A COMMUNITY ACTION-FEEDBACK MODEL FOR OPERATIONAL EFFICIENCY IN OFFICE BUILDINGS

Massachusetts Institute of Technology

The MIT Energy Efficiency Strategy Project [1]
77 Massachusetts Avenue
Cambridge, MA 02139
617-253-1509

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Authors:
Elena Alschuler, Masters in City Planning Candidate - MIT Dept. of Urban Studies & Planning (DUSP)
Kat Donnelly, PhD. Candidate- MIT Engineering Systems Division
Harvey Michaels, Lecturer and Efficiency Research Director - MIT DUSP

Contributors:
Candace Damon, Dara Goldberg, David Yeskel - HR&A Advisors
Kerry O'Neill – Earth Markets
Adam Rein – EmPower Devices

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I. EXECUTIVE SUMMARY

Office buildings account for approximately seven percent of total electric consumption in the United States (EIA 2009). The savings potential from cost-effective energy efficiency measures in office buildings is typically at least 10-20% (PNNL 2009). Many of these measures, such as those related to daily routines in building operations, and cleaning and maintaining equipment, have little or no cost. Thus, from a technical perspective, a 5% reduction in consumption should be easily achievable at little cost in most cases.

As part of MIT's Energy Efficiency Strategy Project (EESP), student researchers since 2008 have explored potential breakthrough strategies to drastically increase the effectiveness of efficiency programs. Over the course of the past year, the EESP researched a range of community-based energy efficiency programs around the country, including interviewing program staff and reviewing program metrics. On April 28, 2011, the EESP facilitated a special session at MIT with support from Duke Energy, to help design an information-enabled community program strategy called *Smart Energy Now*[SM], a utility and community energy pilot program for commercial facilities in center-city Charlotte, NC. With 40 invited researchers, commercial energy managers, and government and utility stakeholders, participants considered approaches for Duke's pilot, which targets at least 5% savings in center-city Charlotte (one-fourth of its overall 20% savings goal over 5 years) through the installation of advanced meters combined with real time feedback and engagement of building owners, facility staff and office workers.

This paper builds on the development research for that program, with information drawn from many of the utility, community, and campus cases previously researched, to propose a general framework for information-driven operational efficiency programs in central business districts. If all office buildings in the US achieved a 5% electricity savings, it would save more than thirteen billion kilowatt-hours and avoid eight million metric tons of carbon emissions.

Office building information-driven efficiency programs have had limited success to date: most programs focus on providing owners with incentives designed to increase their return on efficiency investments. However, owners are often unwilling to make these investments despite the incentives, perceiving considerable risk as to whether the estimated benefits of energy savings will be achieved, partly due to unique dynamics in commercial office buildings whereby owners, facility staff, tenants and occupants each shape energy consumption.

These stakeholders have distinct roles and routines, control different aspects of energy use, and may or may not be responsible for related costs. Owners and senior-level decision makers pay operating expenses related to both the base building and work spaces, but may pass these costs through to tenants to varying extents depending on lease structures. This can create a "split incentive" for the owner in which they are responsible for capital costs but tenants benefit from the resulting operating savings. Even in a building where the owner pays all costs, such as a building that is owner occupied or one in which tenants have electricity included in their rent, electricity costs are typically not a large portion of total expenses. Either way the owner does not have a strong incentive for efficiency.

Facility staff members, whether they work for a third party management company or directly for the building, are typically paid a salary and not compensated based on energy performance. As a result, they may be more concerned about issues such as tenant comfort or avoiding capital expenses, and not electric efficiency. Office workers have direct control over lighting and plug load, but almost never see or pay for electricity use. They are focused on the daily tasks related to their job, and use electricity as a byproduct.

As a result, none of the stakeholders in a typical office building have a strong incentive to promote efficiency. Moreover, each actor faces significant nonfinancial barriers to efficiency such as insufficient information, lack of motivation, absence of social reinforcement, and disincentives inherent in organizational roles and social norms. A successful efficiency program that addresses all three stakeholder types, and the relationships between them, could promote collaborative effort towards efficiency and unlock substantial savings.

In this paper, we propose a *Community Action-Feedback Model*: an approach to operational efficiency in office buildings, addressing nonfinancial barriers through three main strategies:

Community Action Feedback Model

The model is designed to be a self-sustaining system where information, personal motivations and social interactions encourage the formation of new, energy efficient habits and routines, resulting in persistent savings. Implementation requires commitment and contributions from utilities, local government, building owners, and community and civic organizations. Collaborative success in achieving savings goals can help change norms and priorities to value efficiency, and build momentum towards undertaking more complicated and costly improvements.

In summary, the proposed strategies and tactics are to:

1. **Provide meaningful information and feedback:**

   - Establish an energy performance feedback loop
   - Increase energy literacy
   - Guide action

2. **Motivate individuals to act:**

   - Quantify metrics in terms people value
   - Utilize a pledge and tracking system
   - Make it rewarding

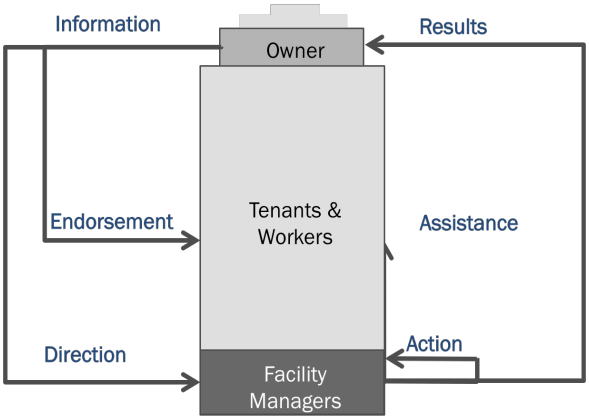
3. **Engage through the community and its networks:**

   - Use a community-wide goal, message and marketing
   - Make efficiency an organizational priority
   - Leverage social networks

The first step, *providing meaningful information and feedback at a tangible scale*, makes everything else possible. Once a feedback loop begins to offer meaningful data, diagnostics and metrics, the loop process itself can be used as way to *enable individual action* and remove other non-market barriers. Community and social networks can then be used to *engage* people, ultimately making the process self-sustaining and the behaviors persistent.

In this paper, we describe how the Community Action-Feedback Model may use information feedback as the basis to build collaboration between stakeholders and sectors toward a common efficiency goal. Yet the framework we suggest should be flexible enough to apply in a range of cities with different resources and efficiency-related challenges. A pledge, tracking and reward system is proposed that may stay in place as technologies and priorities evolve. This model may therefore serve as a low-cost means to drive operational efficiency in office buildings, and support a broader increase in public awareness and concern about energy consumption.

Aligning Relationships and Communications



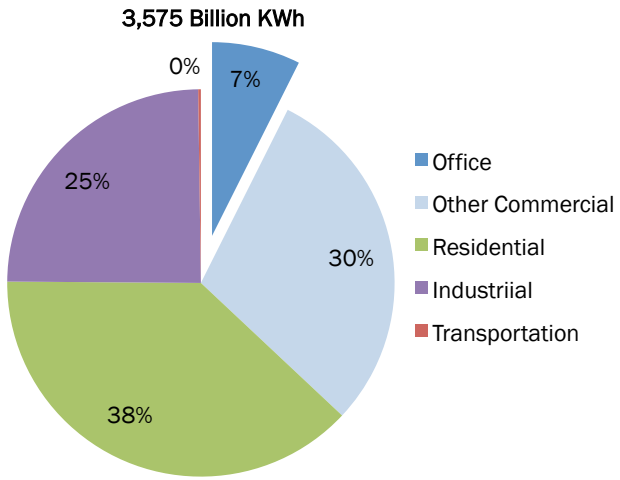
II. INTRODUCTION

Office buildings are currently not operated efficiently. Changes to routines, combined with no and low cost measures, could likely achieve at least a 5% reduction in electricity consumption in most buildings, as proposed by the Smart Energy Now[SM] pilot. Yet most efficiency programs focus on providing financial incentives to owners for capital efficiency improvements. These programs have had limited success as a result of the energy-related financial dynamics between building stakeholders, including owners, facility staff, tenants and workers. These actors also face nonfinancial barriers, such as energy illiteracy, lack of personal motivation to reduce energy consumption, and lack of social reinforcement. A new approach to energy efficiency in office buildings is therefore warranted, based on information sharing and community engagement. A Community Action-Feedback Model could promote efficiency by providing useful information and feedback, motivating people to act, and engaging the community through social networks.

