical, Technical and Economic Model –

PTEM for short (Lutzenhiser, 1993). Figure 1 displays a graphic image of the PTEM Model.

Figure 1: PTEM Model of Decision Making



Programs developed under the PTEM model are designed to improve energy efficiency by causing businesses and consumers to adopt energy efficient devices and products (e.g., lights, motors, HVAC (heating, ventilation, and air conditioning) systems, windows, building shells, etc.). Adoption can occur when a consumer buys something new (like a new house or light bulb) or when they replace an existing product. The targeted energy efficiency improvements come from changing the efficiency of the technology consumers are using, not from changing their use of that technology.[1] This approach is attractive

[1] In fact, changes in the way consumers use the technology may represent a significant threat to the effectiveness of the PTEM model. Consumers who install energy efficient air conditioners and use the savings on their electricity bill to purchase a plasma TV (or worse yet use the incentives from the utility energy efficiency program to buy it) can vitiate the effectiveness of the investment that the regulator has made to enhance the likelihood that the consumer will choose the energy efficient appliance. If this does occur, it is likely true for only a very small percent of the population.

because it doesn't require consumers to change the way they use energy (e.g., the thermostat temperature that they select), and it doesn't require any effort to ensure that any change in behavior persists.

Consumer behavior -- other than the adoption decision -- plays a very secondary role (or no role at all) in achieving energy efficiency under PTEM. As Lutzenhiser (1993) stated:

> "The behavior of human "occupants" of buildings is seen as secondary to building thermodynamics and technology efficiencies in the PTEM, which assumes "typical" consumer patterns of hardware ownership and use. The PTEM also assumes that growth or decline in energy demand results primarily from changes in buildings and equipment – changes that are believed to depend rather systematically upon 'the cost of energy relative to consumer income, as weighted by the priorities of the consumer for services, convenience, comfort and time' (Starr, Searl & Alpert, 1992, p. 986)… assuming human behavior to be a relatively insignificant aspect of consumption."

Energy efficiency programs designed under the PTEM paradigm initially focused only on causing consumers to adopt more energy efficient technology. The principal behavioral assumption underlying the PTEM paradigm is that decisions to adopt energy using technology are economically rational. That is, is the paradigm assumed that the decision-making heuristic used by consumers in selecting among energy using technologies is economic rationality.

Not surprisingly, energy efficiency programs developed under this paradigm tend to focus on providing consumers with information about the availability and performance of energy efficient technology alternatives, and on changing the costs that consumers experience in purchasing these alternatives (i.e., providing economic incentives).

For some years, analysts, policy makers and program planners have been aware of the lack of consumer response to energy efficiency programs based on information and incentives. Two types of reasons have been offered for the lack of traction of conventional utility based energy efficiency programs based on providing information and incentives. One school of thought points to significant institutional and other barriers in the market – barriers that prevent consumers from behaving rationally and the market from performing efficiently. The other school of thought argues that the underlying model of economic rationality embodied in the PTEM model seriously oversimplifies the decision making processes for consumers and businesses and that the performance of programs could be improved if marketing strategies and messages were modified to take account of non-economic factors that influence consumer and business decision making. Both the market barriers and non-economic factors explanations provide interesting insights into how energy efficiency programs can be improved that are beginning to profoundly influence the design of energy efficiency programs.

This paper discusses the evidence for the gap between realized and realizable energy efficiency investment and carefully examines the explanations for it. The objective of this review is to identifying the insights that these explanations offer for improving the

performance of energy efficiency programs. The paper then examines the proposed next generation of energy efficiency programs offered to commercial and industrial customers in California and describes the extent to which these programs attempt to take account of the limitations of the economic rationality assumption in the PTEM model that have been identified in the literature. Finally, the paper highlights significant near-term research and development and public policy challenges that are occurring in conjunction with the evolution of the next generation of energy efficiency programs in California.

The discussion is presented in 5 sections. Section 2 describes the evidence that has been presented for the existence of a gap. Those who are familiar with this literature may want to skip this section. Section 3 describes the explanations for the gap that have been offered by economists, energy policy planners, sociologists, psychologists and anthropologists. This section will be of interest to those who are seeking ways of modifying programs to close the gap. Section 4 describes a state-of-the-art utility energy efficiency initiative taking place in California that appears to take account of many of the limitations in the simple PTEM model. In the final section, Section 5, conclusions and recommendations are presented. In this section, policy issues are raised alongside a discussion of future research that is needed to move the ball forward in both measurement and evaluation and in program development.

2. The Gap Between Economic and Achievable Energy Efficiency Investment

Evidence of the gap between the economically viable investments in energy efficiency technology and the energy efficiency investments that actually are made comes in several forms. They are:

1. Societal level analysis comparing the energy intensity of production or per capita generally indicates that the US has a relatively high energy intensity compared to other societies. For example, in 1988, the US Department of Energy (DOE) estimated that the energy productivity of Japan was approximately twice that of the US with both West Germany and England far outpacing the US. (Hirst and Brown 1990). Of course, studies of this kind are only suggestive of the possibility of a gap since differences in energy intensity are also driven by factors such as population density and the composition of industrial economic activities.
2. Engineering/economic analysis – analyses of this kind generally involve comparisons of the estimated achievable energy efficiency of equipment installed in a given market (e.g., sector, state or nation) with an estimate of the economically cost effective energy efficiency that could be obtained given the life cycle cost of the technology, fuels and other factors that affect the cost of operation (i.e., the economic achievable potential). The achievable energy savings presented in these analyses are the economically justifiable savings adjusted for the historical probability that consumers will adopt the subject technology when it is offered. In this case, achievable savings are obtained by analyzing the success rates of past energy efficiency program efforts. (For a good example of current practice see Rufo and Coito (2002).) In the last several years,

several studies of economic and achievable potential have been conducted in the US. While the results varied substantially from analysis to analysis, a meta-analysis of the results of these studies indicated that about 67% of the technical potential for energy efficiency improvements was economically cost justified and that 60% of the cost effective potential was likely to be achieved (Nadel et al. 2004)[2]. In other words, given the historical success at marketing energy efficiency programs, only about 60% of the economically viable energy efficiency potential is being achieved.

3. Studies of decisions made by consumers and businesses when offered energy efficiency investments (e.g., Hausman (1979), Train (1985), and Goett (1988)). The earliest evaluations of energy efficiency programs indicated that a substantial fraction of parties who were offered energy efficiency improvements declined to implement them. The rate at which they did so indicated that decision makers were applying very high discount rates to energy efficiency alternatives in evaluating the economic attractiveness of these alternatives. [3] Several studies of consumer decision making subsequently confirmed this hypothesis. In general, these studies showed that consumers tended to apply extremely high discount rates (e.g., 25%) to benefits arising from energy efficiency investments relative to other kinds of investments, providing both evidence of the existence of the gap and at least one explanation for it.
4. Results of qualitative interviews, focus groups, and anecdotal evidence from those offering energy efficiency investments across the US indicating that a gap existed.

Looking for evidence of the gap between economically justifiable energy efficiency and achieved energy efficiency is like looking for evidence of the existence of gravity. To anyone who has been involved in the energy efficiency policy arena for any period of time, the fact that there is a gap and that it is large seems self evident. Yet, conclusive evidence of the size of the gap remains somewhat elusive. [4]

Although estimates of the size of the gap vary from study to study and are subject to a variety of debatable methodological assumptions, they all find a fairly wide gap between

---

[2] In considering the ratio of achievable energy efficiency improvements to economic ones, it is important to bare in mind the fact that a significant driver in the cost-effectiveness of energy efficiency investments is the forecasted price of fuels. It is possible that the relative disparity in achievable and economic energy efficiency would be higher if externalities such as the costs of securing fossil fuels and the environmental consequences of continuing growth in GHG emissions were added to the cost of fuels. These costs would certainly make the cost-effectiveness of energy efficient technologies be higher, but given the discount rates consumers appear to be applying to currently available energy efficient technologies, that might not make a difference.

[3] Of course, some have argued that given the vintage of these efforts, customers may have been correct in assigning fairly high discount rates to some energy efficiency offerings given the performance problems that some eventually exhibited.

[4] Over the past 20 years in California, serious efforts have been made to evaluate the performance of energy efficiency programs. It may be that the results of these evaluations could be used to quantify the magnitude of the gap for various measures and over time. A meta-analysis of the results of these evaluations could shed light on this important problem.

the economic potential for energy efficiency and what is believed to be achievable given the history of energy efficiency program experience since the 1970s. While it is possible to argue about the assumptions that have led to the conclusion that the magnitude of the gap is significant, the evidence of its significance and size is cumulative and persuasive. The question now is why is it there?

3. Reasons for the Gap

According to Neo-Classical economics, all other things being equal, consumers should be investing in the optimal level of energy efficiency. If they are not, there is either something wrong with the Neo-Classical model of consumer decision making (i.e., rational decision making with perfect information), or the market is not working properly, or both.

It is possible to view the gap from three different perspectives. On one hand, it is possible to argue that the Neo-Classical view of economic decision-making that underlies the PTEM model is basically sound and that the so-called gap is more the result of failures on the part of engineering analysts to understand the nuances of the market than it is the result of a failure on the part of decision makers to act rationally.

An alternative explanation for the gap is that there exist significant barriers and market failures that prevent decision makers from making rational decisions about energy efficiency investments. This explanation provides the intellectual justification for the establishment and support of codes and standards, tax incentives to stimulate capital investment in energy efficiency, changes in regulatory practices designed to encourage the efficient pricing of electricity and gas, and the establishment of energy efficiency initiatives designed to transform markets by eliminating or reducing the barriers that were identified.