A. Office Building Operational Efficiency Potential

Office buildings present a tremendous untapped opportunity for energy savings. Commercial buildings, including office, retail, healthcare, warehousing and other uses, account for 37% of US electricity sales (EIA 2009), and are projected to increase to 41% by 2030 (DOE 2009). Commercial buildings also average 45% of peak load nationwide[2]. Office buildings account for approximately 1/5 of commercial building consumption (CBECS 2003), equivalent to 265 billion KWh and 161 million metric tons of carbon dioxide emissions annually (EIA 2009).

Figure 1: 2009 Electricity Retail Sales



The savings potential from cost-effective energy efficiency measures in existing office buildings is at least *10-20%*[3] in most cases (PNNL 2009). In many instances, low and no-cost measures such as building retro-commissioning and operational changes can account for over half of these savings.

[2] *Department of Energy (DOE), Energy Information Administration (EIA), National Energy Modeling System, AEO 2007*

Figure 2: Electric Consumption in a Typical Office Building

End Use Category	% Usage from 3 studies[4]
Lighting	22-25%
Cooling	9-28%
Office Equipment	3-26%
Heating	6-35%
Data Center	6-12%
Ventilation	6-9%
Other (water heat, cooking, refrigeration)	10-15%

This paper focuses exclusively on strategies to achieve operational and behavioral-related savings. This includes no-cost actions and changes to routines, such as turning off lights and changing heating and cooling temperatures and schedules. It also includes low-cost measures that are part of maintaining a state of good repair, such as replacing filters and valves and changing lighting and office equipment purchasing practices. From a technical perspective, these changes should easily be able to achieve a 5% energy reduction in a typical office building.

B. Barriers to Operational Efficiency

Energy analysis has been traditionally guided by a Physical-Technical-Economic Model (PTEM) of consumption, which assumes that a rational economic consumer makes decisions based on the technologies available and price signals given, such as electric rates and product costs. Based on this approach, most efficiency programs focus on providing building owners with financial incentives - with the aim of improving their return on capital investments in efficiency.

However, energy efficiency programs based on the PTEM have had limited success in achieving market penetration. EPRI and McKinsey have respectively estimated that achieving 473 and 1080 TWh of energy efficiency by 2020 is both technically achievable and cost-effective. If the rational-economic mechanism worked, we would expect far greater investment in energy efficiency than is occurring. In reality, energy costs are not a large component of building owners' operating budgets, and lease structures that pass energy costs to tenants hinder their ability to capture savings. As a result, office-building owners often do not find capital incentives compelling and doubt they can achieve or capture the projected savings.

One important dynamic underlies the owners' concerns. Energy consumption in office buildings is determined by the decisions and behavior of multiple stakeholder groups with competing priorities, including *owners, facility staff, tenants* and *individual employees.* Each actor's daily routines and awareness of energy use is developed in the context of his or her role within the building. As discussed further in Section III, different actors control different pieces of energy-using equipment, and they may or may not see the costs or savings associated with that equipment. Occupants use lighting and plug load almost never pay energy costs directly. Facility staff members are responsible for base building systems, but are typically not compensated based on energy performance. The energy use patterns of occupants and facility staff are an indirect result of daily actions and responsibilities that are more broadly part of their jobs. Efficiency incentives are thus introduced into settings with pre-existing

[4] Building Energy Data Book (Oct 2009), Environmental Defense Fund (2010), DOE Energy Information Administration, Building End-Use Consumption Survey (1999)

energy-behavior "incentive structures" (Lutzenhiser 1993, 257). This means that to be truly effective, an efficiency program must motivate all of these parties and realign the relationships between them.

Moreover, while financial incentives are necessary, a strict focus on cost effectiveness and payback periods ignores non-monetary market barriers. Economic approaches to efficiency programs assume a rational individual actor who has all the necessary information, is motivated to undertake efficiency and faces no transaction costs, and is not influenced by the actions and priorities of their social group or business organization. In reality, these barriers exist and are equally, if not more, influential than financial motivations. Lutzenhiser writes that the PTEM approach "exaggerates the importance of energy prices and technological solutions, while underestimating the importance of social action and non-economic influences" (1993, 249).

In fact, researchers have consistently identified energy invisibility, and individual behavior and social processes, as central and dynamic forces that determine how energy consumers interact with buildings, systems and appliances (See Lutzenhiser, Egan, Darby, Allcott, Cialdini, Kempton, Wilhite, and Stern among others). This is particularly true in regards to operational efficiency, where most actions have little to no financial cost. Office building stakeholders face three main nonfinancial barriers to efficiency actions:

- *No information.* Energy use is invisible; it is a means to other ends. Egan writes, "energy use is not in and of itself a behavior but the outcome of behaviors… energy use is an indirect consequence of everyday actions" (2001, 3). People use computers and printers, take elevators and turn on lights, and do not see or experience the volume of energy used. Even facility staff may be more focused on equipment operations and tenant comfort than energy use itself. As a result, there is a high level of energy illiteracy. Most office-building stakeholders do not know how much energy their building consumes, how the systems work, or the relative energy-intensity of different end uses.

  This invisibility and illiteracy, "extends not just to energy use itself but to the workings of many efficiency measures" (Egan 2001, 2). It's complicated and time-consuming to evaluate energy consumption and identify the right actions to take. Many people may not understand the technical process underlying the measure. As electricity use and efficiency are invisible, abstract and complex, they are easy to ignore.

- *No personal motivation.* Most individuals lack any reason to undertake efficient actions. Darby writes that people's daily practices are influenced by, "routines, artifacts and know-how (tacit knowledge)" (2010, 4), which reflect past experiences and facilitating conditions. The practices of interacting with buildings and appliances relate to professional activities, personal comfort and lifestyle. So long as these practices are serving their purpose, individuals have no reason to pay attention to energy consumption. Most low and no-cost actions, such as turning off office equipment at night, taking the stairs, or changing the temperature, are perceived as inconvenient and require changing habits. People are also lazy and procrastinate. Thus people do not act as rational investors in efficiency, especially when concerned about appearance, comfort or avoiding hassle (Stern and Aronson 1984, EPRI 1990).

  Moreover, efficiency is not fun, rewarding or "sexy" because there are no clear or directly relevant benefits. If one cares about the environment, efficient behaviors are rather mundane compared with buying a hybrid vehicle or installing a solar panel, both of which are tangible, visible and attract positive attention.

- *No social endorsement.* As seen in "hybrid prestige," individual energy-related activities and decisions occur within a social context. The Fishbein-Azjen model of attitudes and behavior posits that behavior is a result of a dynamic interaction between the individual decision maker's attitudes and the influences of his or her social environment (1975). People are strongly affected by social norms; they do what they see others doing, and they seek approval from others for their actions. Current norms, however, do not encourage energy efficient behaviors such as using the stairs instead of elevators or day lighting instead of electric lights. In fact, both office workers and facility staff may receive positive reinforcement from peers or employers for actions that are energy inefficient, such as taking the elevator to chat with others or keeping the temperature high in the winter.

  Moreover, research on residential energy consumption patterns has revealed the importance of "the household division of labor, and socially determined work roles, as well as the importance of the differential distribution of knowledge in the family regarding energy and technology" (Lutzenhiser 1993, 263). The same can be said of office buildings as social organizations. Different energy-related responsibilities, levels of competence and types of decisions are considered appropriate for owners, facility staff, tenants and workers. As in the residential research, undertaking the initiative to change energy-related activities can even cause tensions in relationships or a perceived loss of comfort in others (Darby 2010, 12-16).

While the PTEM model fails to adequately explain energy-related behaviors, neither are those behaviors totally unpredictable and uncontrollable. Consumption levels can range widely among similar buildings, but energy use within each is typically highly patterned (Lutzenhiser 1993, 256). This is because energy use results from cognitive, emotional and social forces at work within an existing organizational and economic structure. Adjusting these dynamics can permanently change energy consumption patterns.

C. The Community Action-Feedback Model

Few, existing commercial energy efficiency programs have addressed the informational, psychological and social components of behavior and decision-making. Nevertheless, many Americans are showing a growing interest in energy management and environmental stewardship. At the same time, technological advances in metering and building technology are making it possible to perceive and manage energy consumption in real time.

A new, transformational approach to achieving cost-effective energy efficiency in office buildings is therefore warranted. Efficiency programs should begin by promoting low and no cost energy efficiency measures. This can be achieved through providing useful and meaningful information feedback, motivating individuals to act, and engaging the communities through social networks. Office communities may exist within departments, companies, buildings, or an entire downtown. Smart Energy Now^{SM} aims engage at all these levels.

Figure 3: Community-wide action-feedback loop

The first step, *providing meaningful information and feedback at a tangible scale*, makes everything else possible. Once a feedback loop begins to offer meaningful data, diagnostics and metrics, the loop process itself can be used as way to *enable individual action* and remove other non-market barriers. Community and social networks can then be used to *engage* people, ultimately making the process self-sustaining and the behaviors persistent.

These core strategies apply differently to owners, facility staff, tenants and workers. But an effectively designed commercial building energy efficiency program that gets these stakeholders working in unison could unlock substantial operational savings. And success in achieving savings from low and no-cost actions can change social norms and build I momentum towards undertaking more complicated and costly improvements.

III. Office Building Stakeholders

A successful application of educational, psychological and sociological principles must be designed to address the roles of, and relationships between, the stakeholders in a typical office building. This is the pre-existing energy-behavior framework that usually determines people's energy-related interests and actions in office buildings.

Figure 4: **Electric Consumption by Stakeholder in a Typical Office Building**

Space	Consumption	Control over Consumption	Efficiency Opportunities
Base Building	**±30%**	**- Owner (C-suite)** **- Large Tenants** **- Facility staff**	**Heating, ventilation and cooling, building management systems, data centers, operations**
Office spaces	**±70%**	**- Small Tenants** **- Workers** **- Facility staff and Office managers**	**Lighting, plug load, space conditioning, office equipment, behavior**

A. Owners and the C-Suite

Executive-level decision-makers set priorities for building maintenance and operations and must approve any substantial capital investment. These actors can include the building owner as well as the leadership of major tenants. The C-Suite includes decision-makers such as the CEO, CFO, and COO, and its propensity to invest in energy efficiency or endorse efficient operations depends on its business plan for the building and its organization's culture.

The greatest potential financial benefit from efficiency for owners of multi-tenant buildings is often increased income (in the form of higher rent or decreased vacancy), achieved by marketing a green brand or lower operating costs to tenants. This approach is most likely to appeal to owners of buildings in competitive markets, as well as owners that tend to "invest and sell." By contrast, single-occupant buildings and owners with "hold" strategies are more likely to be interested in lowering their own operating costs. Finally, large organizations (whether the owner or a major tenant) may value sustainability because of their cultures or missions or because of the branding possibilities and public relations benefits. Overall, decision-makers may find branding opportunities most compelling as these may allow them to improve their market positions. Nevertheless, leadership is often reluctant to invest capital because they doubt that financial savings will be realized. Energy management programs could therefore have appeal.

B. Facility Maintenance Staff

Facility maintenance staff members have the greatest direct control over building operations and efficiency. However, staff is usually not compensated based on the building's energy performance or net operating income. Facility staff members typically work directly for the C-Suite or for a third party manager and are paid a salary. Third party management firms are usually compensated based on a flat fee or based on gross revenues; neither structure rewards efficiency-related cost savings.

Facility staff members' interests therefore may sometimes run counter to efficiency. They must typically ask permission to implement programs or make investments beyond routine activities. They may actually receive positive reinforcement for avoiding capital expenditures by "keeping things running" well past their useful lives. Staff members also have an interest in maintaining occupant comfort and satisfaction above all else. As a result, the actors that have the greatest expertise about and control over energy performance are not yet incentivized to promote efficiency. Yet there may be opportunities to promote and reward staff for efficiency without rewriting contracts, such as through year end bonuses or recognition programs (i.e. "facility staff member of the year").

C. Workers

Office workers can drive efficiency through changing their everyday habits. As shown in Figure 2, lighting and office equipment alone can account for 25-50% of total office building consumption. Support from building occupants can also be crucial to increasing building efficiency through measures such as lighting automation or changing temperature set-points.

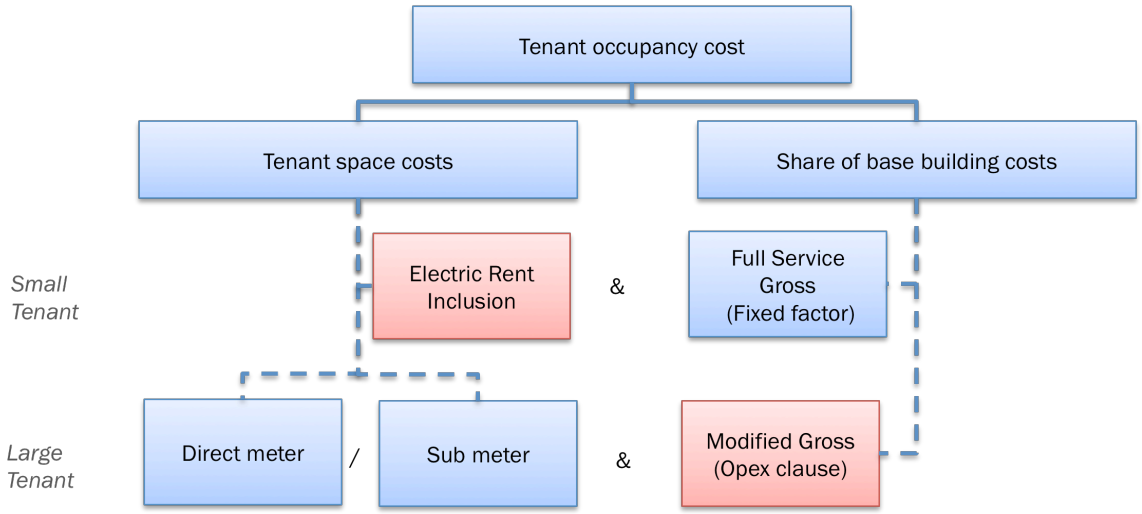
However, workers are completely insensitive to energy costs and unaware of consumption. As such, they are also particularly susceptible to nonmonetary barriers. Building occupants are likely to think energy efficiency is impersonal, technical, complicated, inconvenient, and neither fun nor rewarding. Some workers may be motivated to act efficiently because they or their organizations value sustainability. Even so, they are unlikely to know the range of energy-saving actions that they could take, and the relative impacts of each action. Thus, one of the greatest challenges to achieving energy

efficiency in office buildings is effectively motivating this large group of stakeholders who have no direct financial interest in sustainability.

D. Tenants

It is important to note that many office buildings have multiple tenants, each of which may have a varying level of control over energy systems. In addition, control over systems does not always align with responsibility for operating costs. Lease structures determine how operating costs, related to both the base building and the tenant spaces, are allocated between the owner and tenant. Different lease structures can remove the financial incentive for efficiency for either party.

Figure 5: Breakdown of Tenant-Related Electricity Costs



Many *small tenants* have full service leases, in which their rent increases by a set amount each year and the owner is responsible for all of the actual costs in both the tenant space and base building. In this case, the tenant has no incentive to operate their space efficiently. The owner receives all the savings from efficiency throughout the building, but is unable to control usage in the tenant spaces.