A third possibility is that the Neo-Classical view of economic decision making is just plain wrong – that consumers often don't necessarily make economically rational decisions about energy efficiency investments at all and that energy efficiency programs based on this model were destined to be at best inefficient delivery vehicles for enhancing energy efficiency and at worst completely ineffective. This perspective has yielded many insights concerning the factors that influence consumers' decisions about energy efficiency investments. However, progress has been slow in integrating these insights into the design of energy efficiency programs to close the gap.

In this section, the above three perspectives are described in some detail. They all offer interesting explanations for the gap – some more useful from the point of policy making and program planning than others. Particular attention is paid in section 3.4 to the Non-Economic explanations for the gap as these are probably least well understood by policy makers and program planners and represent a more or less untapped source of ideas for changes to energy efficiency programs that could close the gap. We start with the Neo-Classical explanations for the gap – explanations which, as we shall see, are not very useful from the point of view of closing the gap.

3.1.Neo-Classical Economic Explanations for the Gap

Defenders of the economic rationality assumption underlying the PTEM paradigm have responded to criticisms of this assumption in several ways (Howarth and Sanstad 1995). What is important about these explanations for the gap is that they basically lead to the conclusion that the market is working fine and there is no need for governmental intervention or policy change to fix it. This view stands in sharp contrast to the Market Barriers/Failures explanations that lead to the conclusion that the market is not functioning properly and that significant governmental intervention and/or a change to the focus of energy efficiency programs is required to overcome these market imperfections.

The Neo Classical Economic explanations for the gap are:

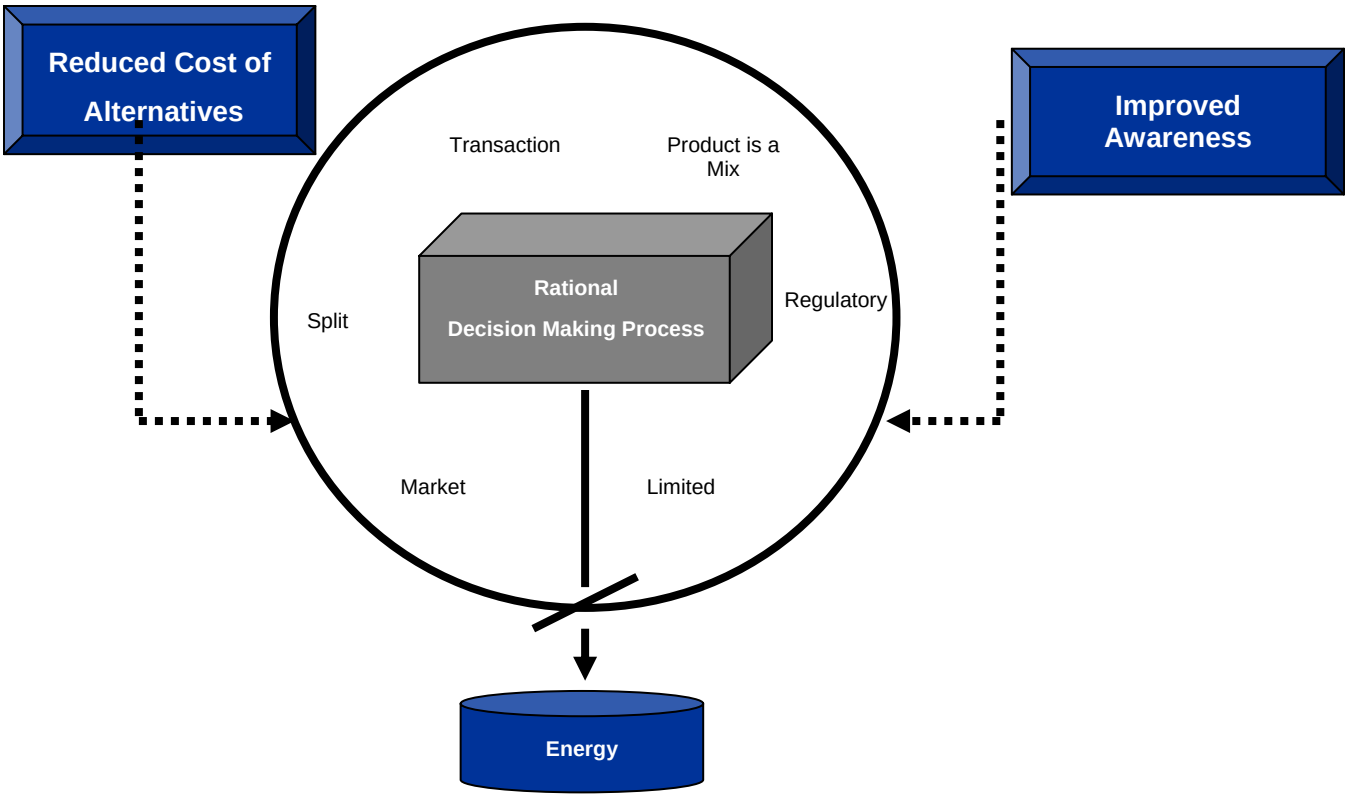
1. The gap is illusory – the analysis leading to the conclusion that there is a gap is wrong. Advocates of this position point out that there should be a gap between the market penetration of cost-effective energy efficient technology and the built environment because energy efficient technology is new and it takes time for it to diffuse into the market. Proponents of this position also argue that the gap arises from the failure on the part of engineering analysts to distinguish between energy efficient and economically efficient decisions (Sweeney 1993). It is possible, they point out, for decisions that are energy efficient to not be economically efficient.
2. There are hidden or unaccounted for costs of energy efficiency investments – there are unaccounted for differences in the performance of energy efficiency investments that impose costs that are not included in the engineering analysis which, when taken account of, would explain the gap.
3. Consumer markets are heterogeneous and, therefore, what is rational on the average may not appear so in different market segments (i.e., what is rational to do on the average may be irrational in sub-markets).
4. High discount rates are assigned to energy efficiency investments resulting from perceived risk, so that the discounted value of the benefits stream will not exceed first cost. The argument is basically that the prices of fuels are historically volatile, and projections that are based on avoided future fuel costs may overstate the benefit that will be achieved in the future if prices fall. Sophisticated investors know this and would heavily discount the stream of benefits to take account of this problem.

In the end, it is impossible to discount the merits of the above arguments. They provide plausible explanations for the existence of the gap between realizable and economically justifiable investment in energy efficiency. Unfortunately, with the exception of the argument concerning the impact of perceived risk on energy efficient investment, these arguments are not very useful for identifying ways to close the gap. They basically tell us to do nothing: just be patient, and the market will eventually close whatever gap may currently be present. On the other hand, the Market Barriers/Failures explanations discussed below are much more useful in suggesting policy actions and program changes designed to close the gap.

3.2.The Market Barriers/Failures Explanations for the Gap

The search for explanations for the gap began with a seminal article by Blumstein et. al. (1980) that argued that there were circumstances or conditions in energy markets (”barriers”) that prevented energy efficiency investment decision makers from behaving rationally. This explanation was based on the assumption that decision makers are normally rational, but that certain features of the market prevent rational decision making from occurring. Figure 2 graphically displays the effect of these barriers on consumer decision making. In essence, barriers and market failures interfere with the ability of consumers to make economically rational decisions by distorting the prices of energy and energy efficient alternatives, blocking out information about energy efficient alternatives, increasing the transaction costs associated with adopting energy efficient alternatives, and restricting the availability of these alternatives.

Figure 2: Effects of Market Barriers on the PTEM Model.



This argument provides a basis for actions on the part of government to overcome barriers and argues for the development of energy efficiency program designs that can

reduce or overcome the obvious barriers to rational decision making. The barriers identified by Blumstein et al. (1980) included:

1. Situations involving Misplaced or Split Incentives (also called agency problems) – these are situations where investment costs are borne by one party in a transaction and the benefits from the investment are received by another. The classic example of this situation is the tenant-landlord relationship where the tenant pays the energy bills and the landlord is responsible for making capital investments in the property. This problem is common in residential real estate. In this situation, it may be that the discounted energy cost savings greatly exceed the investment and maintenance costs associated with the investment. However, because the benefits flow to one party and the costs to another, there is no way the investment can be viewed as economically rational from the point of view of the investor.
2. Limited Availability of Capital – the first cost of energy efficiency investments may exceed the availability of investment capital or the borrowing power of potential investors. The discussion of this problem has generally focused on decision making by individual consumers rather than businesses. However, capital is nearly always limited in one way or another to most firms as well. In any case, it is often the case that the capital required to offset the first cost of an investment in energy efficient technology exceeds what is available to the decision maker, preventing them from taking the economically rational course of action.
3. Market Power – Market power refers to the ability of one or more of the suppliers or buyers in the market to determine the availability and price of products. It has been argued that actions by powerful interests in supplier markets can inhibit the penetration of energy efficiency products into markets using predatory pricing and domination of supply channels. For example, shelf/floor space in many retail establishments is essentially rented to product distributors either directly or indirectly through the incentives offered to retailers to position their products. It is possible for competitors with market power to limit the availability of shelf space of energy efficient alternatives (and thus protect market position) by increasing the rent on the available retail shelf space.
4. Regulatory Distortions – in some energy markets, regulatory actions distort price signals. These price signals shield decision makers from the economic consequences of their actions. For example, in retail electricity and gas markets, prices are set administratively. The market segmentation and rate designs (which are heavily influenced by political considerations) sometimes greatly distort the price signals that consumers receive, causing them to undervalue (and thus reject) energy efficiency investments. A good example of such a distortion is the use of declining block energy rates when the marginal cost of energy is greater than its embedded cost.
5. Transaction Costs – decision makers experience (sometimes significant) costs to identify and select efficient alternatives as well as costs to manage their implementation and operation. These are called transaction costs. This “barrier”

summarizes the effects of a lot of different impediments to implementation of energy efficient technologies. Transaction costs include not only the cost of information search and processing, but also the impacts of organizational structures, processes and decision making styles that are discussed in Section 3.3 (Non-economic Explanations for the Gap). It has been argued that this barrier is the single most important impediment to rational decision making concerning energy efficiency investments.