In contrast, *large, sophisticated tenants* are more likely to have meters and direct accounts with the utility for consumption in their space. This is typically coupled with a modified gross lease, in which the tenant also pays their share of the actual base building costs. Under this lease structure, the tenant has an interest in operating their space efficiently, and would also receive savings resulting from efficiency measures in the base building. However, the owner is responsible for the cost of base building investments and does not receive the savings.

This "split incentive" dynamic underlies many *owners'* reasoning that they are unable to capture the savings identified through audit recommendations. It is beyond the scope of this analysis to untangle lease structures, although significant progress is being made on green leasing. The point is that tenants may behave more like owners or workers depending on their lease structure, and there can be a mix of tenant types in a single building, making it harder to achieve and quantify savings. In lieu of strong financial incentives, information and non-monetary motivations can be used to promote collaborative work towards efficiency.

IV. A NEW PARADIGM FOR INFORMATION-DRIVEN EFFICIENCY

The model proposed in this paper was developed by the MIT Energy Efficiency Strategy Project (EESP) to inform Duke Energy's Smart Energy Now[SM] pilot, a smart metering and behavior change program in Charlotte's central business district. While we are proposing a new comprehensive approach to office building efficiency at the city-scale, none of the individual tactics are new. The Community Action-Feedback Model combines proven strategies from other conservation and behavior-related efforts, and adapts them for the office building setting. The EESP's proposed strategies were identified by researching academic theories and experiments, investigating national best practices, hosting and participating in several workshops, and drawing upon the professional experience of Duke Energy's consulting team.

A. The Energy Efficiency Strategy Project (EESP)

Led by Principal Investigator Harvey Michaels, the EESP is a group of student researchers working to identify breakthrough strategies to drastically increase the effectiveness of utility-led efficiency programs. Participants include students from MIT's Department of Urban Studies and Planning, the Technology and Policy Program, the Engineering Systems Division, and the Community Innovators Lab. Our first research hypothesis is that information and feedback are essential to successful program targeting and delivery. Our second hypothesis is that utilities, local government, and community and trade organizations each have unique skills and assets, and therefore must partner to deliver energy efficiency on a large scale. Over the course of the past year, the MIT Energy Efficiency Strategy Project researched a range of energy efficiency programs around the country, including interviewing program staff and reviewing program metrics. The collaboration resulted in more than 15 theses, dissertations, and papers, which were presented and discussed in forums including the MIT Energy Conference and the Second Annual EESP Symposium.

In conjunction with the Symposium, the Energy Efficiency Strategy Project and the MIT Energy Initiative collaborated with Duke Energy and their consulting team to convene a group of forty leading thinkers to discuss the design of the Smart Energy Now[SM] program. Participants in the workshop, called *Conversations About Community Engagement,* included MIT students and faculty, leading researchers from other universities and non-profits, representatives from large commercial owner and management firms, experts in metering and building systems, experts in community engagement and marketing, local stakeholders from Charlotte, and senior staff from Duke Energy. Through a charrette-style format, the group was challenged to identify core strategies to achieve three goals: align the interests of owners and facility staff, motivate building occupants, and effectively utilize media and engagement tools. The results from this workshop are reflected in the strategy recommendations in this paper.

B. Smart Energy Now[SM]

Duke Energy's planned Smart Energy Now[SM] program was used as the test framework to develop a new model for information and behavior-driven efficiency. The pilot is a first-of-its-kind public-private collaboration between Duke Energy, Cisco, Verizon and Charlotte Center City Partners, and entails installation of smart meters in all 67 large office buildings within the core of Uptown Charlotte, comprising more than 21 million square feet, where more than 75,000 people work. Set to launch in September 2011, the goal of Smart Energy Now[SM] is to reduce consumption in Charlotte's central business district by 5 percent through behavior and operational changes alone, eliminating approximately 55,000 metric tons of greenhouse gas emissions. The pilot is the first regulator-approved,

behavior-based commercial efficiency program in the country and has the potential to set the precedent for a replicable model.

The research findings presented here also draw from the professional expertise of Duke Energy's consulting team, which includes HR&A Advisors, EmPower Devices and Earth Markets. In turn, this framework will be used to guide the Smart Energy Now[SM] program design. Engagement strategies will be tailored to the range of building stakeholders, utilizing a combination of information feedback and actionable tips, a pledge and recognition system, and community marketing and social norm messaging. Outreach methods will include interactive displays placed in building lobbies, tracking tools for building staff, a web site, social media, and in-person engagement. The research and consulting teams plan to continue to collaborate throughout implementation in order to evaluate the success of different strategies and refine the program as needed.

C. Theoretical Basis

The three main barriers and corresponding strategies proposed in the Community Action-Feedback Model are based on three theoretical approaches to behavior: education, psychology, and sociology. Egan writes that feedback is the essential first step because it, "directly attacks the invisibility of energy use by providing end-users a signal about their consumption" (2001, 21). Educational literature demonstrates the importance of providing prompts and feedback, increasing energy awareness and literacy, and allowing for interaction, experimentation and choice.

Psychological theory helps explain the range of motivations that influence energy-using behavior. As energy consumers, people may be pleasure seekers, appearance conscious, life-style simplifiers, conservers, hassle avoiders, or value-seekers (EPRI 1990), or their actions may be more influenced by other non-energy-related motivations. Psychology also provides insights into how habits are formed, including the importance of commitment devices. Pledge and tracking systems have been used effectively in programs ranging from weight-loss to retirement savings (Allcott and Mullainathan 2010, 2).

Finally, sociology reveals the influence of group roles and norms, as well as the power of modeling and social reinforcement. Lutzenhiser explains that energy use occurs within a social context that indirectly energy-behavior "incentive structures" (1993, 257) based on individuals' roles and relationships. Social psychologists Cialdini and Schultz conducted three well-known studies on the effect of messaging on conservation behavior, and concluded that, "normative beliefs exert a powerful influence" (2004, 4). People do what they think others are doing or would approve of. Sociology also emphasizes, "the importance of communication channels and social systems to the relative success of an innovation's acceptance" (Rogers 1995). Similar thinking exists among community engagement professionals, who work through existing social and civic organizations to mobilize groups around a cause.

Specific research findings and case study precedents are cited as relevant under each tactic.

V. COMMUNITY ACTION-FEEDBACK STRATEGIES

The strategies below were developed for the framework of the Smart Energy Now[SM] pilot program. However, the same conceptual approaches could apply to office districts in other cities. The sections below detail potential tactics for implementation, and could be used individually as needed depending on each city's most important challenges and goals. They can also be layered onto existing capital incentive programs. Below we summarize core strategies along with program design tactics, with more detailed discussion following:

1. **Provide meaningful information and feedback:**

   - *Establish an energy performance feedback loop*, with regularly updated, granular data, that provides information both before and after taking action. Whether or not real time sub-metering is possible, tracking efficient actions can be used to make the collective efforts of office workers more apparent.

   - *Increase energy literacy* by educating facility staff and office workers about electricity concepts and how equipment works. Programs should enable people to actively engage in processing information and making choices.

   - *Guide action*, by providing diagnostic tools, which may range from walk-through audit tools for office spaces to web-based dashboards for base building systems, and recommending a menu of simple actions for both workers and facility staff.

2. **Motivate individuals to act:**

   - *Quantify metrics in terms people value.* Workers are more likely to respond to messages about community goals or environmental benefits, and will be interested in individual, group and community-level progress tracking. Owners and major tenants will more likely be interested in the quantifiable direct benefits to their business, such as green branding, tenant or worker attraction and retention, or reduced operating costs.

   - *Utilize a pledge and tracking system.* People should be encouraged to set goals and track their progress against their own goals and the goals of their group or community. A point system can be used to give more challenging or impactful actions greater importance.

   - *Make it rewarding.* Both social recognition and visible rewards can be used to promote efficiency in the absence of clear financial incentives. Office workers and facility staff alike can be recognized through programs such as "Energy champion of the month," or rewards such as company perks or tickets to local events.

3. **Engage through the community and its networks:**

   - *Use a community-wide goal, message and marketing*. The program message should be about working together towards a clear goal. Marketing should utilize range of channels to achieve ubiquitous visibility.

- *Make efficiency an organizational priority.* The leadership of individual buildings should compliment the community-wide effort with a quiet "top-down" strategy that endorses and encourages efficient behavior as part of company culture.

- *Leverage social networks.* Human interaction remains the most effective way to spread ideas. This may include group collaboration and forums, as well as individual champions and modeling.

STRATEGY 1 – PROVIDE MEANINGFUL INFORMATION AND FEEDBACK

A. Establish an energy performance feedback loop

Information is necessary to make good decisions and evaluate actions, for owners, staff and workers alike. Regularly updated energy performance information serves as a stimulus-response mechanism that enables people to exert greater control over consumption and see the impact of their actions. Thus consumption data is useful only to the extent that it is translated into useful *feedback*. Darby writes, "Information may increase knowledge, but does not necessarily affect behavior. Feedback is effective to the extent that it provides highly specific, relevant, actionable information, and a means for checking the effectiveness of actions" (2010, 6). This entails providing both *antecedent information*, such as baseline data, advice and goal-setting, as well as *consequent information*, including comparisons to one's baseline, goals and peers (Abrahamse et al 2005).

Several independent evaluations of the **OPOWER** program in California Minnesota and Washington, found that it results in an average household energy savings of 1.1-2.5% (Alcott 2009, Ayers et al 2009, Ehrhardt-Martinez and Laitner 2009). OPOWER's Home Energy Report utilizes monthly bill data, and provides comparisons against historic consumption and similar households, and gives actionable tips. The report uses descriptive and injunctive social norms in describing one's "energy efficient neighbors."

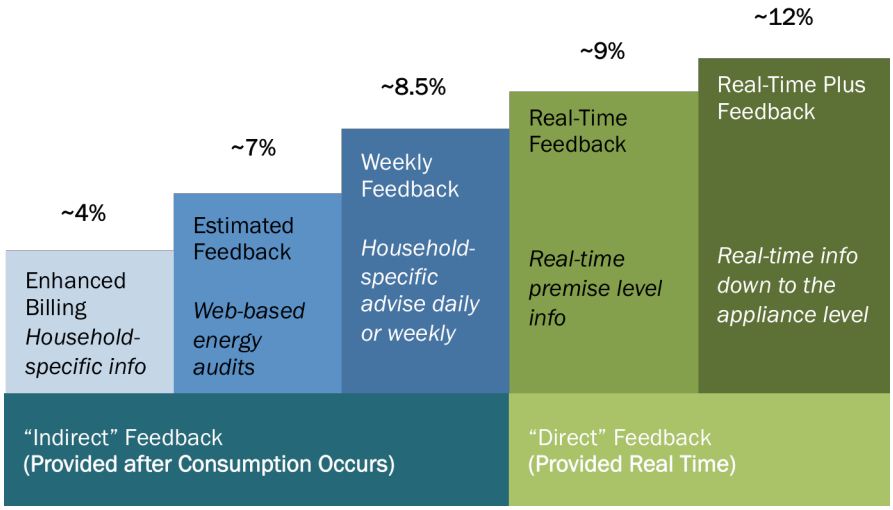
A successful action-feedback loop depends on regularly updated data on current levels of performance and relative levels of success in achieving targets. Relevant feedback should be provided for owners, staff and workers alike. This can be achieved through:

- *Benchmarking*. The EPA's Portfolio Manager is one of the most common and effective ways to evaluate and track building energy performance. The free online tool collects basic building information and 12 months of energy consumption data and generates a 1-100 energy performance score based on comparison to a national dataset. Scores can be used to track and compare the performance of buildings over time. Different buildings will start with different benchmarks and have different efficiency opportunities. Nonetheless, downtown-wide benchmarking will provide a baseline and identify the areas with the greatest opportunity. Benchmarking can be encouraged through a pledge system, incentives or program participation requirements.

- *Sub-metering.* Currently, a single device often meters consumption in very large spaces. Sub-meters, the technology of which is rapidly improving and which may not require costly retrofits, would provide insight into much smaller units of consumption (floors, departments, tenants, building systems) and in shorter time intervals (often fifteen minutes or less) that can reflect the impacts of changes in near real time.

- *Action Tracking*. An individual-level feedback loop is also needed for office workers. In a meta-review of AMI residential feedback programs, Ehrhardt-Martinez et al found that feedback was more effective when it was more granular, given more frequently, and paired with useful explanations and recommendations (2010). In residential programs, persistent direct feedback has resulted in savings of more than 10%, as shown below.

Figure 6: Annual Savings from Feedback in Residential Programs
(Ehrhardt-Martinez et al 2010)



However, in an office setting, the impacts of changing one individual's routines will not be immediately visible through real time metering at the building or floor level. Individual actions, such as turning off the lights when one leaves the room, often seem to be of miniscule importance and impact. Nevertheless, if everyone in the building were to change his or her habits, it would reduce building consumption notably.

Moreover, in Charlotte, most owners have not opted-in to share individual building data due to privacy concerns. Therefore a pledge and tracking system is proposed to provide granular feedback for office workers. A similar strategy may be useful in other programs where advanced metering is not feasible.

A much smaller feedback loop is therefore needed to track individual progress in office spaces. In lieu of installing devices to track consumption at the workspace or plug level, granular feedback in offices can be provided through an action tracking and reporting system, where individuals can "count" their actions. As discussed further, metrics should show progress against short-term baselines, opportunities and goals, on a scale that makes day-to-day success look meaningful.

B. Increase Energy Literacy

Energy is highly abstract and feels disconnected from daily life; core concepts about electricity use and energy efficiency are not part of common knowledge. Even professionals are hard-pressed to explain how a kilowatt-hour relates to the use of a desk lamp. Lay people may even have unconscious "folk

models" (Lutzenhiser 1993, 266) about how equipment works, such as that thermostats function like valves. As a result, energy illiteracy can both weaken the link between good intentions and action, and further obscure the benefits of efficiency.

However, people like to feel smart and to actively engage in processing information and making choices. Feedback can thus be used as a learning tool that allows people to gain energy literacy. Darby writes, "If people can experiment with energy in their homes or workplaces and see the consequences of their usage (feedback), the literature shows that they typically increase control over consumption and may form new habits" (2010, 7). Efficiency programs must therefore both substantively involve people in energy issues and encourage specific actions.

- *For everyone,* information should be made accessible. Energy-users are not a uniform group, but have mixed levels of existing knowledge and motivation. People should be able to learn about the issues in the depth at which they are interested. "There is a balance to be struck between offering rich detail to people who are really interested in researching their usage, and making sites simple and attractive for newcomers" (Darby 2010, 24). Information should be presented in clear, graphic formats.

- *Facility maintenance staff* should be encouraged to participate in ongoing education and certification programs. Staff may also have varying levels of interest and expertise. Programs could focus on how to use existing building management and control systems, interpret real-time data from the advanced metering system, employ best practices in retro-commissioning and continuous commissioning, and/or provide professional certifications. Management can encourage participation through covering the cost of classes and giving permission to use work time for education events.

C. Guide Action

Consumption data is not useful unless it is combined with diagnostic analysis to identify energy saving actions. Efficiency opportunities will vary by building depending on its equipment, systems and controls. Lighting or temperature might be controlled centrally in one building, but by floor or office in another. Consumption data is not useful unless it is combined with diagnostic analysis to identify energy saving actions. Efficiency opportunities will vary by building depending on its equipment, systems and controls. Lighting or temperature might be controlled centrally in one building, but by floor or office in another. In a third building, computers may be left on at night. Educational efforts should therefore also include resources for diagnostic analysis.