6. Inseparability of energy efficiency features from other desirable or undesirable product features. Producers sometimes limit the availability of energy efficiency features to particular product domains and. therefore constrain the consumer's ability to separately choose the most efficient alternatives – causing them to have to trade off energy efficiency against other product features.

In addition to the market barriers listed above, there are also a series of conditions that are known to cause market failure – that is, conditions that can exist in a market that virtually all economists would agree interfere with rational decision making and the efficient allocation of resources to decision alternatives (Golove and Eto 1996). Golove and Eto list four major sources of market failure including: the existence of externalities, imperfect competition, the existence of public goods, and imperfect information. Among these sources of market failure, perhaps the most important impediments to the efficient operation of energy efficiency markets are:

1. Externalities – These are costs that are external to the energy efficiency investment transaction. Increased GHG emissions and the cost of prosecuting wars needed to secure fossil fuel supplies are examples of costs that are external to energy efficiency investment decisions which, if included, could dramatically change the outcome of energy efficiency investment decisions.
2. Imperfect information – the existence of transaction costs.

The existence of the foregoing barriers and market failures has been used to justify a number of important changes to energy efficiency markets including:

1. establishment of construction codes and manufacturing standards;
2. provisions of tax incentives to financial institutions to make capital available for energy efficiency investments;
3. changes in federally regulated energy markets to eliminate cross subsidies and other distortions that discourage investment in energy efficient technologies; and
4. development of energy efficiency programs designed to achieve market transformation.

Energy efficiency programs designed to achieve market transformations are dramatically different from those that were derived from the PTEM paradigm in a number of respects. Under the classic PTEM paradigm, the objective of energy efficiency programs is to cause individual decision makers to adopt more energy efficiency choices by providing information and incentives. Market transformation programs are not designed to do this. Instead they are designed to achieve sweeping and long-term changes in the market share of energy efficient equipment alternatives in the market. While incentives are sometimes

offered in the context of these programs, they are generally considered to be short term and secondary requirements. Instead, efforts in market transformation are designed to intervene at important points in the manufacturing and distribution channels – providing training, financing and advertising designed to change the market penetration (and eventual market share) of energy efficient technology alternatives. These programs can be national or regional in scope and generally include a broad effort to change the behavior of all of the significant actors in the market – from manufacturers to distributors to retailers and eventually to the consumer. The ENERGY STAR labeling program is a good example of a national platform that seeks to change the market shares of energy efficient appliances. The effectiveness of these programs can only be judged by observing whether the changes to the market (the transformations) actually occur and by observing the changing market share of the target technologies over time. Thus, some time is usually required to detect market transformation impacts. That said, there are some very powerful examples of market transformation efforts that have profoundly changed energy markets (e.g., the market share of compact fluorescent lights in California).

3.3.Non-Economic Explanations for the Gap

The third class of explanations for the gap contains what are best thought of as Non-Economic explanations. As Figures 1 and 2 indicate, the PTEM model basically contains a black box model of consumer decision making behavior that assumes decision makers rationally choose among decision alternatives on the basis of price and other product attributes. The critical assumptions underlying the notion of economic rationality are:

1. Decision makers seek to maximize their gain always selecting the best possible choice – by comparing the costs and benefits of the alternatives (sometimes in other ways).
2. They are self-interested – even at the expense of collective interests.
3. All relevant information about alternatives is available and accessible (choices are clear), and individuals have all the needed information – this is the perfect information assumption discussed under the heading market failures.

The assumption of economic rationality in decision making is compelling because of its simplicity and because it suggests actions that can be taken to influence the outcome of decisions about energy efficiency investments (i.e., provide information and incentives). However, one doesn't have to look far in the literature in psychology, experimental economics, sociology and business to find important reasons why the assumptions underlying this model of consumer decision making may be violated in any decision making situation.

Looking inside the black box decision making model, it is evident that there isn't some algorithm, function or mental process in there that is converting information about outcomes and costs into decisions based on goals, constraints and a utility maximization strategy. The decision making process inside the black box is often a lot more complicated than the rationality assumption suggests. It is a lot messier – more like a can of worms than a function.

Non-economic models of the decision making process underlying consumer decisions about energy efficiency investments are a lot more complicated than the rational economic model. However, like the Market Barriers/Failures explanations, these models suggest potentially effective approaches for improving the design of energy efficiency programs, thereby closing the gap.

In reviewing the literature on consumer decision making (including energy efficiency investments), there are several key conclusions:

1. Rationality is only one of several decision-making heuristics that may be applied in a given decision-making situation.
2. Decision makers employ varying decision-making heuristics depending on the situation.
3. Decision-making units are often not individuals.
4. Decisions made by organizations are affected by a wide variety of social processes and heavily influenced by the behaviors of their leaders.

These key findings are described in more detail below, beginning with a discussion of the cognitive processes that decision makers use in making purchase decisions and the ways in which they may be activated.

Decision-making Heuristics

Consumers making purchase decisions employ different decision-making heuristics depending on how the problem is framed. Decision-making heuristics other than rationality are commonly used by consumers and businesses in making purchase decisions and may be triggered (instead of economic rationality) depending on how the issue is framed for the buyer by advertising, culture (societal and corporate) and other aspects of the decision-making situation. Alternatives to economic rationality include:

1. Bounded rationality (rational but limited by information-gathering costs)
2. Elimination by aspects (rational but not based on compensatory evaluation)
3. Association (e.g., automobile features and self image)
4. Conformity (e.g., fashion items)
5. Dissonance reduction (consumers may adopt decisions that cognitively fit with the rest of their self-image and reject those that do not)
6. Altruism (consumers sometimes make decisions that are not necessarily in their individual interests, but benefit others or the society as a whole)

Marketers often design messages to cause consumers to invoke decision-making heuristics other than economic rationality. In fact, it is arguable that the very essence of marketing is “framing” – getting consumers to invoke useful non-rational decision-making heuristics in choosing products and services. If consumers only employed rational decision making in evaluating purchase alternatives, it would be virtually impossible to sell luxury cars, gems, fashion items, art, tattoos, high-end brands of beer, and a host of other products at the markups that these products are able to get in the market.

It is quite possible to design advertising and marketing strategies for energy efficient investment alternatives that invoke powerful heuristics other than economic rationality to motivate consumers to select energy efficient alternatives. Recent examples of such advertising include "Green" sales campaigns by makers of automobiles and other consumer products.

Marketing energy efficiency to consumers based solely on an evaluation of economic costs and benefits may significantly reduce its effectiveness. It is only one way and possibly not the most effective way of framing the energy efficiency purchase decision making problem for consumers. Because there have been few systematic efforts to employ techniques designed to get consumers to invoke different decision making heuristics by energy efficiency program developers, it remains to be seen how much additional traction this approach would produce in the market. However, considering its widespread use in marketing generally, it is certainly worth the effort to find out.

Decision-making Processes

An important complication in the decision-making process is that purchase decisions often are not made by individuals. In the parlance of marketing, purchase decisions are said to be made by "decision-making units." Decision-making units are individuals or groups of individuals that make purchase decisions. Sometimes, a single individual makes the purchase decision (e.g., when consumers are purchasing household products), but more often decisions are made by multiple parties in consultation (Kotler 1994).

When a decision is made by more than one person, the outcome may or may not be economically rational, because, quite simply, the process of decision making is not merely cognitive, it is social. Even assuming the individual parties that make up the decision-making units are employing an economically rational decision-making heuristic, the social process used to eventually select an alternative may not yield a decision that is strictly rational from the standpoint of energy efficiency. This can occur for two reasons. First, goals and objectives can vary among the individual members of the decision-making units, and it may not be possible to fully reconcile the goals of the individuals without compromising rationality. Second, decision-making styles vary for decision-making units, and the use of these styles can easily result in decisions that are not rational in an economic sense. Groups use basically five important decision-making styles:

1. Consensus – a decision is found that satisfies the requirements of all or most of the decision makers in the decision-making unit.
2. Autocratic – a decision is made by a single individual ("the decider" as President Bush would say), possibly with the advice from others
3. Formulaic – decision-making units sometimes engage in a decision-making process that is overtly driven by an analysis of expectations (what they think might happen) and the expected utility of outcomes (Raffia 1997). This is the closest style to rational decision-making that exists for groups. This style is rarely used.
4. Bureaucratic – decisions are made by passing the elements of the decision through several departments of an organization for getting their approval of different aspects of the decision. Given the multiplicity of departments involved, this

process can often lead to decisions that are strictly not rational or, more likely, no decision at all.

5. Chaotic – decisions are made by committees comprised of representatives of several departments. Unlike the bureaucratic process, this process is intended to form a virtual consensus among the representatives (Olsen et al. 1972). This style is very common, subject to huge influences by individuals and department representatives, and it is highly unpredictable.