Dorms, hotels and offices are similar in that occupants often do not see or pay for energy use. The **Campus Conservation Nationals** challenged 40 colleges and universities to compete to conserve the most energy over a three week period. Students were given consumption information and diagnostic tools, but it was up to them to identify and implement energy-saving measures. Through e-mails, posters, rewards, and unique events such as "the big turn off," students collectively saved more than 500,000 kilowatt-hours of electricity and avoided 800,000 lbs of CO2 emissions. The winner, DePauw University, reduced their consumption by 25.8 percent.

- *For workers,* a menu of recommended actions can provide the basic information to make selections and trade-offs between the most common efficiency behaviors. Everyone should be encouraged to undertake a few "quick win" behaviors such as turning off lights and computers when not in use. Simple form-based walk-through audits and equipment surveys can also help identify energy waste unique to each work area, such as cleaning practices or data center operations. *Leadership* should be encouraged to select actions as well, as discussed further.

  These elements of interaction and choice give people control over the problem and help them gain energy knowledge through experience. Moreover, people are more likely to undertake an action if they have thought through how they are going to do it. A study that asked potential voters to describe how and when they would go to the polling place increased turnout by 4.1% (Allcott and Mullainathan 2010, 3)

- *For facility staff,* "dashboards" that show real time operations can enable closer control and management of systems. Retro-commissioning checklists can also be used regularly to prevent the performance "drift" that happens when operating protocols are accidentally overridden or repair work is needed. In addition, facility maintenance staff members frequently do not have effective information-producing tools or communication formats to bring performance information to *decision-makers*. Dashboard outputs and report templates can help facility managers translate consumption data into meaningful metrics for owners in a summary, graphic format.

The **ICLEI Green Office Challenge** used a friendly competition structure to encourage office building owners and tenants in Chicago to cut waste. 160 tenants and 45 owners participated in the program, which provided special training and a custom "Green Scorecard." Participants benchmarked their space, received assistance in developing plans and goals, and then reported back on their results. All participants received awards for their participation and accomplishments.

STRATEGY 2 – MOTIVATE INDIVIDUALS TO ACT

A. Quantify metrics in terms people value

The relative importance of different benefits from efficiency may vary by stakeholder, and their priorities and image. Efficiency programs should present a *variety* of metrics on performance and savings that may resonate with different people. Marketing should communicate individual and community contributions to economic development and job creation, environmental stewardship, public health, and civic responsibility, among other benefits.

- *Occupants are likely to respond to metrics about a community goal or environmental benefit, as opposed to financial gains.* Building-level consumption and savings metrics, in kilowatt-hours and dollars, are not very meaningful to ordinary people and generate privacy concerns among owners. Action-feedback systems should use equivalencies and units that people can relate to, and track progress at both the per person and community-wide level. For example, building energy use reduction, and associated environmental impact, can be shown in terms of number of cars taken off the road, trees planted, funding for local schools, or days of energy provided for local homes. Progress can also be shown in terms of proportions against goals and baselines rather than as absolute values.

- *Owners and major tenants are most likely to be interested in quantifiable, direct benefits*. These stakeholders need a business case to justify the time and operating resources required to promote energy efficiency as an organizational initiative. Value can therefore be established in terms of change in net operating income or asset value, brand premium, ability to achieve internal mandates, e.g. for carbon footprint reduction, improved worker productivity, or improved community or investor relationships. Tenants may be interested in slightly different metrics, such as worker comfort, and "cheap and easy results"

In New York City, **NYSERDA** provides dedicated "Account Management" for large owners and managers through a program called **Focus on Commercial Real Estate**. Marketing and technical assistance is customized based on each firms' portfolios and business strategies. The program has facilitated access to more than $8 million incentive dollars for more than 150 projects.

B. Utilize a pledge and tracking system

As discussed earlier, efficiency actions are complicated and inconvenient, and do not provide clear or tangible rewards for office workers or staff. Particularly in the absence of sub-metering, an engaging approach to establishing efficiency goals and tracking actions is needed. However, the core elements of an energy feedback program, as described thus far, lend themselves to a visible progress-tracking format. This can be achieved through a simple pledge-and-report system. Efficiency programs can use this "game" structure to deliver information, elicit pledges, and track progress. A game structure should:

- *Help people set goals*. Programs that ask people to make pledges and track progress have been used effectively for efforts ranging from fundraising to exercise. People are more likely to undertake an action if they have made an explicit commitment to do so in advance. This is particularly true when the commitment is visible. A recent study found people conserved 15-20% more energy when told their names were going to be published in an article (Egan 2001, 20). Moreover, tests of the theory of "cognitive dissonance" have found that once people take an action, they will retrospectively take on attitudes and opinions to support that action (Stern 1992). Thus getting people commit to a simple action, like turning off the lights, may be the first step in changing underlying beliefs and values.

  Workers should be encouraged to set individualized goals for themselves and as part of their organization/department. This could be achieved by communicating the relative value of different actions using points, and by guiding users to commit to specific actions for specific time periods. In this way workers are "counting up" their efficiency savings, rather than "counting down" from a building baseline in which individual actions are dwarfed by energy-intensive systems that are out of their control. Nevertheless, *facility staff* and *leadership* should also be encouraged to participate. While facility staff and leaders may have a different "menu" of efficiency actions, they should still be "counted" towards building goals.

- *Provide a fair "game board."* The suggested goals cannot be too hard or too easy, and the rewards must be both exciting and appropriate given the level of effort required. The tracking system should provide a simple means for people to measure the efficacy of their actions and evaluate their ability to meet their goals. They should also be able to compare their goals and

progress to others. Thus people should be incentivized to move up a "ladder" of increasingly challenging and rewarding actions, and be able to receive better rewards for greater effort. Rewards are discussed further below.

The **Connecticut Neighbor to Neighbor Energy Challenge** is working with 14 towns to achieve efficiency in 10% of their homes. Towns are guided through a "food chain" of efficiency action from commitment, attending a workshop, conducting an audit, fixing insulation, then addressing HVAC and solar opportunities. Financial rewards were also supplemented with stamps and badges that collect towards visible "green" prizes.

- *Stay fresh and fun.* Communications should be updated regularly to avoid "communication fatigue." Interactive social media and technologies, such as websites, should be updated more frequently to maintain constant engagement in program targets and achievements. People may also need to be incentivized to continue participating, which can be done via news and features on success stories, as well as "calls to action" or time-limited challenges with special prizes on peak demand days. This approach could also entail allowing participants with creative ideas to get rewarded for things not on the "menu."

C. Make it Rewarding

Individuals and groups should be recognized and rewarded for achieving consumption reductions, regardless of whether a formal "game" system is being used. Often social recognition and "cool stuff" is more compelling than financial incentives. This is particularly true for *facility staff* and *occupants*, who are currently not empowered, incentivized or rewarded for efficient building operations.

- *Motivate building occupants through a combination of social recognition and visible rewards.* Recognition can be as simple as featuring a video or news story about a successful energy saving action through interactive media. Individuals and groups can also be recognized for their achievements through an "energy champion/team of the month" or an annual awards ceremony. Individual rewards should leverage the power of social groups by being highly visible. Rewards for achieving individual and group goals can be company perks or community-based prizes such as dinner at a local restaurant or tickets to sports events. Rewards could also be tied to direct community benefits, such as donations to support local schools and non-profits. Indeed, rewards can be social in nature, such as lunch with a local celebrity.

- *Encourage facility staff to undertake best practices in building operations using a parallel structure.* Exceptional achievements of facility staff members and teams should be publicly recognized by organizational and community leaders. A recognition program could be based on improvement to net revenue, change in benchmarking score, achievement of labels such as Energy $tar or LEED, measureable increases in worker productivity (e.g. fewer sick days), and/or superlatives for "best" or "most innovative" staff. Recognition could come from owners, local government, environmental advocates, or trade organizations, and should be given publicly through an event or press story.

  Ultimately, direction from senior management should be aligned with a compensation structure for facility maintenance staff that rewards energy efficiency. Instead or rewriting contracts, this

could be accomplished by tying bonuses to net revenue or achievement of energy performance goals. Management can also reward staff for attending trainings and attaining new professional certifications.

STRATEGY 3: ENGAGE THE COMMUNITY THROUGH ITS NETWORKS

Office workers may participate in communities at a range of scales, including the entire downtown business district, as well as their company or building, and even their department. The strategies below aim to engage people at each of these levels.

A. Use a Community-wide goal, message and marketing

The visible, public focus of an efficiency engagement strategy should be "bottom up" and should leverage people's collaborative and competitive tendencies to encourage involvement in the greater community.

- *Ask people to work together towards a common goal.* A pledge or point-based system discussed above should be used as the organizing structure to place individual action in the context of group/building and community-wide goals. There should be a clearly stated community-wide goal, with an estimate of the benefits of achieving the goal. People should know exactly what they have committed to contributing towards the community goal. Personal goals can then be nested within group goals, and reported in terms of contribution to the community goal. Along the same lines, the pledge and tracking systems should accommodate calculation and communication of the cumulative impact of actions "if everyone in my group were to do it." This will show a greater impact and help promote a sense of working together.

- *Use a branding strategy to raise general awareness of the program and its goals.* Regardless of the outreach target, the overarching message should be about "Our city and its unique culture/ attributes." There should be a clear, simple statement of "why we are doing this." For example, Charlotte has a strong sense of community identity and civic pride. Individuals should choose to participate as a matter of "Charlotte pride," to demonstrate what the community is capable of achieving together. The brand should have a presence at major events and social gatherings and be visible throughout the community. Messaging can then be further customized within organizations or buildings based on their culture or goals.

Arizona State University initiated a "**Campus Metabolism**" project, meant to track all energy use on campus. The interactive web tool displays current resource use by individual building, building type, or the entire campus, and at different time scales. It has a mascot, an ASU-specific brand ("Greening maroon and gold"), and is integrated into education programs and sustainability efforts on campus.

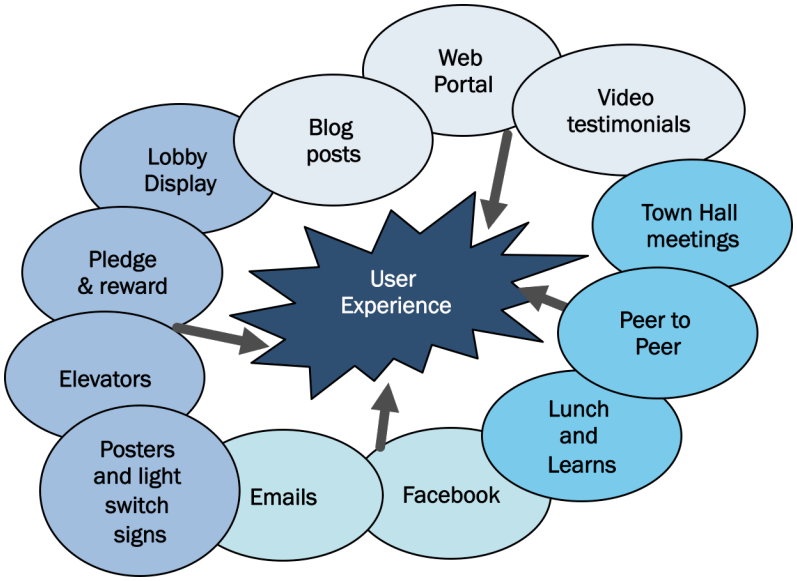
- *Utilize normative messaging.* Social norms have been proven to powerfully influence conservation behavior. Cialdini and Schultz conducted three studies on the impact of different messaging on conservation behaviors including recycling in parks and towel reuse in hotels. They used prompts such as "Save the Environment," "Preserve Resources for the Future," "Partner with the Hotel to Save the Environment," and "Join your Fellow Citizens in Helping to Save the Environment." The researchers,

  …Consistently found: a) that normative beliefs are correlated with behavior, and b) that normative messages can cause a change in behavior… Participants rate normative messages as the least effective and believe that they are not influenced by their perceptions of others. But our data show otherwise. (2004, 6)

  People model their actions based on what they think their peers are doing, or what others would approve of. Efficiency program marketing should therefore utilize social norm messaging, including phrases such as, "Join your colleagues in turning off the lights," as well as images and stories of peers and leaders undertaking energy efficiency measures.

- *Ensure ubiquitous visibility through multi-media engagement.* No single form of media can reach all office workers. Energy efficiency programs should promote constant uptake and engagement through interactive and accessible media that appeal to a variety of individuals, depending on their corporate culture, social tendencies, and demographics. Visible reminders reinforce personal commitments, encourage social norms and the sense of group identity, and establish brand recognition. A mass information strategy should engage people through nearly every conceivable means.

Figure 7: An Integrated Media and Marketing Strategy



Actionable tips, calls for participation, progress tracking and recognition of achievements should be promoted through a variety of different media channels. In addition to web sites and iPhone apps, which "pull" people to participate, alerts and triggers should "push" action.

"Push" strategies should be utilized at key intervention points, including:

- In public spaces throughout the city center. This may include banners and signage along vehicular and pedestrian corridors and at gathering spots such as parks; tangible displays of progress (e.g. the ton of carbon balloon in Copenhagen, the United Way thermometer, or a "countdown clock"); or initiatives that encourage local creativity, such as a public art or video competition. Program-related events could also be connected to schools, churches and sports events.

- On participants' persons. Personal accessories like badges (e.g. LiveStrong, Silly Bandz, ribbons/pins, etc.) can make the scale of participation tangible and encourage positive social feedback.

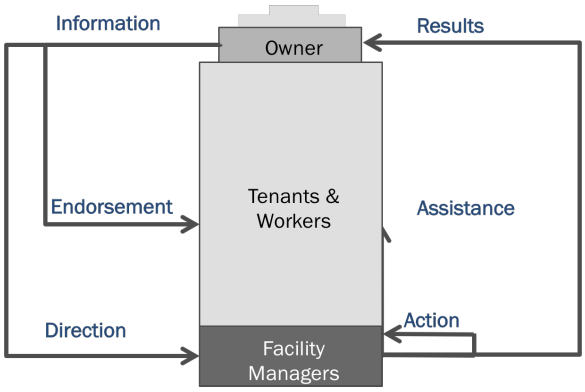
- Within corporate offices. Triggers are most effective when placed near action points such as light switches and revolving doors, in building lobbies and break rooms. Companies might even work within their organization to establish a set of rules or encourage actions for reducing energy consumption and post them publicly. Media such as company web sites, newsletters and email blasts should also be used for outreach within organizations. The message can be tailored as necessary to align with organizational cultures and priorities.

Behavioral change is difficult to achieve quickly, and requires a long-term approach. To ensure program sustainability, messaging and marketing should be dynamic to accommodate changing attitudes and behaviors over an extended period of time. The success of media channels should also be continuously evaluated, for example by using analytics, to ensure the messaging is tailored for and reaching its audiences effectively.

B. Make Efficiency an Organizational Priority

It is not sufficient to provide individuals with information and motivation, given the powerful influence of pre-existing energy-behavior incentive structures within organizations. Staff and workers use energy the way they do because of the routines and actions that are part of their role in an organization. Most workers do not receive any social encouragement for energy efficient behavior, and they may actually receive positive reinforcement for behaviors that are inefficient. Therefore the success of an operational energy efficiency program requires a quiet "top down" strategy that complements the "bottom up" strategy. The information feedback process can be used to ultimately realign the social incentives and remove barriers inherent in the relationships between building stakeholders. Once efficiency becomes a part of the organizational culture, it will persist as individuals come and go.

Figure 8: Aligning Relationships & Communications



The buy-in and support of leadership (building owners, executives and managing partners of firms) is essential, as it can go a long way in changing organizational culture. Leaders help establish efficiency as a priority, provide direction to facility managers, and lead (or don't) by example.

- *Make a public commitment.* Leaders should commit to an efficiency goal for the entire organization, and share it publicly. If using a game structure, the commitment can be framed in terms of the organization's contribution to the community-wide goal. An explicit organizational commitment establishes the value of efficient behavior, and creates an environment of permission and encouragement. Group pledges can be even more effective than individual pledges as people feel accountable to the group for doing their part.