Considering the range of decision-making styles that can occur when groups make decisions, it is not at all surprising that a lot of decisions about energy efficiency investments do not appear to be rational. On one hand, this suggests that a certain, very substantial amount of failure in marketing energy efficiency investments is simply inevitable. On the other hand, it begs the question: "Are there any concrete steps that could be taken to overcome these problems?" The answer is a qualified yes. However, before we discuss the ways of structuring energy efficiency program offerings to take account of the varying decision-making heuristics and styles, it is necessary to consider the aspects of business organizations that influence decision making. As it turns out, certain aspects of the way that business organizations make decisions favor economically rational decision-making outcomes and can be used to improve the prospects of energy efficiency decisions under some circumstances.

Aspects of Business Organizations that Influence Energy Efficiency Investments

Business organizations are not just groups of people. They have well developed social structures that can profoundly impact decision making regarding energy efficiency investment (Cebon 1992). Businesses comprise more or less permanent groups of people who are capable of acting in concert to achieve commonly understood goals (DeCanio 1993) (DeCanio and Watkins 1998). The roles or job descriptions of the individuals in businesses are usually well defined and highly differentiated from one another, so that specific tasks are assigned to specialists (e.g., lawyers for legal problems, accountants for auditing and finance, etc.). These specialists are usually arranged in departments based on the similarities of job descriptions or interdependencies. Most importantly, there is always a formal hierarchy of authority both within and among the departments in a business. Were it not for this hierarchy, pandemonium would result, and the organized and goal-seeking behavior that typifies business activity would be simply impossible.

Hierarchy of Authority

The hierarchy of authority in modern business organizations is the single most important determinant of the outcome of decisions about energy efficiency made by businesses – not cost effectiveness and not whether persons in the organization are aware of energy efficiency opportunities. The reason for this is simple. The leaders of a business organization establish its priorities and the rules for processing decisions. There is empirical support for this notion in the findings of Lutzenhiser concerning the responses of California businesses and governmental organizations (Lutzenhiser et. al. 2002). The policies of management determine whether the organization is attentive to and receptive to energy efficiency investments or resistive.

The management policies that strongly influence the adoption rate of energy efficient technologies include:

1. Whether the organization has annual energy efficiency goals.
2. Whether reserves and budgets are established for funding energy efficiency investments.
3. Whether hurdle rates for energy efficiency investments are high or low.
4. The review process that is to be used to evaluate energy efficiency improvements.
5. Who is responsible for "managing" the company's energy efficiency program.

In the grand scheme of things inside organizations, these policies matter a lot more than the availability of information about alternatives and incentives designed to drive down first costs. Whether or not the company has the required information to make energy efficiency investments or considers them to be cost-effective is largely under the control of the management – or it can be if they focus on it. If they need the information, they will get it. If they need to move the hurdle rate to achieve an objective that is deemed to be important in the long run, they will do it. The operative assumption about business organizations is that they are decidedly not static. They can be made to be more or less receptive to energy efficiency investments.

Until relatively recently, energy efficiency programs targeted at businesses have tended not to focus on company management. Instead, they have focused on plant engineering or environmental compliance departments, sometimes in the context of replacing equipment that has reached the end of its useful life or otherwise become obsolete, and sometimes in the context of plant expansion.

These departments generally do not have the authority to authorize significant capital expenditures, and they usually are not in a position to be corporate sponsors or champions of energy efficiency initiatives. Consequently, other departments, such as procurement, finance and the executive ranks, become involved in evaluating energy efficiency investment decisions. Unless company management has established policies of the kinds outlined above, guidelines used in these various departments may not be consistent with good practice from the point of view of evaluating energy efficiency investment decisions. Procurement departments, for example, may or may not use lifecycle cost analysis to evaluate costs and benefits. They may instead focus entirely on first cost. If they do so, the decision outcome generally will not be the same and will not favor energy efficiency investment over other investment decisions with lower first costs. The same result can occur as a result of the involvement of the finance department or the executive branch. So obviously, how the organization processes these decisions can profoundly influence the outcome.

Centralization of Power and Decision Making

Size and Organizational Form

Between 10% and 20% of the business customers of most electric and gas utilities are responsible for about 70% of all business customers' energy use. While a utility may

serve tens of thousands of business customers, a very large percentage of these are small enterprises. Virtually none of these small businesses have the resources internally to plan their energy use. Moreover, their energy use is generally such a small component of their costs that the gains that can come from actively seeking energy efficiency alternatives are very small. For businesses such as these, the transaction costs of finding and implementing energy efficient alternatives can easily exceed the benefits. Moreover, because these enterprises are usually starved for capital, it is difficult for them to undertake significant energy efficiency investments. There is very little reason to expect these enterprises to make economically rational energy efficiency investments.

The relatively small percentage of medium- to large-sized customers of utilities tends to fall into one of the following three categories:

1. Companies operating one or more facilities with very large energy use (e.g., mines, chemical plants, breweries, refineries, commercial office buildings, hospitals, etc.).
2. Companies operating numerous facilities with medium- to large-sized energy use (e.g. chains of dry good retail stores, gas stations, grocery stores and restaurants).
3. Institutional energy users operating numerous facilities (e.g., school systems, prisons, municipal governments and military bases).

There are enterprises whose energy use, when considering all of their facilities, is significant both to the utility and to the customer. They often have dedicated staff to manage energy use or contract with consultants to manage their energy use. The transaction costs for these enterprises to identify and implement energy efficiency investment opportunities are proportionately less.

Hierarchy of Organizational Needs/Goals

Financial resources in most business organizations are limited. That is, not all available investment alternatives can be adopted at any point in time. Consequently, "routine" funding decisions are generally not made in isolation – they are made in a context in which a potentially large number of other investment alternatives are "on the table" – some with inherently higher value to the organization than others.

There is usually a hierarchy of needs (set by the leadership of business organizations) that is reasonably well understood by everyone in the organization. Examples of needs are:

1. Health and Safety Requirements – most businesses rank this need first, and resources required to meet these needs are not available to other alternatives.
2. Regulatory Compliance – like health and safety requirements, investments designed to come into compliance with regulation are not optional, so resources required to meet these requirements are generally not available to other alternatives.
3. Corporate Improvement Initiatives (e.g., Zero Defects, Six Sigma, Greenhouse Gas Reduction, Energy Efficiency, etc.).
4. Maintenance – periodic repairs and replacements designed to sustain production or extend life.

5. Productivity – investments design to improve production efficiencies or expand production facilities.

Health and safety needs and regulatory compliance needs are generally not viewed as optional. Investments designed to meet these requirements are not in competition with other more "routine" decisions. In the current regulatory environment, energy efficiency investments might be viewed by the company or facility as falling into any of the other categories. It is possible as GHG emissions come under regulatory oversight, this will change and energy efficiency investment decisions would be moved into the non-optional decision-making tier. This would greatly increase investment in energy efficiency and overcome many of the organizational impediments to energy efficiency investment decisions.

The placement of the energy efficiency investment decision in the hierarchy of needs will have a profound effect on its likelihood of adoption. The higher up the energy efficiency decision is placed within the hierarchy of needs, the better its chances of adoption. The important point here is that the decision is not just whether to make the investment in energy efficiency given its economic consequences, it is whether or not to make the investment given its comparative economic consequences – taking account of the other alternatives that are available. Under these circumstances, it is possible for an energy efficiency investment which is very cost effective not to be adopted because some other alternatives within the silo are more attractive – often on some dimension other than cost effectiveness per se.

For example, if a decision to upgrade a chiller on a commercial office building is viewed as a maintenance investment, it may be put in competition with a decision to upgrade the appearance of the entrance to the building. It may not matter how cost-effective the energy efficiency investment is if it is competing for resources with projects that are judged to have inherently higher value to the firm on some dimension that is not measured by changes in operating costs. The energy efficiency improvement may lose out in the competition, despite the fact that it is cost effective, because the "value added" of the competitive alternatives are judged to be higher.

Some organizations that are known to be very successful at implementing energy efficiency investments have set up separate silos in which the energy efficiency investments are evaluated. These silos have dedicated funding and different hurdle rates than other silos. Typically, these are organizations that have energy efficiency initiatives. This can only occur where management takes a strong interest in improving energy efficiency.[5]

[5] There are a variety of other ways in which organizational structures and processes can be used to foster energy efficiency improvements. For example, many firms employ continuous improvement programs in which energy efficiency investments fit nicely. Toyota's kaizan process, which involves finding and eliminating all kinds of inefficiencies as a means of achieving productivity improvements, is a good example of a business initiative that could be used to find and implement energy efficiency improvements across the board. It is important to remember though that the kaizan process is directed at finding the low hanging fruit first, so to the extent that energy efficiency investments do not significantly reduce down time or improve throughput, they may be at a disadvantage to other measures that achieve these all important corporate goals.

Importance of Energy Efficiency to Profitability

There are aspects of energy efficiency decisions that cause decision-making problems that are almost impossible to overcome if the decision makers are focused solely on the economic costs and benefits. Because energy use is often a small component of the cost of production (2%-6% on average), even relatively large energy efficiency improvements often translate into small improvements in profitability. It is difficult to interest company management in problems that have small impacts on the bottom line unless some other sort of benefit is added to the mix.

It is also the case that asset management strategies vary tremendously from business to business. Some companies view their facilities as sustainable production assets (and, therefore, are willing to make long-term investments), others buy and flip production facilities, and still others have a use it up and move on to the next generation of facilities strategy. Only businesses using the sustainable production strategy are likely to make anything other than cosmetic investments to facilities.

Both of the above considerations work against the likelihood that many firms will adopt energy efficiency investments. Of course, when energy prices rise dramatically or are forecasted to rise more or less continuously into the future, this provides a basis for convincing management that future energy costs may significantly influence the bottom line.

3.4.Toward A Unified Approach to Closing the Gap

Throughout this section of the paper, we have outlined a number of weaknesses in the PTEM model arising from its reliance on the assumption that decision makers employ rational decision making in choosing among alternatives that affect energy efficiency. The point of this argument is not that economists are wrong and that the other behavioral scientists are right. The fact is economists have a simple and well-organized model for predicting human decision making that often works well. However, sometimes this model doesn't work for predictable reasons. On one hand, there are Market Barriers and Failures, and on the other hand, there are important nuances in the consumer decision-making process that are not accounted for by this simple model.

The Market Barriers and Failures literature tells us that there are conditions in the market that can interfere with rational economic decision making. This literature provides a reasonable basis for intervention into markets by the government with regulations and programs designed to remove or otherwise ameliorate the effects of barriers and market failures.

The Non-Economic explanations for the gap tell us that there are aspects of decision makers and decision-making processes that can lead to decision outcomes that are strictly not rational from an economic standpoint. They tell us:

1. Decision makers weigh a wide range of factors in deciding among alternatives – some involving economic benefit and costs and some not.
2. Decisions made by businesses are disproportionately influenced by the executive ranks of organizations.

3. Decisions about energy efficiency investments must pass through organizational hierarchies that may or may not authorize an economically rational decision seen from the point of view of its impact on energy efficiency.
4. Decisions made by businesses about investments in energy efficiency often take place inside a larger institutional context in which energy efficiency investment alternatives may be competing with other alternatives that have lower or higher value to the organization.
5. Decision making about energy efficiency investments is not frictionless – the transaction costs associated with making these decisions may be relatively large for businesses that have little experience with such decisions.

These explanations for the gap are more than mere descriptions of the reasons why organizations sometimes behave irrationally from the point of view of energy efficiency investment. They can be used by energy efficiency program designers to enhance the performance of energy efficiency programs. They provide insights that program planners and designers can use to target their marketing efforts more accurately, design training programs for sales personnel, establish outreach programs to executives, and develop value propositions (i.e., what the customer gets for what the customer pays) that may be more attractive to businesses than simple cost effectiveness.

The fact that consumers and decision makers often behave irrationally is a two edged sword. Properly wielded, program changes derived from the Non-economic perspective may be used to cause consumers and businesses to make energy efficiency investments that are not cost effective (because of externalities and their transaction costs).

The obvious next question is: How do current energy efficiency programs address the gap – taking account of both the market barriers and failures that have been identified and the Non-economic assumptions about the decision making behavior?

4. The Energy Efficiency Programs – The State of the Art

In this section, the current generation of energy efficiency programs in California is examined to determine the extent to which these programs employ the PTEM paradigm and rely on the assumption that consumers are economically rational when choosing energy efficiency investments. An effort is also made to assess whether these programs have been designed to take account of other factors that may influence consumer decision making like Market Barriers and other Non-Economic factors that interfere with rational decision making on the part of customers.

As explained in Section 1, this paper focuses on those energy efficiency programs offered in California to non-residential customers by the Pacific Gas and Electric Company (PG&E). PG&E was selected for the analysis because it is a combined gas and electric utility (so its programs are targeted at both gas and electric customers) and because it is the largest of the energy efficiency programs offered by the California IOUs. While a more comprehensive review of programs serving non-residential customers in the US would be interesting and probably would reveal substantial variation in existing program designs, the resources available for this study were insufficient to support a broader review.

The analysis focused on programs proposed by PG&E for the 2009-11 funding cycle (i.e., these are proposed programs and have not been approved by the CPUC). Energy efficiency programs offered by PG&E have evolved over time since the mid-1970s, from a few fairly simple and inexpensive information programs costing only a few million dollars annually to nearly 100 highly targeted programs providing a wide range of information and design services along with significant economic incentives. The cost of these programs is now more than $500 million (M) per year. The evolution in the complexity and size that has taken place over the past 30 years in energy efficiency programs offered by this company is comparable to the evolution of space travel from the Mercury capsule to the Space Shuttle.

Table 1 summarizes PG&E's total proposed budget request for the 2009-11 funding cycle broken down by major program type (excluding statewide marketing and measurement and verification). PG&E proposes to implement 94 programs, directly serving its customers and their governments at a total cost of approximately $1.8 billion (B) over three years. While this sounds like a substantial amount of money, it is a fairly small fraction of the total cost of electric and gas service. PG&E's electric and gas revenues between August of 2007 and 2008 were approximately $14.12 billion. Assuming sales do not grow over the next the next 3 years (probably unrealistic), the total electric and gas cost for PG&E customers over the next three years would be about $42 billion. Thus the proposed cost of PG&E's energy efficiency programs is about 4% of the cost of service. About $820 million of PG&E's request (46%) is dedicated to more than 90 energy efficiency programs targeted at business and government.

Table 1: Proposed PG&E Energy Efficiency Programs and Cost

Core Programs	**Number of Programs**	**$ Requested**
Targeted	7	$312 M
Mass Market	1	$539 M
Other	4	$102 M
Government Partners		
Energy Watch	17	$122 M
State Departments	1	$41 M
Green Communities	1	$17 M
Third Parties	57	$324 M
Long Term Initiatives	6	$262 M
Total	94	$1.8 B

4.1.Overview of Energy Efficiency Programs for Business and the Public Sector

The array of programs and approaches designed to reach PG&E's non-residential customers is mind boggling in both its size and complexity. PG&E's description of its portfolio of proposed energy efficiency programs contains more than 1,000 pages of detailed information describing its programs. To determine the extent to which the 90 programs directed at businesses and governments rely on rational economic decision

making by customers and identify the ways that they may be attempting to overcome market barriers and non-economic factors that influence customer decision making required reviewing the following documents filed by PG&E:

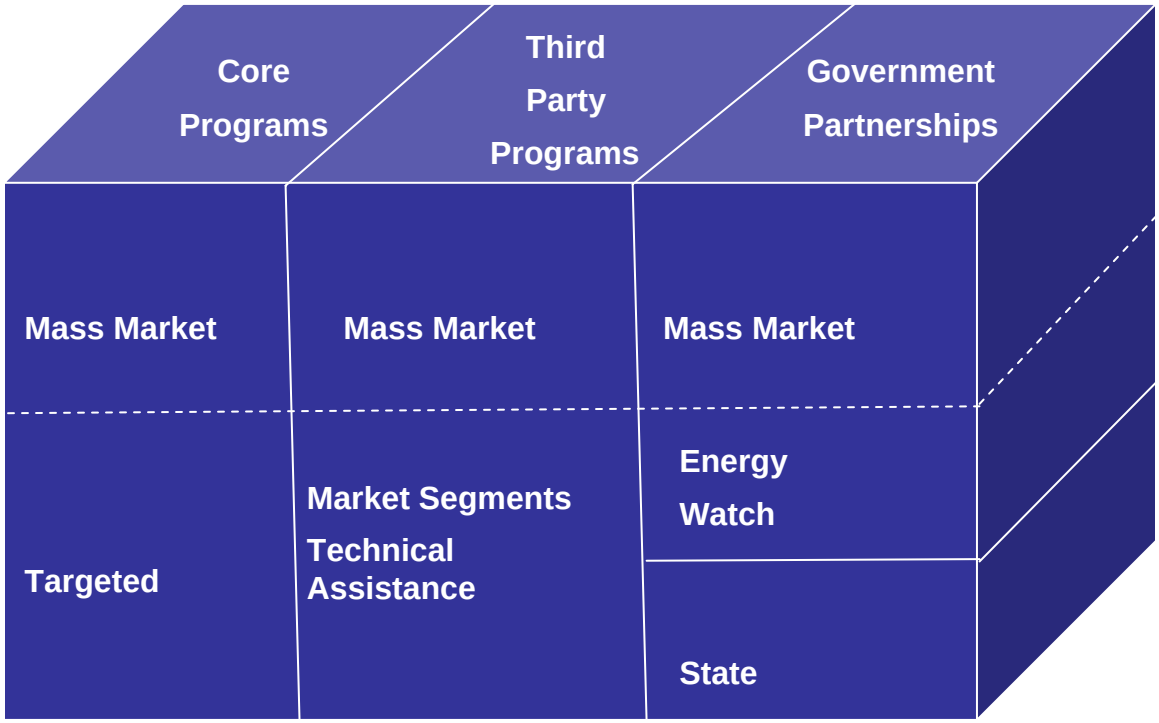
1. Prepared testimony by various parties describing the programs (PG&E 2008A).
2. Appendix B of the prepared testimony entitled "Program Strategy and Implementation Plans" that describes the underlying rational of each of the program offerings (PG&E, 2008B).
3. Appendix C of the above testimony that contains the logic models for all the programs (PG&E 2008C).

While all of the programs under consideration differed from one another in important ways, we found many similarities among the programs – particularly in regard to the assumptions that were made about consumer decision making and the efforts that were developed to respond to market barriers and non-economic influences on decisions.

Figure 3 below shows the structure of the proposed program offerings for the 2009-11 timeframe. The figure shows the three basic *classes* of energy efficiency programs in PG&E's portfolio – Core Programs, Third Party Programs, and Partnerships. It is helpful to think of each of these classes as a leg in a three-legged stool – the seat of the stool being the totality of PG&E's energy efficiency improvement efforts.

The 12 Core Programs are exclusively managed by PG&E. The second class of programs offered by PG&E contains 57 contracts with third parties to provide a wide range of expert services to customers and PG&E, including direct marketing of energy efficiency program services to specific markets. Funding and fiscal management for Third Party Programs flows through the utility, but the responsibility for sales, engineering, project management and the customer relationship rest with the Third Party Contract holders. The third class of programs contains what are called Partnerships. Partnerships are grants to state, municipal, county and area governments to undertake a wide variety of governmental support activities intended to foster energy efficiency in their facilities and on the part of the citizens that they serve. The energy efficiency programs offered within each of the above classes are discussed next.