- *Endorse the actions of staff and occupants that promote efficiency.* In fact, many of the most impactful efficiency initiatives will need owner "push" to occur, such as changing temperature set points, purchasing practices, or cleaning operations. When committing to support the building-wide energy efficiency initiative, senior staff should agree to empower those with direct physical control of energy-consuming equipment (IT staff, office managers, administrative assistants, and, notably, third party facility managers) to enforce identified energy-saving measures. Ultimately, facility staff should be positioned and recognized as energy efficiency heroes, not bad guys.

- *Model efficient behaviors.* Those in positions of power should choose specific actions to which they will commit as a worker. These may include taking the stairs, using day-lighting, or printing less paper. Leadership should tell staff what they have committed to do to help; and the more visible the action is the better.

C. Leverage Social Networks

Human interaction is the most meaningful medium, and word of mouth is the most effective way to spread ideas. An effort should be made to tap into the programs and networks that people already participate in and identify with, such as departmental, social and geographic groups. This can be achieved by encouraging the group to work together towards an efficiency goal, and by identifying individual champions to lead the cause and keep momentum going.

- *Encourage competition/collaboration*. As discussed above, buildings and organizations should be encouraged to set goals. These goals could be further broken down by categories such as floor, department, or job type. Individual goals could thus ultimately be "nested" within department, building and community-wide goals. This enables competition and comparison among groups within a larger collaborative structure. This nesting requires a flexible framework in which groups can self-organize. Groups should be provided with the information and materials necessary to set appropriate goals and undertake projects together. Thus programs should be able to integrate with existing corporate culture, and leverage existing organizational structures, communication channels and initiatives such as "green teams" and community service days.

In 2010, the **EPA** held a **National Building Competition** for the commercial building that could reduce their consumption the most. The winner, Morrison Residence Hall at UNC Chapel Hill, achieved a 35% reduction through an HVAC and lighting retrofit combined with operations and maintenance practices, lobby-touch screens and posted reminders, and a floor-by-floor competition.

- *Use champions and models to reach the most people and create a groundswell of support.* Direct encouragement can come from executive leadership in an organization, or trusted messengers such as local sports stars and community leaders. These individuals can share "testimonials" about their energy behavior through the general marketing channels. Likewise, programs should identify motivated, "program champions" within each organization who can serve as trusted messengers to their peers, make the case for efficiency, and encourage people to get and stay involved. Program champions should also serve as a resource for individuals to ask questions about energy terminology or efficiency ideas. Programs should provide appropriate resources and materials. In fact, every person who undertakes an efficiency action is a champion, because they model the behavior for others. According to Roger's model of innovation diffusion, adoption takes an S-shaped path (1995). Once enough "early adopters" begin a new practice, the majority follows (Rogers 1995). Talking about efficiency with friends and colleagues or simply seeing others taking the stairs exerts a powerful influence. Programs will be successful to the extent that they encourage people to share ideas and experiences directly with each other.

The largest number of sign-ups for **National Grid's Energy Action Program** in Newport resulted from a front page story in the local paper about the Mayor's energy audit. Similarly, in San Antonio, significant interest was generated by a local TV news segment where a reporter accompanied a homeowner getting an audit.

- *Provide a forum for facility staff.* Along these lines, facility staff in particular currently lack opportunities to engage in ongoing education and dialogue through a professional community. A regular breakfast or lunch forum could be used for informal networking and relationship building that leads to sharing of experiences and best practices. The forum could help further information and educational strategies by hosting education sessions around specific topics of interest, such as IT operations, and providing tools for communication between building owner and facility manager, such as template reports on building performance. The forum could also be used to identify facility staff "efficiency innovators" and recognize their accomplishments.

In 2010, approximately 100 property managers and tenants participated in the **Arlington Green Games**. Participants tracked their building performance in Portfolio Manager, set efficiency goals and created plans, then self-reported on progress. The program emphasizes ongoing training, support, and resources for staff, including monthly events such as Mingling Mondays (networking breakfasts), Time Out Tuesdays (lunches with guest speakers), and Webinar Wednesdays (on topics such as low-cost and no-cost actions and utility incentives). At the end of one year, companies that made the greatest achievements were recognized by the Arlington County Board Chairman and in local media.

VI. CONCLUSION: POTENTIAL FOR A SCALABLE MODEL

The Community Action-Feedback Model is a first attempt to propose a testable framework for an information and behavior driven efficiency program in office buildings. Many of the strategies above overlap and build upon each other. Ultimately the goal is to create a self-sustaining system where information, intrinsic motivations and social interactions are all encouraging people to collaborate towards efficiency. This broad system is designed to adapt and remain effective as technologies evolve and people come and go.

The first, essential step is to attack energy invisibility by establishing an energy performance feedback loop. This action-response mechanism provides a means for people to learn about energy and efficiency actions. Nevertheless, consumption and savings metrics should be translated into a range of equivalencies that resonate with different motivations, such as environmental stewardship and economic development.

A meaningful information feedback loop can easily be used as the basis for an individual commitment, tracking and reward system. Similar systems have been used successfully in a range of arenas to encourage daily actions over a sustained period. Individuals should also be rewarded for their progress; often, social recognition and fun prizes are more compelling than financial rewards. While a full game structure is explored in this paper, the core concept of pledge-and-reward works regardless of the formality of the system.

The individual's commitment and actions should also be put in the context of broader community values and goals. Community-wide engagement and social norm messaging give the sense that "we are all doing this together," thus providing both social encouragement and peer pressure to participate and follow-through on commitments. This must be complemented by a realignment of messages and incentives within organizations, in order to make efficiency a valued behavior. Finally, people should be encouraged to take ownership of the effort, talk to each other, share ideas, work together and compare progress. Success and persistence of savings will hinge upon the extent to which efficiency is integrated into social networks.

None of the strategies described here are new. The innovations of the Community Action Feedback Model are that it (1) applies feedback strategies to behavior in office buildings, and (2) integrates individual and community-focused engagement. Ehrhardt-Martinez et al write that energy invisibility, "Impedes the establishment of social norms concerning 'appropriate' levels of energy consumption… Without an appropriate frame of reference, individuals and households have a hard time determining whether their patterns of energy consumption are excessive or moderate and whether some type of intervention is warranted." By providing feedback, and motivating action and discussion, we hope to make it easy and socially acceptable for people to talk to each other about changing their energy-related habits and routines.

Persistent savings will be achieved when feedback and external incentives are translated into new "intrinsic" behavioral controls (Darby 2006). Many studies have found that behaviors become habit after approximately three months of practice. The Community-Action Feedback Model provides a program framework to engage people in monitoring and making small adjustments to their own routines for a long enough time that the changes will become habit. Group and community-level engagement provides further encouragement and social reinforcement, so that new "intrinsic" controls are related to both personal motivations and social norms.

A range of actors in office buildings and in the community will need to be substantively involved in order for a program to be successful. As discussed, a building-level initiative requires the endorsement of leadership, assistance of facility staff and motivation and collaboration among workers. But a community-wide effort also requires partnerships between public, private and community-based organizations. Utilities and private product and service providers can deliver the enabling technology, systems and information to set up a program framework. Local government, community groups, trade associations, and professional organizations can then be the "public face" that champions efforts and provides a sense of community-wide ownership. These groups serve as neutral parties and trusted messengers, as they have existing relationships and trust with community members. The model proposed here could be initiated by any of these partners, but success will require contributions from each.

The Community Action-Feedback Model uses information feedback as the basis to build collaboration between stakeholders and sectors toward a common efficiency goal. Yet the framework is flexible enough to apply in a range of cities with different resources and efficiency-related challenges. The pledge, tracking and reward system can also stay in place as technologies and priorities evolve. This model could therefore serve as a low-cost means to drive operational efficiency in office buildings, and support a broader increase in public awareness and concern about energy consumption.

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