Figure 3: Structure of Proposed PG&E Energy Efficiency Program 2009-11



4.2.Core Programs

While there are 12 separate programs within the Core Program class, there are just two basic program types: one designed to serve the Mass Market and the other designed to serve specific market segments within its large commercial and industrial customer population. The underlying logic and program mechanisms designed to serve these two program types differ substantially from on another, while the programs within them are very similar, at least with regard to the underlying assumptions that are made with respect to the motivations and decision-making processes that will trigger customer response.

Core – Mass Market Program

The Mass Market Program is designed to serve customers that are not directly targeted by other programs intended to serve specific pre-defined market segments offered through Targeted Programs or Third Party Contractors. The Mass Market Program provides information and incentives to both residential and business customers.

The Mass Market program is designed to stimulate investment in energy efficient technologies in three ways:

1. Upstream Initiatives – providing incentives, co-branding and collateral marketing materials to manufacturers of products like refrigerators, motors, lights and other energy using devices. Revenues flowing through this program are used to buy down the price of selected energy efficiency equipment offered in the market, ensure the availability of this equipment in the market, and highlight its availability to customers through marketing and sales campaigns in the mass market. This program is a classic market intervention specifically designed to

improve the availability of energy efficient products in the market and to cause them to be positioned in the distribution and retail channels alongside other less energy efficient alternatives. It is designed to eliminate market barriers arising from factors that influence the availability of products in the market.

2. The Mid-Stream Mass Market Initiative provides incentives, collateral marketing materials, and training to product distributors, dealers and installers to encourage them to stock and sell energy efficient equipment. This program relies on parties in the distribution channel who would normally be involved in the sale of lighting, HVAC and other energy using products to sell those products to their customers. It provides incentives to both sides of the energy efficiency decision (the seller to sell it, and the buyer to buy it). The program attempts to encourage investment in energy efficiency by providing information and incentives. In this case, it relies on the rational decision-making assumption inherent in PTEM programs. However, it goes quite far beyond the simple model that is targeted only at the consumer as decision maker. It uses incentives and training to stimulate selling as well as buying. It is designed to ensure that energy efficient equipment choices are presented to customers during the normal course of business when repairs and replacements are made to energy using equipment. In this way, energy efficiency incentive and information programs can tag along with contractors in the normal course of their business, being inserted wherever they can get traction. This program removes significant barriers from the market by ensuring that energy efficient products are available, increasing the likelihood they are seriously presented to customers, and reducing the transaction costs experienced by decision makers in finding energy efficient alternatives.

3. The Down-Stream Initiative consists of rebates paid to consumers who purchase energy efficient products along with collateral advertising, website and telephone support to business customers who respond to standard advertising (e.g., bill inserts and ads) or become interested in improving the energy efficiency of their businesses by exposure to Government Partnership activities. This is the closest activity in the PG&E portfolio to a pure PTEM-based program: i.e., its primary focus is on providing energy audits, information about energy efficient technologies and incentives to customer to encourage them to buy energy efficient equipment.

About 40% of the revenue that PG&E is requesting (about $540 million) is proposed to be used to fund the Mass Market Program serving residential and commercial customers from 2009-11.

Core - Targeted Programs

The Targeted Programs are designed to serve PG&E's Commercial and Industrial Customers who's electric and gas usage level is high enough to warrant the assignment of a designated utility customer account representative. At PG&E, the account representatives basically "own" the relationship between PG&E and the customers that they are responsible for. In situations where customers have numerous facilities spread across the PG&E service territory (e.g., large store chains), the customer may also have a corporate account representative who works with both the local PG&E representative and

the corporate representative of the customer. The role of the corporate account representatives in the rollout of PG&E's targeted energy efficiency programs is evolving.

There are about 2,500 customers who fall into this category – comprising about 30% of total electric and gas sales. These customers vary from enterprises that have one or many very large facilities (e.g., refineries or commercial office buildings), to customers that operate numerous medium to small-sized facilities under a single corporate umbrella (e.g., big box retail stores, grocery store chains and schools).

In this program, energy efficiency Program Managers in PG&E's corporate headquarters work together with Account Representatives (who have the responsibility for the day-to-day relationship with the customer) to design and present custom energy efficiency solutions for large customers. The job of the customer representative is to be the interface between the energy efficiency project management team (in PG&E's corporate office) and the customer. They are there to work with the customer to identify their needs, understand their business and operating environment, understand their appetite for investment in energy efficiency solutions, and present appropriately designed solutions.

The energy efficiency project management team in PG&E's corporate office has the task of identifying: (1) state-of-the-art energy efficiency solutions for customers using all of the available information that PG&E has on the customer's processes; (2) their willingness to commit capital in making energy efficiency investments; (3) the available energy efficiency technologies that could improve the customer's processes; and (4) the incentive mechanisms that are available. Box 1 (below) describes the results of an interview of a PG&E customer who is on the receiving end of this initiative. This outcome is indicative of the potential of this approach. However, experience and interviews with other industry representatives suggest that there are companies that will not respond as well to this initiative.

Box 1

There is a brewery operating in Northern California that is a frequent participant in PG&E's Targeted energy efficiency programs. Breweries are very large energy users because of process heating and refrigeration requirements. Because of its size and the complexity of its operations, PG&E has assigned a customer representative to this customer. This brewery is one of 13 operated by the corporate parent in the United States. The parent corporation of this brewery has an energy policy that requires all of its breweries to compete with one another to achieve measured energy efficiency gains on an annual basis. They have established a performance metric that is based on energy input per barrel of production for evaluating the performance of the various breweries in meeting their energy efficiency objectives..

The engineering staff of the brewery is highly motivated (by company policy) to achieve energy efficiency gains and works closely with their PG&E representative to identify opportunities both from a technical and economic standpoint. They generally do their own facilities engineering design work, but look to their PG&E representative for assistance in identifying opportunities for technical improvements, support in navigating potential regulatory hurdles (environmental, legal, political and other issues) and in finding opportunities for reducing investment costs by taking advantage of energy efficiency incentives and rebates.

In this case, the utility and its customer have established an effective working relationship that fosters not only energy efficiency investments, but investment in renewable resources like solar, wind and biomass energy resource development.

What makes this relationship work is not just the fact that the customer is being offered incentives to make energy efficiency investments. It is the fact that the management of the company has created an environment and internal decision making process that not only facilitates energy efficiency investments but requires them.

The "targets" of the Targeted Programs are businesses in seven high value market segments (Table 2.).

Table 2: Target Market Sectors

Sector	$ Proposed 2009-11 (millions)
Agriculture/Food Processing	52
High Tech	37
Industrial	73
Commercial and Trade	49
Schools and Colleges	15
Hospitality and Health	37
Government and Public Service	48
Total	311

Within these market segments, integrated energy efficiency and demand response programs are being developed for specific business models. For example, in the Agriculture/Food processing sector, there are separate program initiatives for improving energy efficiency in processes used by wineries, canneries, produce packers and refrigerated warehouses. Different combinations of energy efficient technologies and incentives are being developed for each business model.

This process is being repeated for common business models in all of the high value business segments. While the company is definitely fashioning different program offerings in each of its business segments and offering them in different ways, the underlying logic behind these programs is the same – present cost-effective energy efficient alternatives to customers and information about how they can benefit. In this respect, the Targeted Programs rely heavily on the rationality assumption in the PTEM model. However, the Targeted Programs also address several of the key issues that have been identified as significant behavioral stumbling blocks to organizational decision making. In particular, they rely on a sales team consisting of energy efficiency technology experts, parties familiar with the complex incentive mechanisms that can be used to reduce the cost of energy efficiency and, most important of all, dedicated sales representatives who are familiar with the customer's businesses, the industries in which they are operating and their appetite for making energy efficiency investments.

The dedicated sales representative who is familiar with the customer's business can assist in identifying the value propositions that customers are likely to find attractive and help structure the information that is provided to customers to take account of the decision making styles that may be in use. Information and guidance provided by the sales representative can also be used by the energy efficiency program design teams to identify and design offerings to the customers that would have a higher likelihood of adoption than others that may not fit the customer's appetite for capital investment and risk. This is a far cry from the last generation of energy efficiency programs that were designed to encourage customers to implement energy efficiency measures per se. They are not selling energy efficient lighting, boilers, motors and controls anymore. They are selling energy efficiency solutions.

The results of this effort are just beginning to materialize. Initial reports from the company are that the approach appears to be more effective than the previous approach that focused on marketing measures (e.g., improvements in the energy efficiency of lighting, motors, etc.) to large customers. Because these programs involve integrated solutions, they will pose significant measurement and evaluation challenges. It will be difficult to assess the improvement in the effectiveness of marketing activities by simply observing the results of program activities, because the targets of these programs are being selected, in part, based on the customer representative's assessment of their receptiveness to energy efficiency improvements. For these reasons, conventional measurement and evaluation protocols may not be able to provide much insight into their effectiveness. Nevertheless, these programs contain design changes that could dramatically improve the likelihood that targeted large customers make energy efficiency investments, and significant effort should be expended to develop measurement and evaluation strategies that can conclusively determine whether or not they actually do so.

4.3.Third Party Programs

In addition to its Core Programs, PG&E proposes to enter into contracts with 57 providers of energy efficiency services that are selling energy efficiency improvements to specific, narrowly defined market segments containing customers that may not have been assigned customer representatives but have significant potential for achieving cost-effective energy savings (e.g., oil extraction, food processing, retail groceries, schools, convenience stores, etc.). Some of the Third Party contractors also provide advanced engineering design and project management assistance to customers in the Core Targeted programs who require specialized engineering design and project management assistance (e.g., large manufacturing concerns). The energy efficiency program managers and sales representatives can call on the Third Parties to assist in serving large customers that require expertise that is not contained within the utility's program staff.

Third Party contracts are established through a competitive bidding process as well as through open solicitations that third party providers can use to propose programs that fill specific market niches that are not served by other program offerings. The IOUs oversee Third Party programs, but the Third Party contractors carry them out. The contracts are performance based. That is, contractors don't get paid to make offers to customers. They get paid to sell and install energy efficiency improvements.

Most of the enterprises signed up under third party contracts operate very much like PG&E's Core Targeted program, except that they cannot rely on the knowledge that the PG&E customer representative has of the customers' circumstances, and they don't have the access to customers that comes from being a dedicated customer representative of the utility. The third parties operate more like conventional sales organizations – finding opportunities through business networks, advertising, attendance at business associations and community meetings, booths at county fairs and cold calling. Most of these enterprises focus on specific business models (e.g., grocery stores, dry good retailers, oil extraction operations, parking garages, etc.) offering energy efficiency solutions that are tailored to those business models. A few are experts in industrial processes, lighting, architecture and other more general areas and offer principally design and project management assistance to large businesses – sometimes in cooperation with utility marketing teams.

Like the Core Targeted programs, Third Party Contract programs offer custom, highly targeted opportunities to customers that they understand because they are basically experts in the applications of energy efficiency technology to the customer business models that they are selling to. These are very much like professional sales operations that are targeted at specific energy efficiency opportunities in the market. PG&E proposes to spend about $100 million annually on Third Party programs.

4.4.Partnerships

The third leg of PG&E's energy efficiency portfolio consists of a series of "partnerships" with various governments in California. The Statewide Partnerships, Green Communities Partnerships and Local Government Partnerships are grants to various governments and agencies to fund a wide range of activities by these agencies designed to accomplish and encourage energy efficiency.

The grants are provided to 17 municipal and county governments to fund Energy Watch programs, 4 regional associations to fund the Green Communities initiatives, and various organizations of the State of California including: the University of California, California State Colleges and Universities, community colleges, the Department of General Services and the Department of Corrections.

These grants support a wide range of activities by these agencies including:

1. Improving the efficiency of energy use in government facilities (through investment and training).
2. Directly installing energy efficient equipment in buildings occupied by low-income families and small businesses.
3. Encouraging citizens to make energy efficiency investments.
4. Providing training to government employees responsible for building maintenance and operations, planning, code enforcement, and other activities that governments routinely undertake that affect energy efficiency.

In general, these programs are subsidies to government organizations to encourage them to make energy efficiency investments in facilities under their control, enforce building codes, train planners and other government administrators to write and enforce ordinances that support energy efficiency and the development of renewable resources, and encourage citizens to make their own energy efficiency investments. In that respect, they are mostly designed to accomplish market transformation objectives. In essence, they are creating a social and political climate that is conducive to energy efficiency investment in general.

As might be expected, the effects of this sort of program are difficult to measure – in part, because the elements of the program vary so much from community to community and, in part, because it is difficult and expensive to construct comparative studies (i.e., those with and without programs) of whole communities. However, because they represent very concrete attempts to change the entire social environment, including political institutions, community groups and citizens, it is extremely important to discover what is working in these efforts and what is not. It is possible to build a comprehensive evaluation strategy that can be used to evaluate the effectiveness of the numerous strategies that are being attempted in the various communities. The standard process evaluation is not a sufficient approach. To find out what is working and what is not, the standard measurement and evaluation framework has to include research designs that employ quasi-experiments or experiments to observe the impacts of these program initiatives.

5. Conclusions and Recommendations

The next generation of energy efficiency programs, as evidenced by the designs proposed by PG&E in its 2009-11 funding cycle, is a far cry from the generation of energy efficiency programs that were focused primarily on trying to motivate customers to install selected energy efficiency measures by providing information and incentives. These programs have been carefully crafted to respond to known market barriers and to some

extent the behavioral factors that influence organizational decision making that have been discussed in this paper. Now, the big questions are: what will work, what will not work, and when something doesn't work, why did it not work? This is more than a rhetorical question. It is not a foregone conclusion that the ambitious efforts outlined in PG&E's proposal will work. If experience is any guide to the future, it is likely that a lot of them will either not work or have unintended consequences. How will we know what worked and what didn't and why?

5.1.Additional Research Needed

Reading Section 4, one might be tempted to reach the conclusion that there is no need to continue to worry about closing the gap; that the very comprehensive program proposed by PG&E will solve the problem; and that there is no further need to try to refocus utility programs, so that they take account of market barriers and other behavioral factors that influence energy efficiency decision outcomes. That would be very premature. The devil will be in the details of implementing the ideas put forth in PG&E's proposal, and considerable program design and development will be necessary to successfully implement the ideas that the company has put forth.

PG&E has recognized this need in its filing and asked that substantial evaluation, measurement, and verification (EM&V) funds (about $48 million) be set aside over the next three years to conduct careful investigations of the effectiveness of its new market transformation and customer behavior-related program design elements. The focus of these investigations will be on identifying what works and what does not, and shaping programs, so that they are successful.

It is vital that such substantial sums be set aside for this effort for two reasons. First, PG&E has limited experience with the proposed programs, so it is not a foregone conclusion that their initial efforts will be successful. Substantial experimentation will undoubtedly be required to conduct concept testing and market experiments to identify (messages, marketing strategies and other program elements) that are effective. Without such an effort, it is likely that many of the new efforts to incorporate market transformation and program aspects designed to respond to behavioral impediments to program participation will simply fail; and we won't know why. There is also a second and in some ways more important reason to encourage PG&E to undertake its proposed research program and that is that if the research and development activities required to implement these programs are well executed from a scientific standpoint and well documented, great advances in the state-of-the-art in energy efficiency program development may be transferred to the wider policy and program development community. The opportunity to advance the state of knowledge regarding the reactions of customers to different value propositions and messages, different marketing techniques (e.g., viral marketing), and a wide variety of other issues is very great. It should not be wasted.

The inherent challenge in carrying out the above research agenda will be to control the experiments and other research in the context of the implementation environment where the pressure for performance is extremely great. Establishing the research agenda that should be investigated in the context of such a research program is beyond the scope of this paper, but it certainly should be undertaken as quickly as possible. PG&E has asked

for workshops to discuss evaluation strategies for these programs and that is probably a good place to start the discussion.

The PG&E proposal also includes a substantial effort to stimulate local and state government entities to engage in a wide range of policy, enforcement, training and public outreach activities to enhance the uptake of energy efficiency programs in their communities. This program, which is being carried in different ways in many different communities, could be very useful in significantly transforming the ways in which government entities and non-governmental organizations influence the efficiency of energy use in the communities they serve. However, the evaluation of the effects of these programs is a very serious challenge under the current measurement and evaluation protocols because they are being carried out in so many different ways in different communities. Because of the importance of these programs, substantial efforts should be undertaken to determine the activities that the various communities are doing that are effective in achieving market transformation objectives and those that are not. Community-level programs can be a powerful lever in improving the efficiency of energy use in California, or they can be a gigantic waste of money. The conventional measurement and evaluation framework has not provided very useful information concerning this type of program. Process evaluation practices are simply not robust enough to provide the kind of information that is needed to guide the development of such programs and make reasonable judgments about their usefulness. What is needed is either careful experimentation focusing on key program design elements for selected communities, or a quasi-experimental framework that compares the impacts on key aspects of these programs by comparing communities while controlling for their characteristics.

5.2.Motivating Business Decision Makers

The complexity of the behavioral processes underlying business decision making creates a situation in which it is virtually impossible to take account of all of the possible ways in which things can go wrong in organizational decision making. Virtually, all large organizations are different from one another in respects that are important for the outcome of decision making. Under this circumstance, the appropriate response is to customize products, value propositions and other information based on the best market intelligence available about the organization, its needs, its appetite for investment, the decision-making process it will use to evaluate the proposal, and the party(ies) who will ultimately decide. This is how the complexities of organizational decision making are managed by modern marketing and sales organizations, and this is what PG&E is proposing to do for its Core Targeted Customer programs and for some of the programs offered through Third Party Contracts. It is not clear how this concept will be translated to mass market programs, if at all.

As explained in Section 3, the executive leadership of business organizations controls the fate of virtually all business proposals involving capital expenditures. It controls them through policies and decisions that determine the organization's orientation to energy efficiency (open or closed), whether it has executive sponsorship, funding, labor assigned to achieving energy efficiency gains, processes for evaluating proposals, and hurdle rates that the organization applies to energy efficiency decision-making alternatives. The

receptivity of organizations to energy efficiency improvements is largely controlled by these considerations. If the organization is set up by its executive ranks (i.e., the CEO and his direct reports) to be receptive to energy efficiency investments, organizations can easily adopt them. If it is not, adoption is at best problematic.

The overall strategy proposed by PG&E for marketing energy efficiency to businesses might very well benefit from a program (maybe a Third Party Contract) designed to encourage business leaders to make their organizations more receptive to energy efficiency investments. It appears to complement the strategies being proposed by the company. This should be thought of as a type of market transformation program. It is possible to imagine a number of designs for such a program – some of which have been tried on a small scale outside of California.[6] The benefits of changing "corporate culture" should not be underestimated. Businesses make hundreds of "routine" decisions that affect energy efficiency – not the least of which are decisions about the design of new operations. Successful energy efficiency investments in one location will be applied in other locations, because that is how businesses adapt and change.

It is also possible to try to reach and motivate business leaders in the small business community directly. It may be possible to reach these parties through community organizations of which they are members. It may be that the best approach is to convince the local community leaders (e.g., mayors and county supervisors) to organize meetings with business leaders regarding the activities that they as businesses leaders in the community can and should do to use energy more efficiently. It may be that the best way to reach and motivate business executives in the targeted and mass markets is through a public relations campaign directed at the business organizations that they belong to. Reading through the Third Party targeted market proposals, the different contractors sometimes mention marketing through these channels for specific business types (e.g., a hospital administrators' association). One wonders about the content of these marketing efforts. What are the value propositions that are being put on the table? What actions are meeting attendees being asked to take? What happens when these talks are given? Could a professional public relations expert craft a more effective message? All of these are questions that we would need to know the answer to before deciding to try to improve on what is already being proposed by PG&E. They are worth asking.

Core Mass Market Programs are PTEM-based interventions into the supply chain (Upstream and Midstream) for appliances and other energy-using equipment, or they use a very simple combination of incentives and information provided to consumers (Downstream). These programs are meant to serve either residential or small commercial businesses that are buying new appliances and equipment or replacing old ones. The organizational decision-making problems and opportunities that are presented for larger businesses don't apply.

---

[6] There is at least one successful example of the use of a firm (EnVINTA) by MidAmerican Energy. In addition, CEO forums have been established to encourage company executives to foster corporate policies deigned to limit greenhouse gasses and other environmental problems. It is possible that this idea could be used to encourage senior executives in PG&E customer organizations to establish policies that make their firms more receptive to cost-effective energy efficiency investments.

However, the relatively narrow focus of the current programs on impacting the costs of the energy efficiency investments as a way to tip the balance in their favor may be missing significant opportunities to include other, sometimes more powerful, motivators. It may be possible to increase the likelihood that business consumers select energy efficiency alternatives through these mass market programs by offering other value propositions (in addition to cost savings) to consumers in the transactions that these interventions are designed to affect. For example, it is possible that programs designed to raise the visibility in their markets of businesses that make energy efficiency investments would offer significant additional value for businesses dealing with the public.

There are other value propositions that could be presented to different market segments: e.g., an appeal to altruism (such as slowing the rate of GHG emissions) would motivate some parties to select energy efficient alternatives, if the decision-making problem was framed for them in that manner at the time of the transaction.

5.3.The Elephant in the Room

The next generation of energy efficiency programs, as evidence by the designs proposed by PG&E in its 2009-11 funding cycle, still relies primarily on the PTEM model of consumer decision making. It is not focused on selling measures anymore, but it is still focused on energy efficiency measures that apply to buildings and industrial processes.

Businesses don't just use energy in their own buildings and production processes. They are responsible for a great deal of energy use outside their buildings and production processes. If one views the business as a whole (as opposed to the buildings and production processes under its control), it can be seen that the actual energy use associated with many businesses goes far beyond what is used in the buildings and manufacturing processes. For example:

1. Businesses make choices about products contained in their supply chains that can be more or less energy efficient – depending on a variety of considerations.
2. They make decisions that have consequences for the energy that their employees use in traveling to and from work (e.g., where they locate in relation to transit stops and whether on-site free parking is provided).
3. They make choices that affect how much energy that employees use in transporting their products and themselves to and from customer sites.

Buildings and production processes are just part of the opportunity that businesses have to make energy efficiency improvements. Moreover, because improvements in the energy efficiency of buildings and production processes usually involve capital expenditures, these energy efficiency improvements may be the hardest investments to convince businesses to do to lower their energy use. In essence, there is low hanging fruit right before our eyes, but we are concentrating on the fruit on the top of the tree.

In many ways, focusing on the energy use of the business (as a whole problem), rather than as pieces of technology, makes more sense than the current policy model. Leaders of businesses do not think of their organizations as pieces of technology. They think of them as organic (almost living) things, not as little parts. They don't usually want to know about the little parts, but they probably want to know whether their business is

using energy as efficiently as it can, because that could be a problem now and in the future.

Programs designed to encourage energy efficiency improvements in the whole business (the buildings and production processes being only a part) would undoubtedly be much more successful than the current PTEM-based programs, because they could rely on the efficiency gains and cost savings obtained from identifying the low hanging fruit (not found in buildings and processes) and use the success of those activities to stimulate and fund further improvements. Unfortunately, utility programs are designed to only address energy efficiency opportunities in buildings and production processes served by the companies that are regulated by the CPUC. Well, then we might want to ask, why is that the case?

Unfortunately, the answer is simple, and it is a powerful institutional barrier to improving the overall energy efficiency of businesses by attacking the problem holistically. The CPUC views energy efficiency as an alternative resource to conventional generation alternatives. The CPUC favors energy efficiency investments when their acquisition cost is at or below that of other resource alternatives. The level of effort undertaken by California utilities and the incentives that are offered to consumers to adopt energy conservation are driven entirely by this consideration. This limited focus probably will limit the usefulness of utility sponsored energy efficiency programs in California to the kinds that presently exist for the foreseeable future. It is possible to imagine alternative roles for the CPUC, the ARB and the CEC that would not entail this limitation and might achieve greater energy efficiency savings than the current framework, but that is a subject for another day.

The limitations of the PTEM model for achieving significant *further* improvements in energy efficiency are becoming increasingly apparent. In response to this situation, new programs have been proposed by PG&E (and the other California IOUs) that incorporate a wide range of efforts to transform markets and take advantage of marketing strategies that do not rely solely on the assumption that consumers are making rational decisions about the costs and benefits of energy efficiency.

Unfortunately, these new programs do not fit well within the existing regulatory framework that treats savings obtained from energy efficiency improvements as an energy supply resource. They do not fit well within the existing framework for evaluating the efficacy of energy efficiency programs which is focused on documenting direct energy savings. Lastly, because the proposed next generation of programs is still under development, it remains to be seen how well they will work. These are all considerations that stand in the way of the next generation of more effective energy efficiency programs.

Forcing the utilities back to the drawing board to bring forth programs that are more in line with the PTEM model will impede and perhaps completely halt the progress of the development of more effective energy efficiency programs. It is not an option. So, the important question that remains is how can the current regulatory framework be modified to make it more compatible with the proposed direction of developing the next generation of energy efficiency programs?

References

Cebon, P., "Twixt cup and lip: Organizational behaviour, technical prediction and conservation practice", *Energy Policy*, 20(9): 802-814, 1992

Cohen, M., J. March, and J. Olsen, "A Garbage Can Model of Organizational Choice," *Administrative Science Quarterly* 17(1): 1-25, 1972.

DeCanio, S., "Barriers within Firms to Energy-Efficient Investments," *Energy Policy* 21(9): 906-914, 1993.

DeCanio, S. and W. Watkins, "Information Processing and Organizational Structure," *Journal of Economic Behavior and Organization* 36(3): 275-294, 1998.

Goett, A., "Implicit Discount Rates in Residential Customer Choices," Volume I: Investments in Conservation Measures. Electric Power Research Institute EM-5587 Project 2547-1, Final Report, 1988.

Golove, W. and J. Eto, "Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency," LBNL #38059, Lawrence Berkeley National Laboratory, Berkeley, CA, 1996.

Hirst, E. and M. Brown, "Closing the Energy Efficiency Gap: Barriers to the efficient use of energy," *Resources Conservation and Recycling*, 3: 267-281, 1990.

Hausman, J. "Individual Discount Rates and the Purchase and Utilization of Energy Using Durables," *Bell Journal of Economics* 10(1): 33-54, 1979.

Howarth, R. and A. Sanstad, "Discount Rates and Energy Efficiency," Contemporary Economic Policy 13(3): 101-109, 1995.

Kotler, P., *Marketing Management: Analysis, Planning, Implementation and Control 8th Edition*, Prentice Hall, 1994.

Kulakowski, S., "Large Organizations' Investments in Energy Efficient Building Retrofits," LBNL #40895, Lawrence Berkeley National Laboratory, Berkeley, CA, 1999.

Levine, M. "Electricity Efficiency in California's Future," LBNL presentation, Lawrence Berkeley National Laboratory, Berkeley, CA, 2006.

Lutzenhiser, L., "Social and Behavioral Aspects of Energy Use," *Annual Review of Energy and the Environment* 18: 247-289, 1993.

Lutzenhiser, L,, K. Janda, R. Kunkle, and C. Payne, "Understanding the Response of Commercial and Institutional Organizations to the California Energy Crisis," California Energy Commission, Consultant Report, Sacramento, CA, 2002.

Nadel, S. and H. Geller, "Utility DSM: What Have We Learned and Where Are We Going?" *Energy Policy* 24(4): 289-302,1996.

Raffia, H., Decision Analysis: Introductory Reading on Choices Under Uncertainty, McGraw Hill, 1997.

Rufo, M. and F. Coito, "California's Secret Energy Surplus: the Potential for Energy Efficiency", The Energy Foundation, San Francisco, CA, 2002.

Sanstad, A. and R. Howrath, "Consumer Rationality and Energy Efficiency," Proceedings of the 1994 ACEEE Summer Study on Energy Efficiency In Buildings, pp. 175-183, American Council for an Economic-Efficiency Economy, Washington, DC., 1994.

Train, K., "Discount Rates in Consumers' Energy Related Decisions: A Review of the Literature," *Energy* 10(12): 1243-1253, 1985.